



# Cytomegalovirus (CMV) vaccine (mRNA-1647)

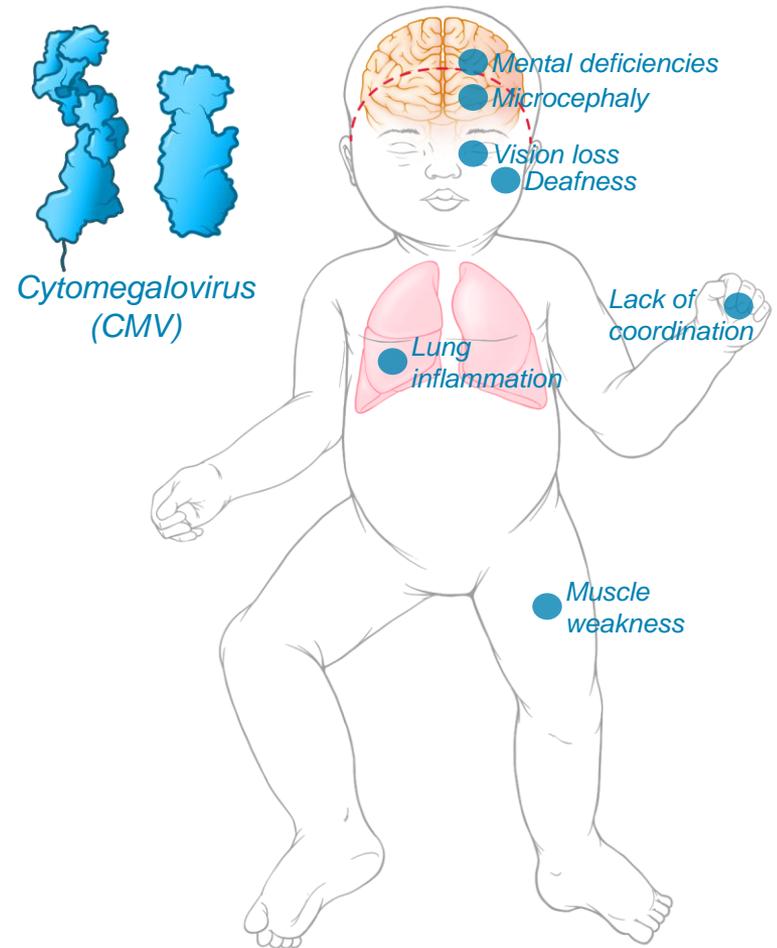
Last updated: December 6, 2018

Modality	Program #	Program		Preclinical development	Phase 1	Phase 2	Phase 3 and commercial	Moderna rights
 Prophylactic Vaccines – Commercial programs	mRNA-1777	RSV vaccine						Merck to pay milestones and royalties
	<b>mRNA-1647</b>	<b>CMV vaccine</b>						Worldwide
	mRNA-1653	hMPV+PIV3 vaccine						Worldwide
	mRNA-1278	VZV vaccine						Merck to pay milestones and royalties

**mRNA-1647 Phase 1 trial is ongoing, dose selection phase is enrolling**

# Congenital cytomegalovirus (CMV) overview

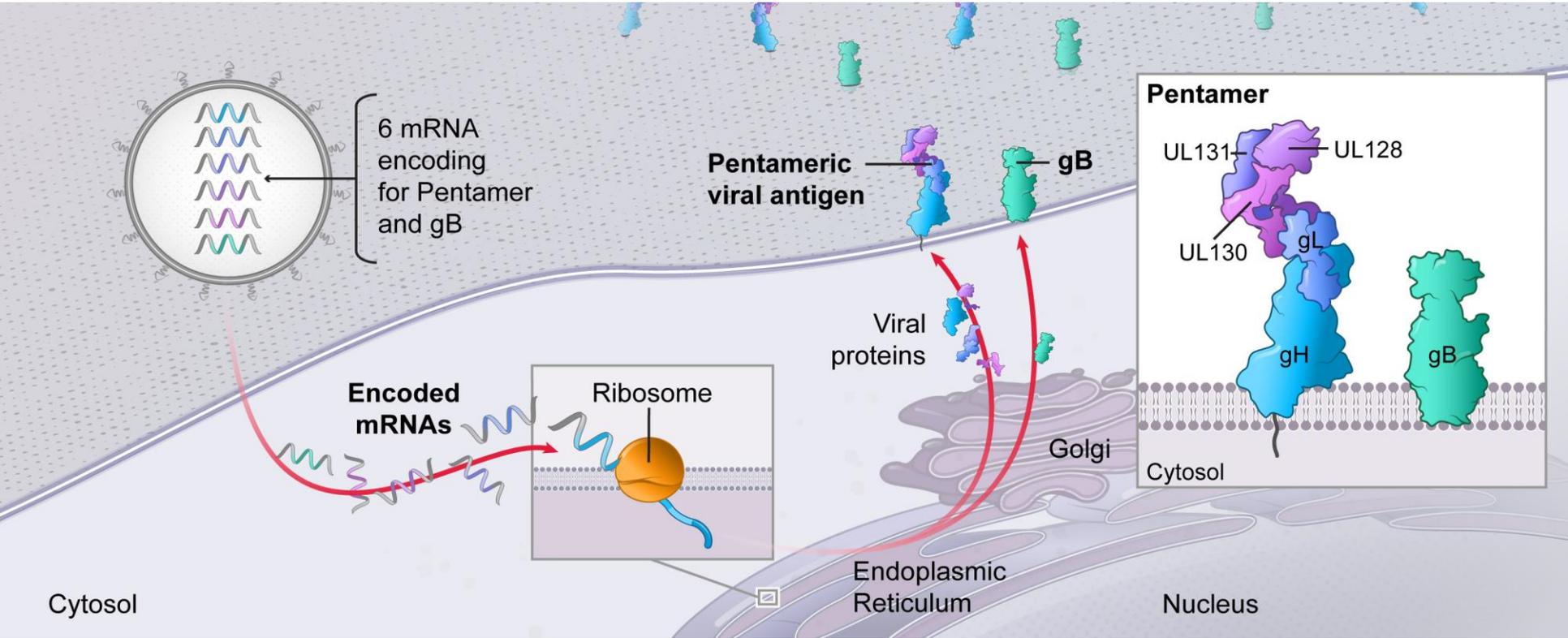
- Human CMV is a common human pathogen and member of the herpes virus family and is the **leading cause of birth defects in the US**
- **Disease burden:** Birth defects in 20% of infected babies – permanent neurodevelopment disabilities
  - 33% of infants with severe congenital disease die in first year; significant long-term burden on survivors, caregivers, and health systems
- **Target population:** 0.65% of US newborns infected annually (~25,000 US newborns)
- **Unmet need:** No approved CMV vaccine
  - Other companies have failed in developing a vaccine: missing pentamer



**Moderna concept: mRNA vaccine, IM-administered, designed to make gB and Pentamer antigens in their natural conformations to prevent or control CMV infection**

# Congenital CMV vaccine includes 6 mRNAs

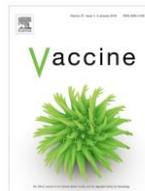
5 encode the Pentamer, 6<sup>th</sup> encodes gB antigen



# Congenital CMV vaccine (mRNA-1647)

## Pre-clinical data – mRNA vaccine vs. CytoGam

Species:  
**Mouse**



John, S. et al. Multi-antigenic human cytomegalovirus mRNA vaccines that elicit potent humoral and cell-mediated immunity. *Vaccine* 36, 1689–1699 (2018).

### Neutralizing titers in human primary epithelial cells for escalating CMV vaccine dose in mice

Dose for vaccine including Pentamer and gB in our proprietary LNP	At 41 days
	Neutralization titers in epithelial cell
1.2 µg	58,336
3.5 µg	682,989
10.5 µg	457,913
CytoGam comparator (used at maximum concentration of 2 mg/ml observed in human serum)	5,905

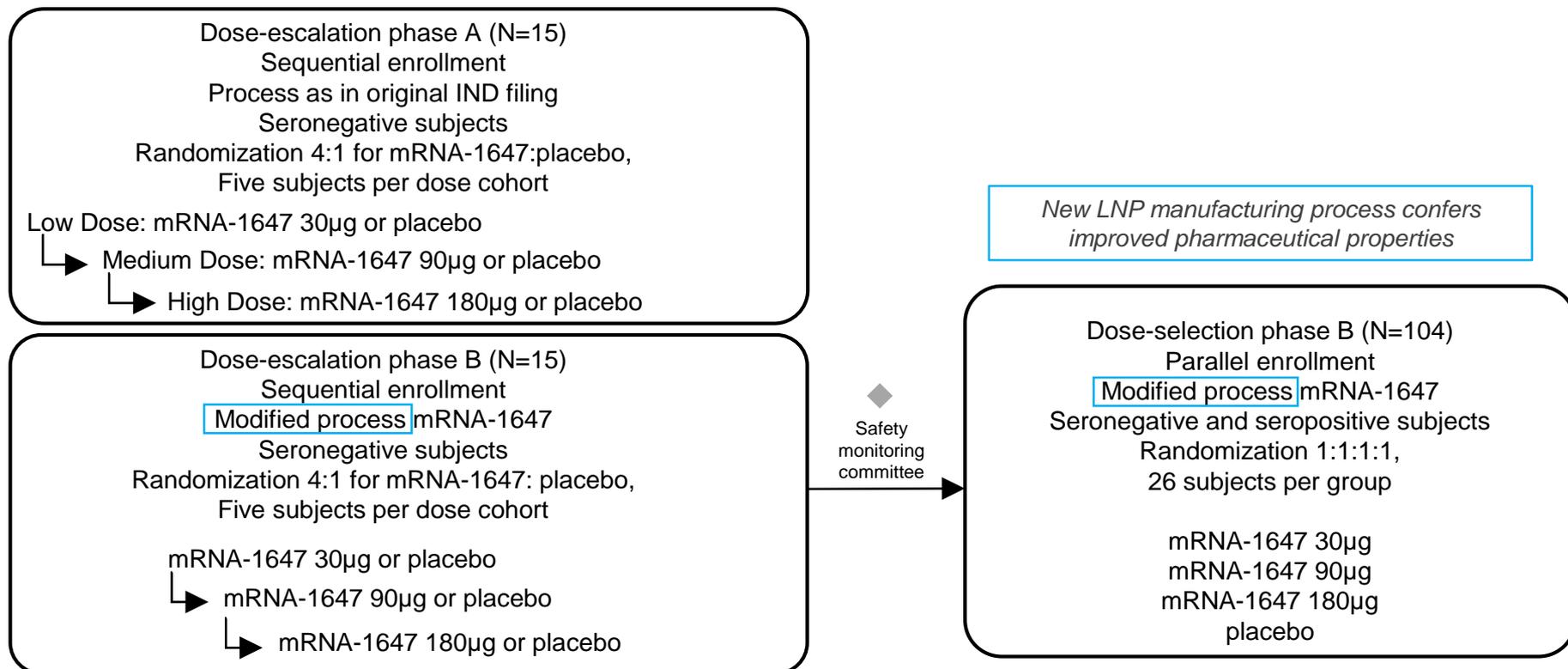
**We have demonstrated that the Pentamer and gB mRNA can produce potent and durable antibody titers against the antigens in mice and non-human primates**

# Congenital CMV vaccine (mRNA-1647)

## Ongoing Phase 1 design

### Key Objectives

- Evaluate safety and reactogenicity of different dose levels
- Evaluate neutralizing anti-CMV antibody responses against epithelial cell and fibroblast cell infection
- Evaluate antigen-specific antibody responses against gB and Pentamer
- Evaluate antigen-specific T cell responses to different doses



# Special note regarding forward-looking statements

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