

List of candidate vaccines developed against MERS-CoV

Platform	Type of candidate vaccine	Developer	Coronavirus target	Current stage of clinical evaluation/regulatory status- Coronavirus candidate	Non-coronavirus candidates	Current stage of clinical evaluation/regulatory status - other products
DNA	DNA plasmid vaccine that encodes the MERS CoV spike (S) glycoprotein Electroporation device [12-15]	Inovio Pharmaceuticals	MERS	Phase I	Lassa, Nipah (CEPI) HIV Filovirus HPV Cancer indications Zika Hepatitis B	Phase III
Non-Replicating Viral Vector	MVA-MERS-S [1-5]	IDT Biologika GmbH	MERS	Phase I	CHIK, Ebola, Lassa, Marburg, Zika, influenza	Licensed Product
Non-Replicating Viral Vector	ChAdOx1 MERS [6-9]	University of Oxford	MERS	Phase I	Malaria, Influenza, CHIK, RABV, TB, RVFV	Phase I

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Replicating Viral Vector	MV MERS-S (Measles vector) [10-11, 146]	Themis Bioscience GmbH	MERS	Pre-Clinical	Chikungunya (P3,), LASV (P1)	Phase III
Protein Subunit	MERS Sclamp [80]	The University of Queensland	MERS	Pre-Clinical	Nipah, influenza, Ebola, Lassa	Pre-Clinical
RNA	nanoparticle delivery with a replicating, VLP-secreting RNA (rvRNA) [94]	IDRI	MERS	Pre-Clinical	InfV, RABV ,RVFV, ZIKV, TB	Pre-Clinical
Protein Subunit	Full length S trimers/ nanoparticle [19-21, 149, 150]	Novavax	MERS	Pre-Clinical	RSV; CCHF, HPV, VZV, EBOV	Phase III
Protein Subunit	Purified recombinant Spike protein D3252 [95]	Protein Sciences	MERS	Pre-Clinical		
Protein Subunit	recombinant MERS spike protein [112]	The Catholic University of Korea, SK	MERS	Pre-Clinical		

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		Chemicals, Chonbuk National University,				
Virus-like Particle	MERS-CoV virus-like particles (Bac- S,E,M & Bac- RBD+VP2) [34,35]	Northeast Forestry University; Academy of Military Medical Sciences; Shandong University; Jiangsu Co- innovation Center for Prevention and Control of Important Animal Infectious Diseases and Zoonoses	MERS	Pre-Clinical		
Inactivated Viral Vector	RABV-MERS [17]	Thomas Jefferson University	MERS	Pre-Clinical	Filoviruses, Hendra	
RNA	MERS-CoV S protein RBD- based mRNA vaccine [18]	New York Blood Center (grant no publications yet)	MERS	Pre-Clinical		

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Protein Subunit	MERS-CoV S protein RBD vaccine enhanced with ASP-1+ALUM combination [22]	New York Blood Center	MERS	Pre-Clinical		
Protein Subunit	MERS-CoV subunit S2 fusion domain-based vaccine expressed in E.Coli platform [23]	Cornell University	MERS	Pre-Clinical		
Protein Subunit	RBD fused with human Fc/ Mersmab1 [24,25]	New York Blood Center; Baylor College Medicine; University of Texas Medical Branch (UTMB)	MERS	Pre-Clinical		
Protein Subunit	MERS-CoV S fused with Fc of human IgG (RBD-Fc) (intranasal delivery) [26]	New York Blood Center	MERS	Pre-Clinical	anthrax rPA, pandemic flu rH5, HSV2 gD2/gB2, Chlamydia, and acellular pertussis	Phase I

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Non-Replicating Viral Vector	AdC68-S (VRP expressing spike protein) [16]	Tsinghua University; University of Iowa	MERS	Pre-Clinical		
Live Attenuated Virus	Live-attenuated recombinant MERS-CoV [27]	University of Iowa	MERS	Pre-Clinical		
DNA	pVRC8400-S1 (spike SI DNA prime-SI protein boost) [115]	National Institute of Allergy and Infectious Diseases (NIAD). Walter Reed Army Institute of Research (WRAIR); Vanderbilt University	MERS	Pre-Clinical		
DNA	pcDNA3.1(+)-S1 or S (1-725) [33]	Academy of Military Medical Science, China; Shandong University, China; University of Iowa; King Abdulaziz University, Saudi Arabia;	MERS	Pre-Clinical		

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Non-Replicating Viral Vector	Ad5-S/S1- or Ad41-S-based [29]	Chinese Center for Disease Control and Prevention (China CDC)	MERS	Pre-Clinical		
Non-Replicating Viral Vector	Ad5 S (GREVAX™ platform) [30]	Greffex, Inc.	MERS	Pre-Clinical	Various Research	
Non-Replicating Viral Vector	Ad5 S with S nanoparticles booster (alum adjuvanted) [31]	The Catholic University of Korea; Chonbuk National University, Korea; SK Chemical, Korea;	MERS	Pre-Clinical		
Replicating Viral Vector	VSVΔG-MERS (S) [32]	Chinese Academy of Agricultural Sciences	MERS	Pre-Clinical		
Protein Subunit	MERS-CoV rRBD [38,39]	Chinese Center for Disease Control and Prevention (China CDC)	MERS	Pre-Clinical		
Protein Subunit	rNTD subunit vaccine [40]	Chinese Center for Disease Control and Prevention (China CDC);	MERS	Pre-Clinical		
Protein Subunit	Oral administration	Defence Science and Technology	MERS	Pre-Clinical	RVF, Plague	Pre-Clinical

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	of MERS peptides and proteins [116]	Laboratory (Dstl); University of Strathclyde; Research Councils UK				
Protein Subunit	S prefusion trimer (sigma adjuvant) [41]	The Scripps Research Institute; Geisel School of Medicine at Dartmouth; VRC, National Institute of Allergy and Infectious Diseases; Vanderbilt University	MERS	Pre-Clinical		
Inactivated Virus	gamma-irradiated inactivated vaccine (EMC/2012, Alum / MF59) [36]	University of Texas Medical Branch (UTMB); Jazan University	MERS	Pre-Clinical		
Inactivated Virus	Inactivated Mers vaccine (EMC/2012, Alum + CpG) [37]	Chinese Center for Disease Control and Prevention (CDC China)	MERS	Pre-Clinical		

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Live Attenuated Virus	MERS-ΔE [42]	Universidad Autonoma de Madrid, Spain	MERS	Pre-Clinical		
Live Attenuated Virus	MERS-dNSP16 [43]	University of Texas Medical Branch (UTMB); University of North Carolina at Chapel Hill	MERS	Pre-Clinical		
Live Attenuated Virus	MERS-dORF3-5 [44]	University of Texas Medical Branch (UTMB); University of North Carolina at Chapel Hill	MERS	Pre-Clinical		
Protein Subunit	RVΔP-MERS/S1 [69]	National Institute of Infectious Diseases, Shinjuku-ku, Tokyo, Japan; Waseda University; Yasuda Women's University	MERS	Pre-Clinical		
Non-Replicating Viral Vector	Ad-MERS-S1[70]	Jordan University of Science and Technology	MERS	Pre-Clinical		
Non-Replicating Viral Vector	rAD5 S1-CD40L [136]	King Abdulaziz University.UTMB, Health Canada	MERS	Pre-Clinical		

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Non-Replicating Viral Vector	rAD5 S1 [152]	University of Pittsburgh, Erasmus University, Council of Health Qatar	MERS	Pre-Clinical		
Protein Subunit	truncated rS1 - Fc [137-140]	New York Blood Center, The University of Hong Kong, UTMB, Beijing Institute of Microbiology and Epidemiology, Fudan University, University of Minnesota	MERS	Pre-Clinical		
Non-Replicating Viral Vector	VEE VRP-S [134]	University of Iowa	MERS	Pre-Clinical		
Protein Subunit	S-protein	Novavax [132]	MERS	Pre-Clinical	Influenza	Phase III
Replicating Viral Vector	S-protein	NIAID [132]	MERS	Pre-Clinical	Various Research	
Replicating Viral Vector	S-protein	Univ. of Iowa [132]	MERS	Pre-Clinical	Various Research	
Replicating Viral Vector	S-protein	University of Pittsburgh [133]	MERS	Pre-Clinical	Various Research	
Protein Subunit	S-protein	Medicago [132]	MERS	Pre-Clinical	Influenza	Licensed Product

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Protein Subunit	S-protein	Novartis [132]	MERS	Pre-Clinical	Various products	Licensed Product
Protein Subunit	S-protein	NY Blood [132]	MERS	Pre-Clinical	Various Research	
Protein Subunit	S-protein	PeptiVir [132]	MERS	Pre-Clinical	Various Research	
Replicating Viral Vector	S-protein	CDC [132]	MERS	Pre-Clinical	Various Research	

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