

NCT02993757

## **Immunogenicity and Safety of a Tetravalent Dengue Vaccine Administered Concomitantly or Sequentially with Gardasil® in Healthy Subjects Aged 9 to 13 Years in Malaysia**

Phase IIIb, randomized, open-label, multicenter study in 528 subjects aged 9 to 13 years in Malaysia.

### **Statistical Analysis Plan (SAP) - Core Body Part**

|  |   |
|--|---|
| <b>Trial Code:</b>                                 | CYD67   |
| <b>Development Phase:</b>                          | Phase IIIb  |
| <b>Sponsor:</b>                                    | Sanofi Pasteur<br>14, Espace Henry Vallée, 69007 Lyon, France     |
| <b>Investigational Product(s):</b>                 | CYD Dengue Vaccine  |
| <b>Form / Route:</b>                               | Powder and solvent for suspension for injection/Subcutaneous      |
| <b>Indication For This Study:</b>                  | Prevention of dengue fever in healthy subjects aged 9 to 13 years |
| <b>Version and Date of the SAP core body part:</b> | Version 1.0, 03JUL2019  |

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## List of Abbreviations

|                    |  |
|--------------------|--|
| Ab                 | antibody                                     |
| AE                 | adverse event                                |
| AESI               | adverse event of special interest            |
| BL                 | blood sample                                 |
| CI                 | confidence interval                          |
| CRF                | case report form                             |
| CSR                | clinical study report                        |
| D                  | day  |
| DC                 | diary card                                   |
| dil                | dilution                                     |
| FAS                | full analysis set                            |
| GM                 | geometric mean                               |
| GMT                | geometric mean of the titer                  |
| GMTR               | geometric mean of the titer ratios           |
| LLOQ               | lower limit of quantitation                  |
| MD                 | missing data                                 |
| MedDRA             | Medical Dictionary for Regulatory Activities |
| mL                 | milliliter                                   |
| NA                 | Not applicable                               |
| NM                 | non-mesurable                                |
| NR                 | not-reportable                               |
| PC                 | phone call                                   |
| PPAS               | per-protocol analysis set                    |
| PRNT <sub>50</sub> | 50% plaque reduction neutralization test     |
| PT                 | preferred term                               |
| RCDC               | reverse cumulative distribution curve        |
| SAE                | serious adverse event                        |
| SafAS              | safety analysis set                          |
| SAP                | statistical analysis plan                    |
| SD                 | standard deviation                           |
| V                  | Visit  |
| WHO                | World Health Organization                    |
| YF                 | Yellow Fever                                 |

## 1 Introduction

The study will assess the safety and immunogenicity of the CYD dengue vaccine when administered concomitantly or sequentially with Gardasil® (Human Papillomavirus Quadrivalent [Types 6, 11, 16, and 18] Vaccine, Recombinant).

Preventive measures presently rely on mosquito control and personal protection. These measures are limited in efficacy, difficult to enforce, and expensive. The best method of prevention lies with the development of a safe and effective vaccine directed at the 4 serotypes of dengue virus responsible for the disease. The first marketing authorization for the CYD Dengue vaccine (under the commercial name Dengvaxia®) was obtained in Mexico on 08 December 2015. As of June 2019, the CYD dengue vaccine has been registered in 20 countries plus in Europe. The CYD dengue vaccine is indicated in most of the countries for the prevention of disease caused by all four dengue virus serotypes in preadolescents, adolescents and adults (9 to 45/60 years of age, depending of the country). Since implementation of a label update, vaccination is recommended in individuals with prior infection with dengue.

There is currently no data on concomitant administration of CYD dengue vaccine with other vaccines in the indicated population in subjects 9 years and above. Co-administration of CYD dengue vaccine with other vaccines has been assessed in clinical studies outside the age indication, in toddlers 9 to 15 months of age at inclusion in dengue endemic countries. A Phase II study was conducted to evaluate the co-administration of CYD dengue vaccine together with Measles, Mumps and Rubella (MMR, Trimovax®, Live attenuated virus vaccine against Measles [Schwartz strain], Mumps [Urabe AM-9 strain] and Rubella [Wistar RA 27/3M strain; Sanofi Pasteur) vaccine (CYD08) and 2 Phase III studies (CYD29 and CYD33) were conducted to evaluate the co-administration of CYD dengue vaccine together with the YF vaccine (Stamaril®, Yellow fever vaccine [live]; Sanofi Pasteur) and the DTaP-IPV-PRP-T (Hib) vaccine (Pentaxim®, Diphtheria, Tetanus, Pertussis [acellular, component], Poliomyelitis [inactivated] vaccine [adsorbed] and *Haemophilus Influenza* Type b Conjugate Vaccine; Sanofi Pasteur). These trials demonstrated that the CYD dengue vaccine could be administered concomitantly with these pediatric vaccines and no safety concerns or impact on the immune response was observed.

The present post-licensure Phase IIb study CYD67? plans to investigate the immunogenicity and safety of the CYD dengue vaccine when it is administered concomitantly or sequentially with Gardasil at least 28 days apart in subjects aged 9 to 13 years.

Gardasil (or Silgard®) is a recombinant quadrivalent HPV (types 6, 11, 16, 18) L1 virus-like particle vaccine (Merck & Co., Inc., Whitehouse Station, N.J., USA) indicated for the prevention of the following conditions caused by HPV types 6, 11, 16, and 18: precancerous lesions in the cervix, vulva or vagina and anus; cervical, vulvar, vaginal and anal cancers; and genital warts and persistent infection. Gardasil was the first cervical cancer vaccine to receive WHO pre-qualification in May 2009, which meant that it was eligible for procurement in national immunization programs. Gardasil is currently recommended by WHO for subjects 9-26 years of age, in ages 9-13 years of age in a 2 dose schedule (0, 6 months) and in ages 14-26 years of age, in a 3 dose schedule (0, 2, 6 months). The WHO and the Food and Drug Administration (FDA)

approve Gardasil for use in boys and men in ages 9-15 or 9-26 years respectively. Since 2006, HPV vaccines have been licensed in over 100 countries.

During the conduct of the CYD67 trial, new clinical data based on the results of exploratory analyses showed that the efficacy and safety profile of the CYD dengue vaccine was different between subjects previously naturally exposed to the dengue virus prior to vaccination and subjects never exposed to the dengue virus prior to vaccination. In light of these results, the Independent Data Monitoring Committee (IDMC) involved in the safety data review of the CYD dengue vaccine clinical development program concluded, in an ad hoc meeting held on 3-4 November 2017, that there is a strong evidence that the CYD dengue vaccine protects seropositive subjects from symptomatic, hospitalized and severe dengue while, in seronegative subjects at baseline, the vaccine confers limited short term benefit against symptomatic dengue and induces an increased risk of hospitalized or severe dengue in the long term (findings are based on follow-up of dengue unexposed subjects having received 3 CYD dengue vaccine doses). Following this meeting, the IDMC recommended not to vaccinate any individuals with no prior dengue infection anymore, and to only continue vaccination in subjects with prior dengue infection.

As a consequence, the Sponsor has amended the CYD67 study protocol to implement the recommendation from IDMC on January 2018. The study was put on hold between IDMC recommendation and approval of protocol amendment. As per IDMC recommendations, the following changes were applied to this trial:

- All vaccinated subjects were informed about their baseline dengue serostatus, and what it means, as soon as possible based on blood samples provided by the subjects before the first vaccination.
- All subjects were asked about their willingness to continue participating in this study. Subject's consent were formalized by signing an amended Assent Form (subject's parent[s]/legally acceptable representative[s] will sign an amended Informed Consent Form).
- Subjects identified as seronegative at baseline were not to receive further CYD dengue vaccine doses. They could continue in the study for safety follow-up at 6 months post last dengue vaccine dose, if they consented to, and had timely access to appropriate care in the event of suspected dengue, for 10 years from the date of last dengue vaccination whether they remained in the study or not.

Subjects identified as subjects seropositive at baseline who were eligible to continue dengue vaccination in the study were additionally asked to consent for further CYD dengue vaccine injection. Subjects that consented to receive the third and last dose of CYD dengue vaccine completed the study as it was initially planned. Subjects that consented to remain in the study but preferred not to receive the last injection were able to continue in the study for safety follow-up at 6 months post last dengue vaccine dose.

## 2 Trial Objectives

### 2.1 Primary Objectives

#### *Immunogenicity:*

##### *Gardasil Immunogenicity*

- To demonstrate that the humoral immune response (in terms of geometric mean titers[GMTs]) to Gardasil after concomitant administration is non-inferior to sequential administration with the CYD dengue vaccine measured 28 days after the last dose of Gardasil\*

##### *CYD Dengue Vaccine Immunogenicity*

- To demonstrate that the humoral immune response to the CYD dengue vaccine after concomitant administration is non-inferior to sequential administration with Gardasil measured 28 days after the last dose of the CYD dengue vaccine\*

\*Providing that the number of evaluable seropositive subjects allows a global power of at least 80% (otherwise analyses will be descriptive).

The endpoints for the primary objectives are presented in Section 4.1.

### 2.2 Secondary Objectives

#### *Immunogenicity*

##### *Gardasil Immunogenicity*

- To demonstrate that the humoral immune response (in terms of seroconversion) to Gardasil after concomitant administration is non-inferior to sequential administration with the CYD dengue vaccine measured 28 days after the last dose of Gardasil\*
- To describe the humoral immune response to Gardasil at baseline and after each dose of Gardasil in each and any group

##### *CYD Dengue Vaccine Immunogenicity*

- To describe the humoral immune response to the CYD dengue vaccine at baseline and after each dose of the CYD dengue vaccine in each group and any group in case of no differences between the 2 groups

\*Providing that the number of evaluable seropositive subjects allows a global power of at least 80% (otherwise analyses will be descriptive).

#### **Safety**

##### *Gardasil and CYD Dengue Vaccine Safety*

- To describe the safety of Gardasil and the CYD dengue vaccine after each and any dose in each group

The endpoints for the secondary objectives are presented in Section 4.2.

### 3 Description of the Overall Trial Design and Plan

#### 3.1 Trial Design

This is a Phase IIIb, randomized, open-label, multicenter study in 528 subjects aged 9 to 13 years in Malaysia.

Subjects have been randomized in a 1:1 ratio into one of 2 following groups, stratified by gender in a 2:1 (female:male) ratio to receive:

- Group 1 (N=264): 3 doses of CYD dengue vaccine and 2 doses of Gardasil® (Human Papillomavirus Quadrivalent [Types 6, 11, 16, and 18] Vaccine, Recombinant) concomitantly to the first 2 doses of CYD dengue vaccine
- Group 2 (N=264): 3 doses of CYD dengue vaccine and 2 doses of Gardasil sequentially to the first 2 doses of CYD dengue vaccine

For both vaccines, each dose is to be administered 6 months apart.

As per Protocol Amendment 1, only subjects identified as dengue immune (seropositive) before administration of the first CYD dengue injection (at V01 for Group 1 and at V02 for Group 2) and who consented to receive the remaining injection of dengue vaccine could remain in the study as per initial study procedures.

Subjects identified as non-immune (seronegative) at baseline could continue in the study for a 6-month safety follow-up. They did not receive any further CYD dengue vaccine injection and had a blood sample for the assessment of HPV antibodies after the 2 doses of Gardasil if they returned in study for M7 (Visit 5).

#### 3.2 Trial Plan

A summary of the schedule of study vaccination and blood samplings for eligible subjects is provided in [Table 3.1](#).

**Table 3.1: Study procedures**

Phase IIIb Trial; 5 Injections;

Group 1: 6 Visits, 1 Safety Follow-up Phone Call, 6 Interim Phone Calls, 4 Blood Samples, 18 Months duration per subject.

Group 2: 8 Visits, 1 Safety Follow-up Phone Call, 8 Interim Phone Calls, 6 Blood Samples, 19 Months duration per subject.

Interim phone calls (PCs) will be given 7 days after each injection (PC1, PC2 [Group 2 only], PC4, PC5 [Group 2 only], and PC7) and 2 months after blood samples during the 6-month period after each vaccination (PC3, PC6, and PC8). The last phone call will be held 6 months after the last injection.

As per Protocol Amendment 1, only dengue immune subjects before the first dengue vaccine injection will be eligible to continue study vaccinations with the CYD dengue vaccine.

| Visit (V) Number  | Time period prior to Protocol Amendment 1 |                         |                         |                        | Time period post Protocol Amendment 1 _ Dengue immune subjects only ****   |                               |  |  |  |  |
|---|---|-------------------------|-------------------------|------------------------|--|-------------------------------|--|--|--|--|
|   | V01                                       | V02                     | V03<br>(Group 2)        | V04                    | V05**<br>****  | V06 **<br>****<br>(Group 2)   | V07**                                  | V08**                                  | Phone Call<br>††††   |  |
| <b>Trial Timelines</b>                                  | <b>D0</b>                                 | <b>M1<br/>(V01+28D)</b> | <b>M2<br/>(V02+28D)</b> | <b>M6<br/>(V01+6M)</b> | <b>M7<br/>(V04+28D)<br/>(Group 1)</b><br><br><b>(V02+6M)<br/>(Group 2)</b> | <b>M8<br/>(V05+28D)</b>       | <b>M12<br/>(Group 1)<br/>(V01+12M)</b> | <b>M13<br/>(Group 2)<br/>(V02+12M)</b> | <b>M13<br/>(V07+28D)<br/>(Group 1)</b><br><br><b>M14<br/>(V07+28D)<br/>(Group 2)</b> | <b>Last<br/>vacc+6M<br/>(Group 1)</b><br><br><b>Last<br/>vacc+6M<br/>(Group 2)</b> |
| <b>Time Windows (days)</b>                              |   | <b>+14</b>              | <b>+14</b>              | <b>±20</b>             | <b>+14</b>   | <b>+14</b>                    | <b>±20</b>                             | <b>+14</b>                             | <b>+30</b>   |  |
| Informed Consent and assent form (if applicable) signed | X   |                         |                         |                        |  |                               |  |  |  |  |
| <i>Addendum I to Assent and Informed Consent</i>        |   |                         |                         |                        | X (Amdt 1)<br>(as applicable)  | X (Amdt 1)<br>(as applicable) |  |  |  |  |
| <b>Inclusion/Exclusion Criteria</b>                     | X   |                         |                         |                        |  |                               |  |  |  |  |
| <b>Significant Medical History</b>                      | X   |                         |                         |                        |  |                               |  |  |  |  |
| <b>History of Dengue Infection/Vaccination</b>          | X   |                         |                         |                        |  |                               |  |  |  |  |
| <b>Demography/Body Stature</b>                          | X   |                         |                         |                        |  |                               |  |  |  |  |
| <b>Physical/Clinical<sup>†</sup> Examination</b>        | X   | X                       | X                       | X                      | X  | X                             | X                                      | X                                      |  |  |
| <b>Temperature</b>                                      | X   | X (Group 2)             |                         | X                      | X (Group 2)  |                               | X                                      |  |  |  |
| <b>Concomitant Therapy<sup>‡</sup></b>                  | X   | X                       | X                       | X                      | X  | X                             | X                                      | X                                      |  |  |
| <b>Urine Pregnancy Test<sup>††</sup></b>                | X   | X (Group 2)             |                         | X                      | (Group 2)  |                               | X                                      |  |  |  |
| <b>Randomization</b>                                    | X   |                         |                         |                        |  |                               |  |  |  |  |
| <b>Contraindications</b>                                |   | X (Group 2)             |                         | X                      | X  | X                             | X                                      |  |  |  |

| Visit (V) Number   | Time period prior to Protocol Amendment 1   |                                       |                          |  | Time period post Protocol Amendment 1 _ Dengue immune subjects only **** |                             |                               |                               |  |  |
|--|---|---------------------------------------|--------------------------|--|--|-----------------------------|-------------------------------|-------------------------------|--|--|
|  | V01   | V02                                   | V03<br>(Group 2)         | V04  | V05**<br>****  | V06 **<br>****<br>(Group 2) | V07**                         | V08**                         | Phone Call<br>++++   |  |
| Trial Timelines  | D0  | M1<br>(V01+28D)                       | M2<br>(V02+28D)          | M6<br>(V01+6M)   | M7<br>(V04+28D)<br>(Group 1)<br><br>(V02+6M)<br>(Group 2)                | M8<br>(V05+28D)             | M12<br>(Group 1)<br>(V01+12M) | M13<br>(Group 2)<br>(V02+12M) | M13<br>(V07+28D)<br>(Group 1)<br><br>M14<br>(V07+28D)<br>(Group 2) | Last<br>vacc+6M<br>(Group 1)<br><br>Last<br>vacc+6M<br>(Group 2) |
| Time Windows (days)                                      |   | +14                                   | +14                      | ±20  | +14  | +14                         | ±20                           | +14                           | +30  |  |
| Blood Sampling §   |   |                                       |                          |  |  |                             |                               |                               |  |  |
| Dengue neutralizing Abs                                  | X (Group 1)   | X                                     | X (Group 2)              |  | X (Group 1)  | X (Group 2)                 |                               | X                             |  |  |
| HPV Abs  | X   | X                                     |                          |  | X***   |                             |                               |                               |  |  |
| Virological confirmation of dengue†††                    | All acute febrile illness with diagnosis of dengue requiring hospitalization within the first 5 days after fever onset, occurring anytime throughout the trial period   |                                       |                          |  |  |                             |                               |                               |  |  |
| Vaccine injection  | Gardasil<br>Dose 1<br>(Groups 1&2)<br>+<br>CYD Dose 1<br>(Group 1)  | CYD Dose 1<br>(Group 2)               |                          | Gardasil<br>Dose 2<br>(Groups 1&2)<br>+<br>CYD Dose 2<br>(Group 1) | CYD Dose 2<br>(Group 2)  |                             |                               | CYD Dose 3<br>(Groups 1&2)    |  |  |
| Post-injection phone calls (PCs)*                        | Interim phone calls will be given 7 days after each injection and 2 months after blood samples during the 6-month period after each vaccination. The last phone call will be held 6 months after the last injection |                                       |                          |  |  |                             |                               |                               |  |  |
| Diary Card (DC)  |   |                                       |                          |  |  |                             |                               |                               |  |  |
| Provided   | X   | X (Group 1 for SAE only, and Group 2) | X (Group 2 for SAE only) | X  | X (Group 1 for SAE only, and Group 2)                                    | X (Group 2 for SAE only)    | X                             |                               |  |  |
| Checked  |   | X                                     | X (Group 2)              | X  | X  | X (Group 2)                 | X                             | X                             |  |  |
| Collected  |   | X                                     | X (Group 2)              | X  | X  | X (Group 2)                 | X                             | X                             |  |  |
| Memory Aid (MA)  |   |                                       |                          |  | X  | X                           |                               | X                             | X  |  |
| Provided****   |   |                                       |                          |  |  |                             |                               |                               |  |  |
| Checked  |   |                                       |                          |  |  |                             |                               |                               |  |  |
| 30-Min. Observation Period                               | X   | X (Group 2)                           |                          | X  | X (Group 2)  |                             | X                             |                               |  |  |
| Injection Site Reactions & Systemic Events Assessment §§ | X   | X                                     | X (Group 2)              | X  | X  | X (Group 2)                 | X                             | X                             |  |  |
| Collection of SAEs, and serious AESIs §§                 | Throughout the trial period (for SAEs) or in defined time windows according to the type of AESI   |                                       |                          |  |  |                             |                               |                               |  |  |
| Termination Record §§§                                   |   |                                       |                          |  |  |                             |                               | X                             |  |  |

Abs: antibodies; AE: Adverse event; AESI: AE of special interest; BL: blood sample; CYD: CYD dengue vaccine; D: Day; M: Month; SAE: Serious adverse event; V: Visit

\* Interim phone calls will be given 7 days [+8 days of time window] after each injection (PC1: V01 + 7 days, PC2: V02 + 7 days [Group 2 only], PC4: V04 + 7 days, PC5: V05 + 7 days [Group 2 only], and PC7: V07 + 7 days) and approximately 2 months after blood samples (PC3: M3 or M4, PC6: M9 or M10, and PC8: M15 or M16) during the 6-month period after each vaccination with the CYD dengue vaccine.

\*\*: Vaccinations and associated or subsequent procedures may be out of the defined time-windows in dengue-immune subjects continuing the study due to the pause of vaccine injections (as per Protocol Amendment 1).

† A full physical and clinical examination will be performed and documented on each vaccination visit (mandatory before vaccination) and at the Investigator's discretion if necessary based on the health status of the subject for the other visits.

††: In female subjects of childbearing potential: result of urine pregnancy test should be confirmed as negative before vaccination.

†††: In such case, 1 unplanned acute blood sample (approximately 3 mL) will be collected for virological confirmation of dengue disease by NS1 (nonstructural protein 1) antigen test (ELISA), and/or WT dengue RT-PCR.

‡: Concomitant therapy and ongoing medication will be collected for Days 0–28 after each injection only.

§: Blood samples planned during vaccination visits will be taken before vaccination.

§§: Solicited injection site reactions will be collected for Days 0–7 after each injection. Solicited systemic reactions will be collected for Days 0–14 after each injection. Unsolicited events will be collected for Days 0–28 after each injection. Serious adverse events (SAEs) will be reported throughout the study and AEs of special interest (AESIs) will be collected in defined time windows according to the type of AESI (hypersensitivity/allergic reactions [serious or not] within 7 days after each CYD dengue vaccine injection, serious viscerotropic disease within 30 days after each CYD dengue vaccine injection, serious neurotropic disease within 30 days after each CYD dengue vaccine injection; serious dengue cases requiring hospitalization [i.e., hospitalized suspected dengue case] will be reported during the entire study).

§§§: Termination record will be checked either during a planned study visit or a phone call.

\*\*\*: If the first visit performed after vaccination pause is Visit 5, both dengue unexposed and dengue exposed subjects who will continue in the study but refuse to receive the next CYD dengue vaccine injection(s) will be proposed to be blood sampled for HPV immunogenicity assessment post Gardasil dose 2.

\*\*\*\*: All subjects will either attend an unscheduled visit (V00) or have an unscheduled phone call (PC00) during the study pause and **before** the next scheduled visit (V05, V06 or V07). During the unscheduled visit or phone call, the subject will be informed about the new safety data thanks to a "dear participant letter" and also on their baseline serostatus result. The signature of the ICF/AF by the parents/subjects and the check of contraindications to continue in the study will be at the next visit planned, as applicable.

\*\*\*\*: MA will be delivered to subjects who will not receive further CYD dengue vaccine injection but consent to continue their participation in the study.

††††: The 6-month phone call will be given to all subjects who consented to continue in the study whether they were identified "dengue-exposed" or "dengue unexposed"

## 4 Endpoints and Assessment Methods

### 4.1 Primary Endpoints and Assessment Methods

See Section 9.1 of the protocol.

### 4.2 Secondary Endpoints and Assessment Methods

See Section 9.2 of the protocol.

### 4.3 Observational Endpoints and Assessment Methods

There are no observational objectives in this study.

### 4.4 Derived Endpoints: Calculation Methods

#### 4.4.1 Safety

The solicited period for solicited injection site reactions is from Day (D) 0 to D7 and from D0 to D14 for solicited systemic reactions.

Table 4.1, Table 4.2, and Table 4.3 present, respectively, the injection site reactions and systemic reactions that are prelisted in the DCs and case report form (CRF) for the different age group, together with the intensity scales.

**Table 4.1: Solicited injection site reactions: terminology, definitions, and intensity scales for subjects aged 9 to 11 years**

| CRF term<br>(MedDRA<br>lowest level<br>term [LLT]) | Injection site pain   | Injection site erythema   | Injection site swelling  |
|--|---|---|--|
| DC term  | Pain  | Redness   | Swelling   |
| Definition   |   | Presence of a redness including the approximate point of needle entry           | Swelling at or near the injection site<br>Swelling or edema is caused by a fluid infiltration in tissue or cavity and, depending on the space available for the fluid to disperse, swelling may be either soft (typically) or firm (less typical) to touch and thus can be best described by looking at the size of the swelling |
| Intensity scale*                                   | Grade 1: Easily tolerated<br><br>Grade 2: Sufficiently discomforting to interfere with normal behavior or activities<br><br>Grade 3: Incapacitating, unable to perform usual activities | Grade 1: > 0 to < 25 mm<br><br>Grade 2: ≥ 25 to < 50 mm<br><br>Grade 3: ≥ 50 mm | Grade 1: > 0 to < 25 mm<br><br>Grade 2: ≥ 25 to < 50 mm<br><br>Grade 3: ≥ 50 mm  |

\* For the subjective reaction of pain, subjects or parents/legally acceptable representatives recorded the intensity level (Grade 1, 2, or 3) in the DC. For the measurable reactions of redness and swelling, they recorded the size of the reaction and the classification as Grade 1, 2, or 3 will be assigned at the time of the statistical analysis.

**Table 4.2: Solicited injection site reactions: terminology, definitions, and intensity scales for subjects aged >= 12 years**

| CRF term<br>(MedDRA<br>LLT) | Injection site pain   | Injection site erythema  | Injection site swelling  |
|-----------------------------|---|--|--|
| DC term                     | Pain  | Redness  | Swelling   |
| Definition                  |   | Presence of a redness including the approximate point of needle entry                            | Swelling at or near the injection site<br>Swelling or edema is caused by a fluid infiltration in tissue or cavity and, depending on the space available for the fluid to disperse, swelling may be either soft (typically) or firm (less typical) to touch and thus can be best described by looking at the size of the swelling |
| Intensity scale*            | Grade 1: No interference with activity<br>Grade 2: Some interference with activity<br>Grade 3: Significant; prevents daily activity | Grade 1: $\geq 25$ to $\leq 50$ mm<br>Grade 2: $\geq 51$ to $\leq 100$ mm<br>Grade 3: $> 100$ mm | Grade 1: $\geq 25$ to $\leq 50$ mm<br>Grade 2: $\geq 51$ to $\leq 100$ mm<br>Grade 3: $> 100$ mm   |

\* For the subjective reaction of pain, subjects/parents/legally acceptable representatives recorded the intensity level (Grade 1, 2, or 3) in the DC. For the measurable reactions of redness and swelling, they recorded the size of the reaction and the classification as Grade 1, 2, or 3 will be at the time of the statistical analysis

**Table 4.3: Solicited systemic reactions: terminology, definitions, and intensity scales for all subjects**

| CRF term<br>(MedDRA<br>LLT) | Fever  | Headache  | Malaise  | Myalgia  | Asthenia  |
|-----------------------------|--|---|--|--|---|
| DC term                     | Temperature  | Headache  | Feeling unwell   | Muscle aches and pains   | Weakness  |
| <b>Definition</b>           | Elevation of temperature to $\geq 38.0^{\circ}\text{C}$ ( $\geq 100.4^{\circ}\text{F}$ )   | Pain or discomfort in the head or scalp. Does not include migraine.   | General ill feeling. Malaise is a generalized feeling of discomfort, illness, or lack of well-being that can be associated with a disease state. It can be accompanied by a sensation of exhaustion or inadequate energy to accomplish usual activities. | Muscle aches and pains are common and can involve more than one muscle at the same time. Muscle pain can also involve the soft tissues that surround muscles. These structures, which are often referred to as connective tissues, include ligaments, tendons, and fascia (thick bands of tendons). Does not apply to muscle pain at the injection site which should be reported as injection site pain. | Generalized weakness.   |
| <b>Intensity scale*</b>     | Grade 1: $\geq 38.0^{\circ}\text{C}$ to $\leq 38.4^{\circ}\text{C}$ ,<br><b>or</b> $\geq 100.4^{\circ}\text{F}$ to $\leq 101.1^{\circ}\text{F}$<br><br>Grade 2: $\geq 38.5^{\circ}\text{C}$ to $\leq 38.9^{\circ}\text{C}$ ,<br><b>or</b> $\geq 101.2^{\circ}\text{F}$ to $\leq 102.0^{\circ}\text{F}$<br><br>Grade 3: $\geq 39.0^{\circ}\text{C}$<br><b>or</b> $\geq 102.1^{\circ}\text{F}$ | Grade 1: No interference with activity<br><br>Grade 2: Some interference with activity<br><br>Grade 3: Significant; prevents daily activity | Grade 1: No interference with activity<br><br>Grade 2: Some interference with activity<br><br>Grade 3: Significant; prevents daily activity  | Grade 1: No interference with activity<br><br>Grade 2: Some interference with activity<br><br>Grade 3: Significant; prevents daily activity  | Grade 1: No interference with activity<br><br>Grade 2: Some interference with activity<br><br>Grade 3: Significant; prevents daily activity |

\* For all reactions but fever, subjects or parents/legally acceptable representatives recorded the intensity level (Grade 1, 2, or 3) in the DC. For fever, they recorded the body temperature and the classification as Grade 1, 2, or 3 will be assigned at the time of the statistical analysis.

#### 4.4.1.1 **Solicited Reactions**

##### 4.4.1.1.1 **Daily Intensity**

Intensity will be categorized as follows: None, Grade 1, Grade 2, Grade 3, or Missing. The daily intensity will be recorded by the Investigator for solicited reactions whose scale is not a measure. For measurable solicited reactions, the intensity will be calculated at the time of the statistical analysis based upon the intensity scales defined in the protocol.

A reaction that is too large to measure (non-measurable [NM]) will be considered as Grade 3.

##### 4.4.1.1.2 **Maximum Overall Intensity**

Maximum overall intensity is derived from the daily intensities and is calculated as the maximum of the daily intensities over the period considered. The maximum intensity during the solicited period will be computed without considering the ongoing period.

Note: The maximum overall intensity should be considered as "Missing" only if all daily intensities over the period considered are "Missing."

##### 4.4.1.1.3 **Presence**

Presence of solicited reactions will be computed based on daily records during the solicited period. For any specific period, a subject would be considered to have a reaction if the intensity is greater than or equal to Grade 1 for at least one day during that period. If no data is recorded and the presence recorded by the Investigator is different from "No", the presence will be considered as "Missing."

##### 4.4.1.1.4 **Time of Onset**

Time of onset is derived from the daily intensities. It corresponds to the first day with intensity of Grade 1, Grade 2, or Grade 3.

Note: If a reaction is not continuous (i.e., reaction occurs over two separate periods of time intervened by at least one daily intensity "Missing" or "None") then the time of onset is the first day of the first occurrence.

Time of onset will be displayed by period as follows:

**Table 4.4: Categories for Time of Onset**

| Period of Time of Onset                     |  |
|---|--|
| <b>Injection Site Reactions<br/>(D0-D7)</b> | <b>Systemic Reactions<br/>(D0-D14)</b> |

| Period of Time of Onset |          |
|-------------------------|----------|
| D0 - D3                 | D0 - D3  |
| D4 - D7                 | D4 - D7  |
|                         | D8 - D14 |

#### 4.4.1.1.5 Number of Days of Occurrence

The “number of days of occurrence” of a solicited reaction during the solicited period is computed as the number of days the solicited reaction is present, (intensity different from none or missing between D0 and the end of the solicited period), over the daily record period. For instance, for calculating number of days of fever occurrence, only daily temperature  $\geq 38^{\circ}\text{C}$  will be considered.

Number of days of occurrence during and after the solicited period will be displayed by category (range) as follows:

**Table 4.5: Categories for Number of Days of Occurrence**

|                         | Period of Number of Days of Occurrence |  |
|-------------------------|--|--|
|                         | Injection Site Reactions               | Systemic Reactions                           |
| During solicited period | 1-3 days<br>4-7 days<br>8 days         | 1-3 days<br>4-7 days<br>8-14 days<br>15 days |

#### 4.4.1.1.6 Overall Number of Days of Occurrence

If a reaction is ongoing at the end of the solicited period, then the overall number of days of occurrence is derived from the daily intensities and the stop date of the reaction after the end of the solicited period. The overall number of days of occurrence is:

- $(\text{stop date} - \text{last vaccination date}) + (\text{number of days of occurrence within the solicited period}) - \text{length of the solicited period} + 1$

If the stop date is missing or incomplete (contains missing data [MD]), the overall number of days of occurrence will be considered as "Missing".

**Table 4.6: Categories for Overall Number of Days of Occurrence**

|   | Period of Overall Number of Days of Occurrence |   |
|---|--|---|
|   | Injection Site Reactions                       | Systemic Reactions  |
| Ongoing period after D7 for injection site/D14 for systemic reactions | 1-3 days<br>4-7 days<br>≥ 8 days<br>Missing    | 1-3 days<br>4-7 days<br>8-14 days<br>≥ 15 days<br>Missing |

#### 4.4.1.1.7 Ongoing

Ongoing is derived from the last daily intensity of the solicited period and the maximum intensity of the ongoing period.

If the last daily intensity of the solicited period is Grade 1, Grade 2, or Grade 3 and maximum intensity of the ongoing period is also Grade 1, Grade 2, or Grade 3, then the reaction is considered ongoing. In any other case, the reaction will not be considered as ongoing.

#### 4.4.1.2 Unsolicited Non-serious AEs

##### 4.4.1.2.1 Intensity

Intensity will be categorized as follows: None, Grade 1, Grade 2, Grade 3, or Missing. For unsolicited non-serious adverse events (AEs) the intensity will be recorded by the Investigator for AEs whose scale is not a measure. For measurable AEs that have the same preferred term (PT) as a solicited reaction, the intensity will be calculated at the time of the statistical analysis.

##### 4.4.1.2.2 Last Vaccination

Last vaccination before an unsolicited non-serious AE is derived from the visit numbers provided in the clinical database and is calculated as follows:

- If an unsolicited non-serious AE has a non-missing visit number, the visit number should be used to determine the last vaccination before the unsolicited non-serious AE
- If the visit number is missing, then the start date should be used to determine the last vaccination before the unsolicited non-serious AE

##### 4.4.1.2.3 Time of Onset

Time of onset in days following the vaccination will be computed as follows:

- Time of onset = start date – date of previous vaccination

If the start date of the AE is the same as the last vaccination date, then the onset is “0”.

If one of the dates is partially missing, time of onset will be considered as “Missing”. Events that occur before vaccination (negative time of onset) will not be included in the analyses but will be listed separately. The unsolicited non-serious AEs will be analyzed within 28 days after vaccination, which corresponds to AEs with a time of onset between 0 and 28 days after vaccination or missing. An AE with missing time of onset will be considered to have occurred just after the vaccination indicated by the visit number, so will be included in these tables.

Time of onset will be displayed by period as follows:

- D0-D3
- D4-D7
- D8-D14
- $\geq$  D15
- Missing

#### 4.4.1.2.4 Duration

The duration will be computed as: Duration = stop date of event - start date of event + 1.

If start or stop dates are unfilled (“blank”) or missing (contain “MD”) or ongoing is ticked, then the duration will be considered as “Missing.”

If the start date of the AE is the same as the last vaccination date, then the duration is 1 day.

Duration will be displayed by period as following:

- 1-3 days
- 4-7 days
- 8-14 days
- 15 days or more
- Missing

#### 4.4.1.3 SAEs

##### 4.4.1.3.1 Last Vaccination

Last vaccination will be computed using the same methodology as for unsolicited non-serious AEs described in Section 4.4.1.2.2.

##### 4.4.1.3.2 Time of Onset

Time of onset will be computed using the same methodology as for unsolicited non-serious AEs described in Section 4.4.1.2.3.

SAEs will be analyzed throughout the study using the following periods:

- Within 28 days after each/any injection
- During the study (i.e., all SAEs occurred during the study)

An SAE with missing time of onset will be considered to have occurred after the vaccination indicated by the visit number, so will be included in these tables.

Note: SAEs that occurred before vaccination (negative time of onset) will not be included in analysis, but will be listed separately.

Note for SAEs: Elapsed time from last vaccination recorded will be calculated if the SAE occurred within 24 hours of vaccination.

#### **4.4.1.3.3 Duration**

Duration will be computed using the same methodology as for unsolicited non-serious AEs described in Section 4.4.1.2.4 .

#### **4.4.1.4 Other Safety Endpoints**

##### **4.4.1.4.1 Action Taken**

This information will not be included in the analysis, but will be listed separately. No derivation or imputation will be done.

##### **4.4.1.4.2 Seriousness**

This information will be summarized as collected. No derivation or imputation will be done.

##### **4.4.1.4.3 Outcome**

This information will be summarized as collected. No derivation or imputation will be done.

##### **4.4.1.4.4 Causality**

This information will be summarized as collected. Missing causality (relationship) will be handled as described in Section 5.3.1.2.

##### **4.4.1.4.5 AEs Leading to Study Discontinuation**

A flag is available in the clinical database for all AEs in order to identify AEs leading to discontinuation.

##### **4.4.1.4.6 AEs of Special Interest (AESIs)**

The following serious AESIs (reported as SAEs) will be considered:

- Serious hypersensitivity/allergic reactions occurring in all subjects within 7 days after vaccination
- Serious viscerotropic disease occurring in all subjects within 30 days after vaccination
- Serious neurotropic disease occurring in all subjects within 30 days after vaccination
- Serious dengue disease requiring hospitalization<sup>1</sup> occurring in all subjects at any time during the study

The following non-serious AESI will be considered:

- Hypersensitivity/allergic reactions occurring in all subjects within 7 days after vaccination

#### 4.4.2 Immunogenicity

##### 4.4.2.1 Computed Values for Analysis

For the computation of GMTs, any titer reported as < the lower limit of quantitation (LLOQ) will be converted to a value of  $\frac{1}{2}$  LLOQ.

While a single approach will be used for GMTs, two different approaches for geometric mean of the titer ratios [GMTR] will be applied:

- For CYD dengue vaccine, < LLOQ will be converted to  $\frac{1}{2}$  LLOQ for a numerator and < LLOQ will be converted to LLOQ for a denominator
- For Gardasil, < LLOQ will be converted to  $\frac{1}{2}$  LLOQ.

##### 4.4.2.2 CYD Dengue vaccine Seropositivity and other thresholds

Several thresholds of interest will be used to evaluate the immunogenicity of CYD Dengue vaccine.

For each threshold applied on each serotype, the derived indicator will be "Yes" for that serotype if the computed value meets the threshold, otherwise indicator will be "No".

At baseline and 28 days after each dose of CYD Dengue vaccine, the thresholds considered are:

- Seropositivity: titer  $\geq 10$  (1/dil)
- Distribution rates of titers against each serotype according to the following predefined thresholds (1/dil):  $<10, \geq 10, \geq 20, \geq 30, \geq 40, \geq 60, \geq 80, \geq 100, \geq 120, \geq 140, \geq 160, \geq 180, \geq 200, \geq 220, \geq 240, \geq 260, \geq 280, \geq 300, \geq 320, \geq 340, \geq 360, \geq 400, \geq 640$  and  $\geq 1280$ .

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<sup>1</sup> A hospitalized subject is any subject admitted to hospital with bed attribution or any healthcare institution and requiring in-patient care.

#### **4.4.2.3 CYD Dengue vaccine Seropositivity against at least X serotype(s)**

The criteria below will be computed for each subject and visit as soon as at least one of the four dengue serotype result is different from missing or not-reportable (“NR”) (i.e. coded no result in the serology database):

- Number and percentage of subjects with antibody titer  $\geq 10$  (1/dil) against at least 1, 2, 3, or the 4 serotypes with the parental dengue virus strains.

Titer(s)  $\geq 10$  (1/dil) for at least X serotype(s) with parental dengue virus strains is computed as a Yes/No/Missing variable (note: in the case no titer is available the variable will be missing). If at least X among the 4 serotypes titers meet the threshold then the variable is derived to “Yes”, otherwise if at least one titer is available and does not meet the threshold the variable is derived to “No”. For the percentage calculation, all the subjects with at least one titer available regardless of the serotype will be considered in the denominator.

#### **4.4.2.4 Gardasil Seroconversion**

Seroconversion 28 days after each dose is defined as changing serostatus from seronegative at baseline to seropositive ( $>$  LLOQ of the assay) or  $\geq 4$ -fold rise in Ab titer if seropositive at baseline.

#### **4.4.3 Efficacy**

Not applicable.

#### **4.4.4 Derived Other Variables**

##### **4.4.4.1 Age for Demographics**

The age of a subject in the study is the calendar age.

##### **4.4.4.2 Duration of the Study**

The duration of the study is computed in days as follows:

Latest date of all subjects (termination date, last visit date, date of last contact) – earliest date of all subjects (date of visit V01) +1.

##### **4.4.4.3 Subject Duration**

The duration of a subject participation in the study is computed as follows:

Maximum (Visit dates, Termination date, Follow-up date, Last contact date) – V01 date + 1.

#### **4.4.5 Baseline Dengue status**

The dengue serostatus at baseline is defined as the presence of Abs against at least one dengue serotype in the baseline sample (by dengue 50% plaque reduction neutralization test [PRNT<sub>50</sub>]) in

the blood sample collected at V01 for group 1 and at V02 for group 2. The baseline dengue status will be derived for each subject as follows:

- Dengue immune subjects (seropositive) at baseline are defined as those subjects with titers  $\geq 10$  (1/dil) for at least one serotype with the parental dengue virus strain.
- Dengue non-immune subjects (seronegative) at baseline are defined as those subjects with titers  $< 10$  (1/dil) (not quantified) for all serotypes with parental dengue virus strains with available and “valid” results (i.e. not coded “NR”) in the serology database.
- Otherwise the baseline status will be classified as undetermined and subjects will have their dengue baseline status derived as non-immune.

## 5 Statistical Methods and Determination of Sample Size

The statistical analyses will be performed under the responsibility of the Sponsor's Biostatistics platform using SAS® Version 9.4 software or later.

The results of the statistical analysis will be available in the final clinical study report (CSR).

For descriptive purposes, the following statistics will be presented:

**Table 5.1: Descriptive statistics produced**

|   |  |  |
|---|--|--|
| <b>Baseline characteristics and follow-up description</b> | <b>Categorical data</b>                      | Number of subjects.<br>Percentage of subjects.   |
|   | <b>Continuous data</b>                       | Mean, standard deviation, quartiles, minimum, and maximum.   |
| <b>Clinical safety results</b>                            | <b>Categorical data</b>                      | Solicited: Number and percentage (95% confidence interval [CI]) of subjects and number of events<br>Unsolicited: Number and percentage (95% CIs) of subjects and number of events.<br>Hospitalized VCD cases: Number and percentage (95% CIs) of subjects                                      |
| <b>Immunogenicity results</b>                             | <b>Categorical data (cutoff)</b>             | Number and percentage (95% CIs) of subjects.   |
|   | <b>Continuous data (titer / titer ratio)</b> | $\log_{10}$ : Mean and standard deviation.<br>Anti- $\log_{10}$ (work on $\log_{10}$ distribution, and anti- $\log_{10}$ applied): Geometric mean, 95% CI of the geometric mean, quartiles, minimum, and maximum.<br>Graphical representation by Reverse Cumulative Distribution Curve (RCDC). |

The CI for the single proportion will be calculated using the exact binomial method (Clopper-Pearson method, quoted by Newcombe (1), i.e., using the inverse of the beta integral with SAS®).

For immunogenicity, assuming that  $\log_{10}$  transformation of the titers follows a normal distribution, at first, the mean and the 95% CI will be calculated on  $\log_{10}$  titers using the usual calculation for normal distribution (using Student's t distribution with n-1 degree of freedom), then antilog transformations will be applied to the results of calculations, in order to provide geometric means (GMs) and their 95% CI.

GM is defined as follows:

$$GM = \left( \prod_{i=1}^n y_i \right)^{1/n} = 10^{\hat{\left( \frac{1}{n} \sum_{i=1}^n \log_{10}(y_i) \right)}}$$

where  $(y_1, y_2, \dots, y_n)$  are the observed titers or other data where applicable for each subject.

## 5.1 Statistical Methods

In a general way, non-inferiority testing will be performed on dengue immune subjects. The tests will be done only if the number of evaluable subjects provides a global power of at least 80% for the co-primary objectives and secondary objective. In case the global power is insufficient to perform non-inferiority testing, only descriptive analyses will be performed.

Only descriptive analyses will be conducted in dengue non-immune subjects and in the overall population.

### 5.1.1 Hypotheses and Statistical Methods for Primary Objectives

#### 5.1.1.1 Hypotheses

##### *Non-inferiority on Gardasil*

The objective is to demonstrate that the humoral immune response to Gardasil administered concomitantly with CYD dengue vaccine is non-inferior to the immune response to Gardasil administered sequentially with CYD dengue vaccine.

##### Individual hypotheses on Gardasil response for each antigen:

A non-inferiority testing approach will be used to compare geometric mean of titer (GMTs) for the 4 antigens (HPV-6, HPV-11, HPV-16, HPV-18) 28 days after the last dose of Gardasil, based on the following individual hypotheses:

$$H_0^i: \text{GMT}_{\text{Group1}}^i / \text{GMT}_{\text{Group2}}^i \leq \frac{1}{\delta} \Leftrightarrow \log_{10}(\text{GMT}_{\text{Group1}}^i) - \log_{10}(\text{GMT}_{\text{Group2}}^i) \leq -\log_{10}(\delta)$$

$$H_1^i: \frac{1}{\delta} < \text{GMT}_{\text{Group1}}^i / \text{GMT}_{\text{Group2}}^i > \frac{1}{\delta} \Leftrightarrow \log_{10}(\text{GMT}_{\text{Group1}}^i) - \log_{10}(\text{GMT}_{\text{Group2}}^i) > -\log_{10}(\delta)$$

with:

i, antigen (HPV-6, HPV-11, HPV-16, HPV-18)

$\delta$  non-inferiority limit is set at 2, ie, 0.301 ( $=\log_{10}[2]$ ), for each antigen "i"

Non-inferiority for antigen i will be demonstrated if the lower bound of the 2-sided 95% CI is greater than  $-\delta$  ( $\alpha=2.5\%$  one-sided).

##### Global hypotheses for non-inferiority on Gardasil response:

The global hypotheses are:

$H_{0G}$ : Non inferiority of Gardasil co-administered with CYD dengue vaccine versus Gardasil administered sequentially with CYD dengue vaccine is not demonstrated for at least one antigen.

$H_{1G}$ : Non-inferiority of Gardasil co-administered with CYD dengue vaccine versus Gardasil administered sequentially with CYD dengue vaccine is demonstrated for all the antigens.

$H_0^G$  : at least one  $H_0^i$  not rejected

$H_1^G$  : all  $H_0^i$  are rejected

### ***Non-inferiority on CYD Dengue Vaccine***

The objective is to demonstrate that the humoral immune response to the CYD dengue vaccine administered concomitantly with Gardasil is non-inferior to the immune response to CYD dengue vaccine administered sequentially with Gardasil.

#### **Individual hypotheses on CYD response for each antigen:**

A non-inferiority testing approach will be used to compare GMTs 28 days after the third injection of CYD dengue vaccine between groups for each serotype “i” based on the following individual hypotheses:

$$H_0^i: \text{GMT}_{\text{Group1}}^i / \text{GMT}_{\text{Group2}}^i \leq \frac{1}{\delta} \Leftrightarrow \log_{10}(\text{GMT}_{\text{Group1}}^i) - \log_{10}(\text{GMT}_{\text{Group2}}^i) \leq -\log_{10}(\delta)$$

$$H_1^i: \frac{1}{\delta} < \text{GMT}_{\text{Group1}}^i / \text{GMT}_{\text{Group2}}^i > \frac{1}{\delta} \Leftrightarrow \log_{10}(\text{GMT}_{\text{Group1}}^i) - \log_{10}(\text{GMT}_{\text{Group2}}^i) > -\log_{10}(\delta)$$

with:

i, serotypes in {1, 2, 3, 4}

$\delta$  non-inferiority limit is set at 2 ie, 0.301 ( $=\log_{10}[2]$ ), for each serotype “i”

Non-inferiority for serotype i will be demonstrated if the lower bound of the 2-sided 95% CI is greater than  $-\delta$ .

#### **Global hypotheses for non-inferiority on CYD response:**

$H_0^G: \text{at least one } H_0^i \text{ not rejected}$

$H_1^G: \text{all } H_0^i \text{ are rejected}$

Overall, non-inferiority among the groups will be demonstrated if, for each antigen of Gardasil and each serotype of CYD dengue vaccine, the 2-sided 95% CIs lie above  $-\delta$ .

#### **5.1.1.2 Statistical Methods**

The non-inferiority test will be performed using the 95% 2-sided CI of the difference of the means of the  $\log_{10}$  transformed post- vaccination titers between Group 1 and Group 2 ( $\alpha=2.5\%$  one-sided). The CI for differences will be calculated using normal approximation of log-transformed titers.

#### **5.1.2 Hypotheses and Statistical Methods for Secondary Objectives**

##### **5.1.2.1 Hypotheses**

###### ***Non-inferiority on Gardasil***

The objective is to demonstrate that the humoral immune response (in terms of seroconversion) to Gardasil after concomitant administration with CYD dengue vaccine is non-inferior to sequential administration with CYD dengue vaccine measured 28 days after the last dose of Gardasil.

A non-inferiority testing approach will be used to compare seroconversion rates for the 4 antigens (HPV-6, HPV-11, HPV-16, HPV-18) 28 days after the last dose of Gardasil.

The individual tested hypotheses for the antigen “i” will be as follows:

$$H_0^i: P_{Group1}^i - P_{Group2}^i \leq -\delta$$

$$H_1^i: P_{Group1}^i - P_{Group2}^i > -\delta$$

where the non-inferiority limit  $\delta$  is set at 5% for each antigen “i”.

#### ***Non-inferiority on CYD dengue vaccine***

No statistical hypothesis will be tested on CYD dengue vaccine for secondary objectives.

#### **5.1.2.2 Statistical Methods**

##### ***Non-inferiority on Gardasil***

Non-inferiority for antigen “i” will be demonstrated if the lower bound of the 2-sided 95% CI is greater than  $-\delta$ .

The non-inferiority test will be performed using the 95% 2-sided CI of the difference between groups ( $\alpha=2.5\%$  one-sided). The 95% CI will be calculated based on the Wilson score method without continuity correction as quoted by Newcombe for seroconversion rates.

##### ***Descriptive analysis on Gardasil and CYD dengue vaccine immunogenicity***

No hypotheses will be tested.

Immunogenicity point estimates and their 95% CI will be presented for each and any group, at baseline and after each dose of Gardasil and CYD dengue vaccine.

A complementary analysis on CYD dengue vaccine immunogenicity after each dose will be conducted for each and any group according to the dengue status at baseline (dengue immune, dengue non-immune, and all subjects).

The 95% CIs will be calculated using:

- The normal approximate method for GMTs and GMTRs  
Assuming that  $\log_{10}$  transformation of the titers / data follows a normal distribution, at first, the mean and the 95% CI will be calculated on  $\log_{10}$  (titers / data) using the usual calculation for normal distribution (using Student’s t distribution with  $n-1$  degree of freedom), then antilog transformations will be applied to the results of calculations, in order to provide geometric means (GMs) and their 95% CI.
- The exact binomial distribution for single proportions (Clopper-Pearson’s method, quoted by Newcombe)

##### ***Safety***

All analyses will be descriptive; no hypotheses will be tested. Safety will be assessed for all subjects and for immune subjects after each and any dose of Gardasil and CYD Dengue vaccine. Moreover, a complementary analysis will be performed for each dose of CYD dengue vaccine, for each and any group, on non-immune subjects.

As there are differences in the intensity considered for measurable reactions depending on ages of subjects, a complementary analysis will be performed according to the following age groups: 9-11 years and 12 to 13 years.

For the main parameters, 95% CIs of point estimates will be calculated using the normal approximation for quantitative data and the exact binomial distribution (Clopper-Pearson method, quoted by Newcombe) for single proportions.

## 5.2 Analysis Sets

Four analysis sets will be used: the Per-Protocol analysis set for Gardasil (PPG), the Per-Protocol analysis set for CYD Dengue Vaccine (PPC), the Full Analysis Set (FAS) and the Safety Analysis Set (SafAS).

### 5.2.1 Full Analysis Set

The Full Analysis Set (FAS) is defined as the subset of subjects who received at least one dose of the study vaccines.

Subjects will be analyzed by baseline dengue status and the vaccine treatment group to which they were randomized.

### 5.2.2 Per-Protocol Analysis Set

Two per-protocol analysis sets will be defined: one for Gardasil (PPG) and one for CYD dengue vaccine (PPC). The per-protocol analysis sets are subsets of the FAS.

#### **PPG**

The subjects presenting with at least one of the following relevant protocol deviations will be excluded from the PPG:

- Subject did not meet all protocol-specified inclusion criteria or met at least one of the protocol-specified exclusion criteria
- Subjects identified as dengue non-immune subjects (seronegative) at baseline
- Subject is seropositive at baseline for Gardasil (ie, at least one Ab levels against Gardasil HPV antigens > LLOQ at baseline)
- Subject did not complete the Gardasil vaccination schedule (until V05)
- Subject received a vaccine other than the one that she was randomized to receive (until V05 for Group 1, V06 for Group 2)
- Administration of vaccine was not done as per-protocol (site and route of administration) (until V05)
- Subject did not receive vaccine in the proper time window (until V05 for Group 1, V06 for Group 2)
- Subject did not provide after the 2<sup>nd</sup> dose of Gardasil a post-dose serology sample in the proper time window or a post-dose serology sample was not drawn (V05 for Group 1, V06 for Group 2)

- Subject received a protocol-prohibited medication (prohibited therapies/ medications/ vaccines are indicated in the Protocol Section 6.7) (until V05 for Group 1, V06 for Group 2)
- Subject's serology sample after the 2nd dose of Gardasil did not produce a valid test result, ie, no Gardasil antigen titer available (V05 for Group 1, V06 for Group 2)

#### **PPC**

The subjects presenting with at least one of the following relevant protocol deviations will be excluded from the PPC:

- Subject did not meet all protocol-specified inclusion criteria or met at least one of the protocol-specified exclusion criteria
- Subjects identified as dengue non-immune subjects (seronegative) at baseline
- Subject did not complete the vaccination schedule
- Subject received a vaccine other than the one that she was randomized to receive
- Administration of vaccines was not done as per-protocol (site and route of administration)
- Subject did not receive vaccines in the proper time window
- Subject did not provide after the 3<sup>rd</sup> dose of CYD dengue vaccine a post-dose serology sample in the proper time window or a post-dose serology sample was not drawn (V08, M13 for Group 1 and M14 for Group 2)
- Subject received a protocol-prohibited medication (prohibited therapies/ medications/ vaccines are indicated in the protocol Section 6.7) (until V07)
- Subject's serology sample did not produce a valid test result, ie, no Neutralizing Ab titers against any of the four parental dengue virus serotypes of CYD dengue vaccine available (at V08, M13 for Group 1 and M14 for Group 2)

#### **5.2.3 Safety Analysis Set**

The SafAS is defined as those subjects who have received at least one dose of the study vaccines. All subjects will have their safety analyzed after each dose according to the vaccine they actually received, and after any dose according to the vaccine received at first dose.

The safety data will also be presented separately for dengue immune, non-immune / undetermined subjects.

Safety data recorded for a vaccine received out of the protocol design will be excluded from the analysis (and listed separately).

Note: Subject will be included in the “any dose” analysis according to the 1st dose received that corresponds to a protocol group.

#### **5.2.4 Other Analysis Set**

##### ***Randomized subjects***

A randomized subject is a subject for whom an injection group has been allocated.

### **5.2.5 Populations Used in Analyses**

The main immunogenicity analyses (non-inferiority tests) will be performed on the per protocol analyses sets PPG and PPC respectively for Gardasil and CYD dengue vaccine comparisons and will be confirmed on the FAS immune subject. The subjects will be analyzed by the vaccine group to which they were randomized.

All other immunogenicity analyses will be performed on the FAS and by baseline dengue status. Subjects will be analyzed by the vaccine group to which they were randomized.

The safety analyses will be performed on the SafAS. Subjects will be analyzed according to the vaccine they actually received and by baseline dengue status.

## **5.3 Handling of Missing Data and Outliers**

### **5.3.1 Safety**

No replacement will be done.

In all subject listings, partial and missing data will be clearly indicated as missing.

#### **5.3.1.1 Immediate**

For unsolicited non-serious systemic AEs, a missing response to the “Immediate” field will be assumed to have occurred after the 30-minute surveillance period and will not be imputed.

For SAEs, missing or partially missing elapsed time from last vaccination recorded will remain missing and not be imputed. Such SAEs will not be considered as immediate.

#### **5.3.1.2 Causality**

Missing causality (relationship) for unsolicited non-serious AEs and SAEs will be considered at the time of analysis as related to vaccination.

#### **5.3.1.3 Measurements**

Partially missing temperatures will be handled as described in Section 4.4.1.1.1.

#### **5.3.1.4 Intensity**

For solicited reactions, missing intensities will be handled as described in Section 4.4.1.1.1.

For unsolicited non-serious AEs, missing intensities will remain missing and will not be imputed.

### 5.3.1.5 Start Date and Stop Date

Missing or partially missing start dates for unsolicited AEs will remain missing and not be imputed. If either the start or stop date is missing or partially missing, the time of onset will be considered to be missing. Nevertheless unsolicited AEs with missing time of onset will be included in analyses according to the visit collected.

Missing or partially missing stop dates for AEs (solicited reactions and unsolicited AEs) will remain missing and not be imputed.

### 5.3.1.6 Action Taken

Missing actions taken will remain missing and not be imputed.

### 5.3.2 Immunogenicity

For the computation of GMTs, any titer reported as < LLOQ will be converted to a value of 1/2 LLOQ.

While a single approach was used for GMTs, two different approaches for GMT ratios were applied:

- For Gardasil, < LLOQ will be converted to 1/2 LLOQ
- For CYD dengue vaccine, < LLOQ will be converted to 1/2 LLOQ for a numerator and < LLOQ will be converted to LLOQ for a denominator

Missing data will not be imputed. No test or search for outliers will be performed.

### 5.3.3 Efficacy

Not applicable.

## 5.4 Interim / Preliminary Analysis

No planned interim / preliminary analyses were performed.

## 5.5 Determination of Sample Size and Power Calculation

A total of 528 subjects was enrolled: 264 subjects in each group.

The reference standard deviations (SD) considered are the following for Gardasil: 0.6, 0.4, 0.5 and 0.5 for HPV-6, HPV-11, HPV-16 and HPV-18, respectively.

The reference seroconversion rates for Gardasil were set to 99% for all of the 4 antigens.

The reference SD considered are the following for the CYD dengue vaccine: 0.7 for serotypes 1 and 2, 0.5 for serotypes 3 and 4 (based on CYD studies conducted in Asia Pacific: CYD14, CYD23, CYD22 and CYD28).

Considering a potential attrition rate of 15%, such sample size would provide 222 evaluable subjects per group in the PPAs. This will give, for the co-primary objectives, a global power of 98.4% and for secondary objectives (in terms of Gardasil seroconversion) a power of 90.2%.

Following Protocol Amendment 1, the number of evaluable subjects may be difficult to achieve (considering only exposed/seropositive subjects at baseline to be included in the Per-Protocol populations). Thus the non-inferiority testing will be done only if the number of evaluable subjects provides a global power of at least 80% for the co-primary objectives and secondary objective i.e., if the number of evaluable subjects per group is at least 121 per group for the co-primary objectives and 194 per group for the secondary objective. The power for non-inferiority in terms of GMTs per antigen and serotype will be than as follows:

This sample size will also provide a 95% probability of observing an AE that has a true incidence of 1.1% in each group.

**Table 5.2: Powers for Non-inferiority between GMT for each antigen and serotype**

| Antigen/Serotype    | Alpha | $\delta$ | References<br>SD(s) | Power (%) for<br>222 evaluable<br>subjects per<br>group | Power (%) for<br>121 evaluable<br>subjects per<br>group |
|---------------------|-------|----------|---------------------|---|---|
| HPV-6               | 0.025 | 0.301    | 0.6                 | > 99.9  | 97.3  |
| HPV-11              | 0.025 | 0.301    | 0.4                 | > 99.9  | > 99.9  |
| HPV-16              | 0.025 | 0.301    | 0.5                 | > 99.9  | 99.7  |
| HPV-18              | 0.025 | 0.301    | 0.5                 | > 99.9  | 99.7  |
| Dengue serotype 1   | 0.025 | 0.301    | 0.7                 | 99.5  | 91.5  |
| Dengue serotype 2   | 0.025 | 0.301    | 0.7                 | 99.5  | 91.5  |
| Dengue serotype 3   | 0.025 | 0.301    | 0.5                 | > 99.9  | 99.7  |
| Dengue serotype 4   | 0.025 | 0.301    | 0.5                 | > 99.9  | 99.7  |
| <b>Global power</b> |       |          |                     | <b>98.4%</b>  | <b>80.4%</b>  |

**Table 5.3: Powers for Gardasil seroconversion for each antigen**

| Antigen             | Alpha | $\square$ | Power (%) for 222 evaluable subjects per group | Power (%) for 194 evaluable subjects per group |
|---------------------|-------|-----------|--|--|
| HPV-6               | 0.025 | 5%        | 97.4   | 94.6   |
| HPV-11              | 0.025 | 5%        | 97.4   | 94.6   |
| HPV-16              | 0.025 | 5%        | 97.4   | 94.6   |
| HPV-18              | 0.025 | 5%        | 97.4   | 94.6   |
| <b>Global power</b> |       |           | <b>90.2%</b>                                   | 80%  |

This sample size will also provide a 95% probability of observing an AE that has a true incidence of 1.51% in each group.

## **5.6 Data Review for Statistical Purposes**

A review of the data is anticipated through the data review process led by Data Management before each database lock.

## **5.7 Changes in the Conduct of the Trial or Planned Analyses**

According to Protocol amendment 1, the study population for the non-inferiority is reduced to the dengue immune subjects (seropositive) compared to initial sample size.

The results for immunogenicity and safety will be presented by baseline dengue status.

## 6 References List

- 1 Newcombe R.G., Two-sided confidence intervals for the single proportion: comparison of seven methods, Statistics in Medicine, (1998) 17, 857-872