moderna

Epstein-Barr virus (EBV) vaccine (mRNA-1189)

Last program update: May 7, 2020

Modality	ID #	Program	Preclinical development	Phase 1	Phase 2	Phase 3 and commercial	Moderna rights
Prophylactic vaccines	mRNA-1273	Novel coronavirus (SARS-CoV-2) vaccine					Worldwide *BARDA funded*
	mRNA-1647	Cytomegalovirus (CMV) vaccine					Worldwide
	mRNA-1653	hMPV/PIV3 vaccine		Phase 1 (healthy volunteers)	Phase 1b (Age de-escalation) Seropositives		Worldwide
	mRNA-1172/ Merck V172	Respiratory syncytial virus (RSV) vaccine					Merck to pay milestones and royalties
	mRNA-1777	Respiratory syncytial virus (RSV) vaccine					
	mRNA-1893	Zika vaccine					Worldwide *BARDA funded*
	mRNA-1345	Pediatric respiratory syncytial virus (RSV) vaccine *Future respiratory combo*					Worldwide
	mRNA-1189	Epstein-Barr virus (EBV) vaccine					Worldwide
	mRNA-1851	Influenza H7N9 vaccine					Worldwide *Advancing subject to funding*

Epstein-Barr virus (EBV) overview

- EBV is a member of the herpesvirus family that includes CMV, is spread through bodily fluids (e.g., saliva) and contracted primarily by young children and adolescents
- **Disease burden:** EBV is a major cause of infectious mononucleosis (IM) in the U.S., accounting for over 90% of the ~1+ million cases annually
  - IM can debilitate patients for weeks to months, can lead to hospitalization and (rarely) splenic rupture
  - EBV infection is also associated with certain lymphoproliferative disorders, cancers and autoimmune diseases
  - IM and EBV infection are associated with increased risk of developing multiple sclerosis (MS)
- **Unmet need:** No approved vaccine

EBV infection sequelae	
Adolescents and young adults	*Infectious Mononucleosis* • Sore throat • Lymphadenopathy • Fever • Body aches • Fatigue
Lifetime associated risks	Increased risk of developing cancer and multiple sclerosis

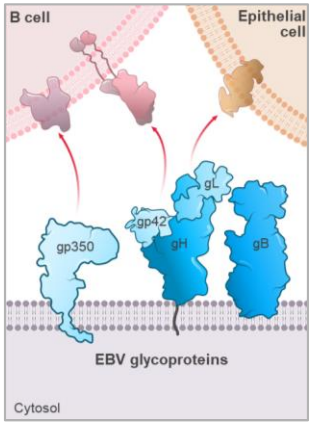
Moderna product concept: Develop a multi-antigen vaccine to prevent IM and EBV infection, with long-term potential to impact EBV-associated diseases

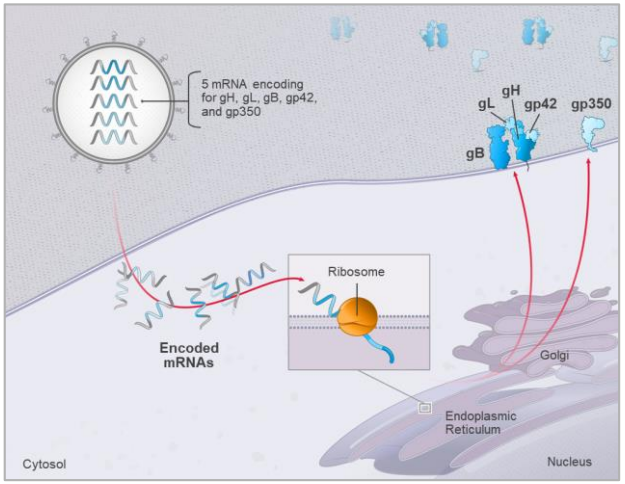
moderna

EBV vaccine (mRNA-1189)

Encodes for five glycoproteins to inhibit both mechanisms for viral entry

- EBV lifecycle has lytic and latent stages, similar to other herpesviruses like CMV
- EBV has multiple surface (envelope) glycoproteins that mediate virus entry in different cell types[1]
  - **gp350** and **gp42/gH/gL complex** primarily mediate B cell infection
  - **gH/gL complex** primarily mediate epithelial cell infection
  - **gB** drives viral fusion for all cell types
- Vaccination with *only* gp350 (partial B cell protection) reduced the rate of IM by 78% in a clinical trial, but did not prevent infection[2]
- Our vaccine encodes five glycoproteins to inhibit both mechanisms for viral entry into **B cells (gp350** *plus* **gH/gL/gp42)**, adds protection for **epithelial cells (gH/gL)**, and includes **gB** for protection of all cells
- We believe that by protecting both cell types our vaccine will **reduce the rate of IM, and possibly prevent EBV infection**



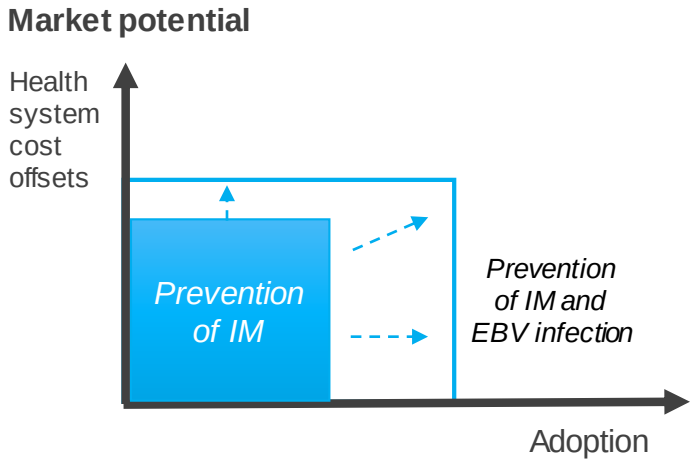


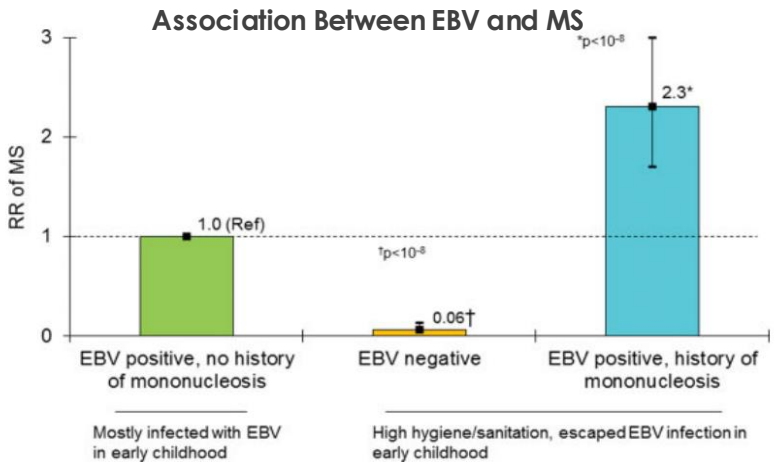
1. Balfour. Pediatr Res. 2020 Jan;87(2):345-352
2. Sokal. The Journal of Infectious Diseases, Volume 196, Issue 12, 15 December 2007, Pages 1749–1753
3. Nielsen. *Arch Neurol*. 2007; 64:72; Ascherio. *Semin Neurol*. 2016; 36:103
4. Semin Neurol 2016; 36(02): 103-114

moderna

EBV vaccine (mRNA-1189) opportunity

- We estimate worldwide direct costs of EBV-linked IM to reach $500 million annually and indirect costs to exceed $1 billion
- Vaccine that prevents IM in seronegative adolescents could be a significant commercial opportunity, analogous to meningitis vaccines
  - Bexsero (Meningitis B vaccine) has forecasted revenue of ~$970 million in 2020[1]
- Prevention of EBV infection – in addition to prevention of IM – could encourage broader adoption and upside[2]
- Impact on EBV-associated diseases, such as increased risk of some cancers and multiple sclerosis, would be a long-term potential upside but are not part of the current clinical development plan[3]



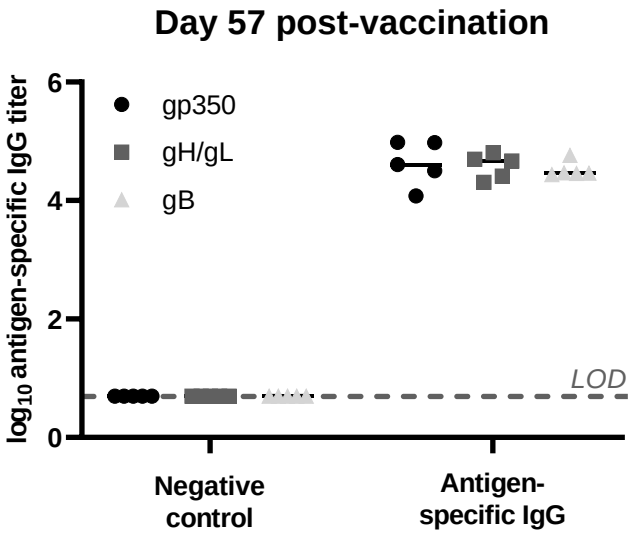


1. EvaluatePharma
2. Nielsen. *Arch Neurol*. 2007; 64:72; Ascherio. *Semin Neurol*. 2016; 36:103
3. Semin Neurol 2016; 36(02): 103-114

moderna

EBV vaccine (mRNA-1189)

Preclinical data demonstrates the ability to induce antibodies against EBV antigens



Antibody titers against glycoproteins involved in epithelial and B cell entry were observed in preclinical studies

Results shown here represent five animals per group and demonstrate high levels of antigen-specific immunoglobulin G ("IgG") as compared to negative controls.

Naïve Balb/c mice were given two doses of a vaccine against EBV antigens in combination approximately four weeks apart. Antibody titers against viral proteins involved in epithelial cell entry (gH/gL and gB) or B cell entry (gp350, gH/gL and gB) were measured in peripheral blood at day 57.

moderna

Forward-looking statements

This presentation contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, as amended including, but not limited to, statements concerning potential development candidate applications, development candid ate activities, preclinical and clinical studies, regulatory submissions and approvals, risk management and estimates and forward -looking projections with respect to Moderna or its anticipated future performance or events. In some cases, forward -looking statements can be identified by terminology such as “may,” “should,” “expects,” “intends,” “plans,” “aims,” “anticipates,” “believes,” “estimat es,” “predicts,” “potential,” “continue,” or the negative of these terms or other comparable terminology, although not all forward -looking statements contain these words. The forward-looking statements in this presentation are neither promises nor guarantees, and you should not place undue reliance on these forward-looking statements because they involve known and unknown risks, uncertainties and other factors, many of which are beyond Moderna’s control and which could cause actual results to differ materially from those expressed or implied by these forward -looking statements. These risks, uncertainties and other factors include, among others: preclinical and clinical development is lengthy and uncertain, especially for a new category of medicines such as mRNA, and therefore Moderna’s preclinical programs or development candidates may be delayed, terminated, or may never advance to or in the clinic; no mRNA drug has been approved in this new p otential category of medicines, and may never be approved; mRNA drug development has substantial clinical development and regulatory r isks due to the novel and unprecedented nature of this new category of medicines; and those described in Moderna’s most recent Annual Report on Form 10-K filed with the U.S. Securities and Exchange Commission (SEC) and in subsequent filings made by Moderna with SEC, which are available on the SEC's website at www.sec.gov. Except as required by law, Moderna disclaims any intention or responsibility for updating or revising any forward-looking statements in this presentation in the event of new information, future developments or otherwise. These forward-looking statements are based on Moderna’s current expectations and speak only as of the date hereof.

moderna®