Influenza Vaccines Research & Development (R&D) Roadmap (IVR)

Monitoring, Evaluation, and Adjustment (ME&A) Taskforce Meeting

Summary Report

7 December 2023
London, UK

Influenza Vaccines Research & Development Roadmap

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Background

The Influenza Vaccines Research and Development (R&D) Roadmap (IVR), which was launched in September 2021, is aimed at accelerating progress toward the improvement of seasonal influenza vaccines and the development of new universal or broadly protective influenza vaccines. By highlighting key research gaps, identifying strategic goals and milestones, and encouraging synergistic R&D activities, the roadmap serves as a valuable tool to advance the complex field of vaccine research over the next 10 years and stimulate investment in influenza vaccine R&D.

The Center for Infectious Disease Research and Policy (CIDRAP) is tracking progress toward meeting the IVR goals and milestones through numerous Monitoring, Evaluation, and Adjustment (ME&A) activities. The IVR expert taskforce plays a critical role in guiding and informing this effort. This is the second of three annual meetings convened for this project.

The IVR is organized into the following sections; progress in each of these areas was discussed during the meeting:

- Vaccinology for Seasonal Influenza Vaccines
- Vaccinology for Universal Influenza Vaccines
- Immunology and Immune Correlates of Protection
- Virology Applicable to Vaccine Development
- Animal Models and the Controlled Human Influenza Virus Infection Model (CHIVIM)
- Policy, Finance, and Regulation

Meeting Objectives

The ME&A taskforce was convened on Dec 7, 2023 to achieve the following objectives:

1. Highlight key advances that have been made in next-generation influenza vaccines R&D.
2. Identify activities essential to advance R&D for next-generation influenza vaccines.
3. Examine priority milestones; describe key underlying reasons for lack of progress.
4. Determine opportunities to catalyze progress in priority areas of influenza vaccines R&D.

Meeting Participants

The meeting was a hybrid meeting, with participants joining in-person at the Wellcome Trust or online via Zoom.

Table 1. December 7, 2023 IVR meeting participants.		
IVR Steering Group (SG), Taskforce (TF), and Guest Participants		
Pirada Allen*	Teresa Hauguel*	Diane Post (SG)
William Ampofo (TF)	Scott Hensley (TF)*	Malia Richmond-Crum
Shobana Balasingam*	Freya Hopper	Chris Roberts
Edward Belongia (TF)*	Irina Isakova-Sivak (TF)*	Tiago Rocca (TF)
Pamuk Bilsel*	Michael Ison	Melanie Saville
Joseph Bresee (SG)	Kari Johansen (TF)	Julie Schafer
Britni Burkhardsmeier	Eric Karikari-Boateng (TF)*	Stacey Schultz-Cherry (TF)
Christopher Chadwick*	Jackie Katz	Ethan Settembre (TF)
Jing Chen	Charu Kaushic	James Southern (TF)*
Cheryl Cohen (TF)*	Elizabeth Klemm	Marianne Stanford*
Rebecca Cox (TF)	Keith Klugman (SG)	Kanta Subbarao (TF)
Florie Doublet*	Philipp Lambach	Jessica Taaffe
Vivien Dugan	Sam Lee	John Tam (TF)
Alexander Escoffier*	John Lim (TF)*	Erica Telford
Martin Friede (SG)	John McCauley (TF)	Sophia Wang (SG)
Bruce Gellin (SG)*	Ann Moen	Jerry Weir (TF)
Josie Golding (SG)	Sonja Olsen (SG)	Casey Wright
Jennifer Gordon	Michael Osterholm (SG)	Heather Youngs
Pierre Gsell	Punnee Pitisuttithum (TF)	
Chan Harjivan	Olga Pleguezuelos*	
CIDRAP IVR Core Team and Wellcome Meeting Team		
Sushmita Barman	Eve Lackritz	Julie Ostrowsky
Lauren Bigalke	Anje Mehr	Angela Ulrich

* Virtual attendance
(TF) Taskforce
(SG) Steering group

Meeting Materials

Materials distributed to meeting participants included:

- IVR ME&A Taskforce Meeting Agenda (Appendix A)
- Summary of Research Outcomes Addressing the IVR Strategic Goals and Milestones
- Summary of IVR Funding Tracker Dashboard (Appendix B)

Meeting Format

The meeting was divided into eight sessions. All participants (Table 1) including members of the IVR steering group, IVR taskforce, and guests were encouraged to participate fully and provide feedback, including those attending virtually.

Sessions 1 & 8

Sessions 1 and 8 focused on higher-level implementation issues such as presenting strategic initiatives, identifying major challenges, and discussing key recommendations from various perspectives.

Sessions 2 - 7

Sessions 2-7 focused on each of the six IVR topic areas, with one session dedicated to each topic. For each session, as time and discussion allowed, the goals were to:

1) Identify activities essential to advance R&D for next-generation influenza vaccines.
2) Describe the key obstacles to progress in critical areas.

In each session, a facilitator presented a brief summary of milestone status and key highlights and advances relating to the topic area. This was followed by a large group moderated discussion focused on high-priority milestones.

Meeting Discussion Highlights, by Session

Session 1: Strategic Initiatives for Advancing Influenza Vaccines

This session was moderated by Michael Osterholm (CIDRAP) and included the following speakers: Martin Friede (World Health Organization [WHO]), Chan Harjivan (White House), Michael Ison (National Institute for Allergy and Infectious Diseases [NIAID], US National Institutes of Health [NIH]), and Melanie Saville (Coalition for Epidemic Preparedness Innovations [CEPI]).

The speaker presentations were followed by a panel discussion moderated by Michael Osterholm. The session sought to achieve the following aims:

1. Provide an overview of ongoing and future strategic initiatives for advancing influenza vaccines from multiple perspectives.
2. Understand the landscape of global influenza vaccine R&D priorities and activities.
3. Provide context for the status of the various IVR milestones to be discussed throughout the meeting.

Presentation highlights include the following:

Chan Harjivan, White House

The newly developed Office of Pandemic Preparedness and Response Policy (OPPR) shows the dedication of the United States (US) government to addressing future pandemics, including those caused by influenza. However, there are many challenges to overcome, including a decrease in vaccination rates, vaccination cost, and insufficient global manufacturing capacity. Future efforts should seek to develop sustainable manufacturing procedures that could be easily modified to address specific pandemic requirements. Increased communication on vaccine safety and benefits could increase vaccine uptake and provide necessary education on vaccination schedules. The response to COVID demonstrated how collaboration among different sectors (industry, academic, and government), adequate funding, and

global engagement can meet ambitious goals. Leaders should seek to leverage programs such as the US Health and Human Services agency's Project NextGen to coordinate efforts to advance the pipeline of new vaccines.

Mike Ison, NIAID

NIAID's research strategy is aimed at the development of a universal influenza vaccine that is effective against all influenza subtypes/lineages. However, there is a benefit to improving current seasonal vaccines that last longer and/or have greater breadth and effectiveness. NIAID has committed more than one billion dollars to support influenza research, a clear and compelling commitment to advancing influenza vaccine R&D. NIAID funded over 648 unique individual programs in basic, translational, and clinical research. Of note, NIAID is planning an animal model workshop for April 2024.

NIAID is actively evaluating their strategic plan, which identifies priority research areas for vaccine development: (1) transmission, natural history, and pathogenesis; (2) immunity and correlates of protection; (3) rational design of universal influenza vaccines. Projects are funded across all areas, which include Collaborative Influenza Vaccine Innovation Centers (CIVICs) and the infant immunity program. The CIVICs program is a network of research centers and provides important resources such as publications to the scientific community and assays to study immunologic response. Each center has its priorities but there are common areas among them, providing opportunities for collaboration. One important area of focus is identifying the most promising candidates to move forward to clinical trials.

Melanie Saville, CEPI

CEPI is focused on the "100 Days Mission," i.e., the development and deployment of a vaccine against "disease X" within 100 days from virus sequence identification. Three objectives support the mission: prepare, transform, and connect; key initiatives have been identified in each of these objective areas. For example, under the "transform" objective is the development of virus family vaccine libraries—which includes prototype versions of vaccines against representative viruses—a key component for achieving broad protection. In addition, vaccine libraries have the potential to allow for pooling of existing data and resources on platform and immune response, which can help decrease the timeline for vaccine development.

Collaboration between the scientific community and funding organizations is essential to enable a quick response during a pandemic. This was shown recently as simultaneous activities were critical in developing a COVID vaccine in less than a year. Recognizing the need to evaluate lessons learned from the COVID response to inform future preparedness activities, CEPI completed interviews with vaccine-development firms, international organizations, regulatory agencies, academia, and the media. However, the length of time required to develop a new vaccine is a significant obstacle and vaccine equity is yet to be achieved.

Martin Friede, WHO

WHO is currently developing a full value of influenza vaccine assessment (FVIVA) and updating the WHO's 2017 Preferred Product Characteristics for Next-Generation Influenza Vaccines (PPCs). The PPC guidance helps define the value proposition for markets in low- and middle-income countries (LMICs) markets for vaccines in development, and informs the Target Product Profiles.

Development of a more effective vaccine with extended durability has the potential to increase the value of influenza vaccines. The messenger ribonucleic acid (mRNA) vaccine platform may present an opportunity to increase vaccine production infrastructure if the same technology platforms can be used for vaccines against different pathogens (e.g., coronavirus, influenza, tuberculosis). Concerns regarding reactogenicity of mRNA vaccines remain a barrier to expanded R&D and acceptance.

Though new vaccine technologies offer the potential for expanded access in LMICs, influenza vaccine R&D still faces many barriers, such as vaccine equity and vaccine production infrastructure that is sustainable before, during, and after a pandemic. Other challenges include the relative value of influenza vaccines compared with other available vaccines and assessing the value of influenza vaccines in different situations.

Panel Questions

The following questions were posed to the entire panel and panelist answers are summarized below.

Question: From your organization's perspectives, what are the greatest barriers right now to creating next generation influenza vaccines?

Many different organizations are doing important work but there is a need for truly effective collaboration. Collaboration is key to guaranteeing organizations are not just communicating but working together. The White House is striving to ensure there is collaboration across US governmental agencies but it is a monumental task, especially when multilaterals are also included. There is the need for common metrics to track progress in influenza vaccine R&D.

Equitable access continues to be a challenge and sustainable manufacturing is still lacking. Regulatory restrictions and uncertainty regarding vaccine regulatory requirements, primarily in LMICs, also create barriers across the R&D pipeline. Developing better breadth of protection was noted as the greatest barrier for one organization while multiple stated access to resources is the major barrier.

Q: How do you imagine we can address these barriers to influenza vaccine R&D, especially the decline in vaccination rates?

Understanding human behavior is as important as understanding the science when trying to increase vaccination rates. Learning from COVID, we should create different messages for different stages of the pandemic and clearly define the utility of vaccines. Great care should be taken to ensure community engagement from the outset and public awareness of the safety and value of a vaccine. If possible, we should identify novel methods for vaccine administration and storage requirements to improve accessibility.

Q: What is the current prioritization and funding for flu vaccine research and development? And what are the challenges you see to that funding over the course of the next 3 to 5 years?

Priorities varied across organization but indicated a strong focus on infectious disease. Sustainable global manufacturing was mentioned multiple times as a priority along with learning from the COVID-19 experience. Other priorities included investing in platform technologies, increasing infrastructure and manufacturing capabilities, and a focus on broadening the degree of protection for both seasonal and supraseasonal vaccines. There is hope that generative artificial intelligence (AI) will create a vast new set of opportunities which could modify future priorities.

Session 2: Vaccinology for Seasonal Influenza Vaccines

Joseph Bresee facilitated discussion for the *Vaccinology for Seasonal Influenza Vaccines* session, which focused on 6 high-priority milestones across 5 strategic goals.

Milestone Status

Table 2. Number and status of milestones in the *Vaccinology for Seasonal Influenza Vaccines* IVR topic area.

	All Milestones (n[d])	High-Priority Milestones (n[d])
Accomplished[a]	4	0
In Progress[b]	14	5
No Progress[c]	8	1
Total	26	6

[a]Accomplished: Milestone has been accomplished, fully or partially
[b]In Progress: Relevant research outcomes reported, indicating progress toward the milestone
[c]No Progress: No relevant research outcomes identified, indicating no progress toward the milestone
[d]Table reflects the numbers included in slides and printed materials distributed to participants at the time of the meeting.

Key Highlights and Advances

The following items were highlighted in slides as examples of key advances in this topic area:

- Multiple new potency assays developed for timely release of annual vaccine preparations.
- Ongoing studies assessing alternate routes of vaccine delivery (intranasal, oral, and transdermal).
- The Bill & Melinda Gates Foundation (BMGF) is planning a workshop on novel platforms for seasonal and broadly protective or universal influenza vaccines.
- Four COVID and Influenza combination vaccine candidates in active clinical development.
- Safety and efficacy profiles for improved immune response for elderly and the very young being evaluated in preclinical, phase 1, phase 2, and phase 3 trials.
- Preclinical studies have examined the potential for neuraminidase (NA) antigens to enhance immunogenicity of different influenza vaccine constructs.
- 70 funded projects identified.

Discussion Highlights

Table 3. Discussion highlights for the *Vaccinology for Seasonal Influenza Vaccines* IVR topic area; includes high-priority milestones discussed during ME&A taskforce meeting and associated strategic goals.

Strategic Goal 3.2: Identify strategies and policies to optimize seasonal influenza vaccines and improve vaccine effectiveness.	
High-Priority Milestone	**Discussion Highlights**
Milestone 3.2.b: Convene a workshop to review the development of novel platforms (e.g., mRNA-based) for COVID-19 vaccines to identify how best to apply them to	● Interest in this topic is well demonstrated (see Landscape for examples of mRNA-based seasonal influenza vaccine candidates in preclinical and clinical development).

developing improved seasonal influenza vaccines.	● Further review of progress could be incorporated into the US Department of Health and Human Services (HHS) Project NextGen.
Milestone 3.2.e: Conduct a workshop to determine optimum methods for assessing the effectiveness of conventional egg-based and cell culture-based vaccines with new vaccine technologies, in coordination with regulatory agencies and using consistent end points, to allow data to be combined as appropriate over multiple seasons and to allow better comparability of data across studies.	● TF suggestions: revise the milestone to (1) compare the effectiveness of product-specific or platform-specific influenza vaccines for seasonal use and pandemic preparedness, particularly in LMICs; (2) broaden the approach for synthesizing the data; and (3) include methodologic development (e.g., regarding endpoints such as reducing virus transmission and evaluating the effectiveness of vaccines that are not widely used).
Milestone 3.2.h: Evaluate the effectiveness of alternate routes of vaccine delivery (e.g., intranasal, oral, intradermal needle-free administration, topical) in preclinical and clinical studies, to identify new mechanisms of immune protection, such as enhancement of mucosal immunity.	● Milestone continues to be a priority for the field.
Strategic Goal 3.4: Further assess the role of existing and new adjuvants in creating next-generation seasonal influenza vaccines, informed by recent R&D with adjuvants in new COVID-19 vaccines.	
High-Priority Milestone	**Discussion Highlights**
Milestone 3.4.b: Determine, through clinical studies, if any promising new adjuvant candidates under investigation can substantially improve the immune response to influenza vaccines in the elderly and assess their safety and efficacy profiles.	● Milestone continues to be a priority for the field.
Milestone 3.4.c: Determine, through clinical studies, if any existing adjuvants substantially improve the immune response to influenza vaccines in the very young, (e.g., as an initial vaccination followed by non-adjuvanted vaccines) and assess their safety and efficacy profiles.	● Concern regarding the limited studies focused on examining impact of adjuvants on immune response in the very young (< 6 months).

Strategic Goal 3.5: Determine the role of NA as a vaccine antigen for improving the effectiveness and immunogenicity of seasonal influenza vaccines.	
High-Priority Milestone	**Discussion Highlights**
Milestone 3.5.d: Determine if the presence of NA improves new or next-generation seasonal influenza vaccines, and, if so, establish the optimal dose of NA that improves immunogenicity and effectiveness, and maintains and acceptable safety profile.	• Agreement that this milestone continues to be a priority for the field. • Could consider a broader description for antigen rather than focusing only on NA.

Priority Focus Areas for Investment and/or Potential Actions to Catalyze Progress

Meeting participants indicated that all milestones discussed in this section are critical to advancing R&D for next generation influenza vaccines and should retain their high-priority status. There was discussion surrounding the language of certain milestones, including many that require a workshop to achieve accomplished status. The priority areas identified for *Vaccinology for Seasonal Influenza Vaccines* included the need for the following:

- Conduct comparative effectiveness studies between products.
- Evaluate the effectiveness of alternate routes of vaccine delivery.
- Conduct clinical studies to evaluate if adjuvants improve the immune response in high-risk populations (i.e., elderly, young, obese).

Session 3: Vaccinology for Broadly Protective or Universal Influenza Vaccines

Jennifer Gordon served as facilitator for the *broadly protective or universal vaccinology* session, which focused on the 7 high-priority milestones across 2 strategic goals.

Milestone Status

Table 4. Number and status of milestones in the *Vaccinology for Broadly Protective of Universal Influenza Vaccines* IVR topic area.

	All Milestones (n[d])	**High-Priority Milestones (n[d])**
Accomplished[a]	2	2
In Progress[b]	7	4
No Progress[c]	4	1
Total	13	7

[a]Accomplished: Milestone has been accomplished, fully or partially
[b]In Progress: Relevant research outcomes reported, indicating progress toward the milestone
[c]No Progress: No relevant research outcomes identified, indicating no progress toward the milestone
[d]Table reflects the numbers included in slides and printed materials distributed to participants at the time of the meeting.

Key Highlights and Advances

The following items were highlighted in slides as examples of key advances in this topic area:

- Promising influenza vaccine candidates (potentially universal, broadly protective, or next-generation) from both public and private sector sponsors being evaluated in preclinical and phase 1-3 trials.
- Large and diverse group of candidates are in active preclinical development.
- BMGF is planning a workshop on novel platforms for seasonal and broadly protective or universal influenza vaccines.
- The International Society for Influenza and other Respiratory Virus Diseases (ISIRV) held a conference in March 2023: *Correlates of protection for next generation influenza vaccines: lessons learned from the COVID pandemic*.
- 44 funded projects identified.

Discussion Highlights

Table 5. Discussion highlights for the *Vaccinology for Broadly Protective of Universal Influenza Vaccines* IVR topic area; includes high-priority milestones discussed during ME&A taskforce meeting and associated strategic goals.

Strategic Goal 4.1: Identify the most promising broadly protective or universal influenza vaccine candidates that elicit durable protection against influenza viruses in preclinical studies, with a focus on targeting conserved regions of the virus.	
High-Priority Milestone	**Discussion Highlights**
Milestone 4.1.d: Convene a workshop to review the development of novel platforms (e.g., mRNA-based) for COVID-19 vaccines to identify how best to apply them to developing broadly protective or universal influenza vaccines.	● Not discussed, participants encouraged to revisit 3.2.b discussion.
Milestone 4.1.e: Identify promising influenza vaccine candidates that elicit robust and broadly protective immunity, based on a set of defined selection criteria.	● Continues to be a high priority for this area.
Strategic Goal 4.2: Evaluate the most promising broadly protective or universal influenza vaccine candidates, using at least several different platforms, in clinical trials, informed by recent experience with COVID-19 vaccine trials.	
High-Priority Milestone	**Discussion Highlights**
Milestone 4.2.e: Develop consensus on streamlining clinical research for evaluating broadly protective influenza vaccines, drawing on COVID-19 vaccine experience.	● Consider gathering input from regulatory agencies on how they will assess the outcome of clinical trials. ● Difficult to accomplish until better consensus is established on how best to evaluate universal and/or broadly protective influenza vaccine candidates. ● Consider deleting this milestone.

Milestone 4.2.f: Identify an initial set of vaccine candidates that demonstrate broad-based immunity—humoral, cell-mediated, or both—in preclinical research and assess them for safety and immunogenicity in phase 1 clinical trials in healthy adults.	● Ongoing milestone that is a high priority.
Milestone 4.2.g: Determine correlates of protection for assessing broadly protective or universal influenza vaccines that are appropriate for different stages of vaccine development and different vaccine platforms.	● Potential for ISIRV to hold similar conferences every 2-3 years to build upon conference held in March 2023: "Correlates of protection for next generation influenza vaccines: lessons learned from the COVID pandemic."
Milestone 4.2.h: Identify the most promising vaccine candidates from phase 1 trials and advance them into phase 2 or directly to phase 3 clinical trials in high-risk populations.	● Considerable discussion surrounding language of this milestone. Potential to change language and remove 4.2.i. ● Suggestion to add new milestone to include funding and designing clinical trials that effectively evaluates different vaccines (e.g. enhanced, seasonal, universal) ● Concerns about recruiting in clinical trials in Europe and underrepresented high-risk populations (elderly, obese, young); ● Suggestion to add IVR definition for high-risk populations.
Milestone 4.2.i: Identify the most promising vaccine candidates from phase 2 trials for general and pediatric populations that demonstrate broad protection and provide durable immunity (more than 1 year) and assess them for efficacy in phase 3 clinical trials.	● Consider refocusing this milestone on considerations of the design, funding, recruitment of study subjects into clinical trials for broadly protective influenza vaccines, accounting for different risk groups (e.g., based on age and obesity), and use cases for different goals (e.g., vaccines for pandemic response vs. for durable protection).

Priority Focus Areas for Investment and/or Potential Actions to Catalyze Progress

Meeting participants indicated that all milestones discussed in this section are critical to advancing R&D for next generation influenza vaccines and should retain their high-priority status. There was discussion surrounding the language of certain milestones, particularly those requiring a consensus or discussion high-risk populations. After careful examination of the discussion and the identified key obstacles to progress in these areas, a number or priority areas were identified. These areas include:

- Determine how to evaluate next generation influenza vaccines.
- Differentiate use cases for different public health scenarios.

Session 4: Immunology and Immune Correlates of Protection

Rebecca Cox served as facilitator for the *immunology and immune correlates of protection* session, which focused on 8 high-priority milestones across 7 strategic goals.

Milestone Status

Table 6. Number and status of milestones in the *Immunology and Immune Correlates of Protection* IVR topic area.

	All Milestones (n[d])	High-Priority Milestones (n[d])
Accomplished[a]	1	0
In Progress[b]	25	8
No Progress[c]	0	0
Total	26	8

[a]Accomplished: Milestone has been accomplished, fully or partially
[b]In Progress: Relevant research outcomes reported, indicating progress toward the milestone
[c]No Progress: No relevant research outcomes identified, indicating no progress toward the milestone
[d]Table reflects the numbers included in slides and printed materials distributed to participants at the time of the meeting.

Key Highlights and Advances

The following items were highlighted in slides as examples of key advances in this topic area:

- Longitudinal clinical studies established to follow cohorts of different age groups in various geographic locations (IMPRINT, DIVINCI, NCT05108818).
- ISIRV held a conference in March 2023: *Correlates of protection for next generation influenza vaccines: lessons learned from the COVID pandemic*.
- Immune imprinting being evaluated in varied populations.
- Assays being developed or assessed to capture protective responses including enzyme-linked immunosorbent assay (ELISA)-based potency assays and influenza virus protein microarray (IVPM) technology.
- 253 funded projects identified.

Discussion Highlights

Table 7. Discussion highlights for the *Immunology and Immune Correlates of Protection* IVR topic area; includes high-priority milestones discussed during ME&A taskforce meeting and associated strategic goals.

Strategic Goal 2.2: Gain better understanding of human immunology to inform influenza vaccine development through basic research focused on new tools and technologies.	
High-Priority Milestone	**Discussion Highlights**
Milestone 2.2.c: Determine key mechanisms of long-term protection following influenza virus infection (i.e., immunity lasting at least several years), including the discovery of	● Long-term protection is hard to define; should be revised to “durability of immunity” following influenza infection or vaccination.

early biomarkers associated with durable immune responses, to inform the development of durable vaccine-induced protection.	● Consider refocusing the milestone on determining whether long-term protection after infection or vaccination is achievable, before focusing on mechanisms.
Strategic Goal 2.4: Determine the impact of prior influenza virus infection or vaccination on future immune responses to influenza viruses or vaccines.	
High-Priority Milestone	**Discussion Highlights**
Milestone 2.4.b: Determine through prospective birth-year cohort studies how repeated influenza vaccinations affect the immune response to subsequent influenza vaccinations.	● Continues to be a high priority for the field and ongoing studies could significantly contribute to this milestone (NIH-funded multicenter study in Australia ongoing). ● Important to re-evaluate this milestone as results from the ongoing studies become available.
Milestone 2.4.c: Determine how the initial encounter with an influenza virus (i.e., immune imprinting) affects B and T cell responses, including immunologic responses to subsequent influenza virus infection or vaccination.	● Restructure language to determine how immune imprinting impacts B and T cell responses, i.e., the first encounter with influenza virus.
Milestone 2.4.d: Determine if vaccination with inactivated influenza vaccine (IIV) versus live-attenuated influenza vaccine (LAIV) of very young children before their first encounter with influenza virus has a significant impact on future influenza vaccine responses.	● Consider combining 2.4.c and 2.4.d to determine how the initial encounter with an influenza virus or vaccine (IIV or LAIV) affects immunologic responses to vaccination. ● As highlighted by discussion of previous milestone (2.4.c), this continues to be a high priority.
Strategic Goal 2.6: Improve understanding of the role of mucosal immunity in protecting against influenza.	
High-Priority Milestone	**Discussion Highlights**
Milestone 2.6.a: Further determine the role of mucosal antibodies in protecting against influenza virus infection, disease, and transmission.	● Suggestion to remove the word “further” from milestone. ● Agreement that this milestone is critical and COVID could help inform the role of mucosal antibodies.
Milestone 2.6.d: Determine the role of mucosal T cells in protecting against influenza virus infection, disease, and transmission.	● Potential to combine 2.6.d with 2.6.a to determine the role of mucosal immunity (including antibodies and T cells) in protecting against influenza virus infection, disease, and transmission.
Strategic Goal 2.7: Develop novel correlates of protection for assessing seasonal influenza vaccines and broadly protective or universal influenza vaccines, as part of clinical studies that demonstrate efficacy against a disease end point.	
High-Priority Milestone	**Discussion Highlights**
Milestone 2.7.a: Develop functional assays that are fit for clinical trial purpose to accurately capture the breadth and range of protective responses other than virus	● Agreement that this is a high-priority milestone. ● The FLUCOP project (standardization and development of assays for assessment of influenza vaccine correlates of protection) and others contributing to milestone (including industry, academia, and public health experts)

neutralization, such as influenza virus–specific antibody-dependent cellular cytotoxicity (ADCC), antibody-dependent cellular phagocytosis, and complement dependent cytotoxicity	to advocate for continued funding to accomplish milestone. ● Consider revising to "develop functional assays that are fit for clinical trial purpose to accurately capture breadth and range of protective immune responses to explore correlates of protection".
Milestone 2.7.b: Develop new measurement tools, including qualified correlates of protection, for mucosal immunity, particularly for assessing LAIVs or other mucosal vaccines if developed.	● Suggestion to combine with 2.6.a and 2.6.d but decided to continue with separate milestone.

Priority Focus Areas for Investment and/or Potential Actions to Catalyze Progress

Meeting participants indicated that all milestones discussed in this section are critical to advancing R&D for next generation influenza vaccines and should retain their high-priority status. There was discussion surrounding the language of many milestones. After careful examination of the discussion and the identified key obstacles to progress in this area, a number or priority areas were identified. These areas include:

- Expand cohorts beyond high income countries.
- Investigate the role of mucosal immunity in interrupting transmission.
- Continue funding for the most complex but pivotal components (e.g., correlates of protection).
- Apply lessons learned from COVID vaccine R&D to inform our understanding of influenza immunity and transmission.

Session 5: Virology Applicable to Vaccine Development

John McCauley served as facilitator for the *Virology Applicable to Vaccine Development* session, which focused on the 1 high-priority milestone and broad discussion of the 4 strategic goals.

Milestone Status

Table 8. Number and status of milestones in the *Virology Applicable to Vaccine Development* IVR topic area.

	All Milestones (n[d])	High-Priority Milestones (n[d])
Accomplished[a]	0	0
In Progress[b]	10	1
No Progress[c]	5	0
Total	15	1

[a]Accomplished: Milestone has been accomplished, fully or partially
[b]In Progress: Relevant research outcomes reported, indicating progress toward the milestone
[c]No Progress: No relevant research outcomes identified, indicating no progress toward the milestone
[d]Table reflects the numbers included in slides and printed materials distributed to participants at the time of the meeting.

Key Highlights and Advances

The following items were highlighted in slides as examples of key advances in this topic area:

- Multiple agencies (including the US Centers for Disease Control and Prevention [US CDC], WHO, Africa CDC, and NIAID) are working to improve the understanding of human and influenza virus evolution.
- Multiple transmission and modeling studies in progress or completed.
- Multiple active influenza surveillance systems, including OFFLU (the World Organisation for Animal Health (OIE)/Food and Agriculture Organisation of the United Nations (FAO) Network on Expertise on Animal Influenza), the United Kingdom (UK) Flu-MAP project, FAO, the WHO, and/or the NIAID Centers for Excellence for Influenza Research and Response (CEIRR) network.
- NIAID R01 grants are awarded to investigate methods to improve forecasting, modeling, and to improve antigenic match between vaccine and circulating strains.
- 105 funded projects identified.

Discussion Highlights

Table 9. Discussion highlights for the *Virology Applicable to Vaccine Development* IVR topic area; includes high-priority milestones discussed during ME&A taskforce meeting and associated strategic goals.

Strategic Goal 1.2: Enhance the ability to forecast viruses that are likely to circulate in the upcoming season to improve the antigenic match between circulating influenza viruses and viral strains selected for vaccine production.	
High-Priority Milestone	**Discussion Highlights**
Milestone 1.2.e: Develop, standardize, and implement methods (e.g., the use of predictive artificial intelligence and other new technologies) to improve antigenic characterization of H1N1 and H3N2 viruses.	● Further explore population serology to inform predictive modeling (e.g., serology analysis in the months before an influenza season); see also predictive modeling methods developed by University of Cologne researchers Michael Lassig and Marta Luksza. Other notes: ● Consider adding a milestone to strategic goal 1.3 that includes documenting or assessing studies focused on the human-animal interface. ● Explore developing a consortium of studies in different parts of the world focused on the human-animal interface.

Priority Focus Areas for Investment and/or Potential Actions to Catalyze Progress

Meeting participants indicated that all milestones discussed in this section are critical to advancing R&D for next generation influenza vaccines and should retain their high-priority status. There was discussion surrounding the potential for adding new milestones and importance of increased communication. After careful examination of the discussion and the identified key obstacles to progress in this area, a number or priority areas were identified. These areas include:

- Develop a global consortium of studies to better understand the human-animal interface.
- Develop methods to predict predominant circulating strains.
- Enhance understanding of factors that enhance transmission.

Session 6: Animal Models and the Controlled Human Influenza Virus Infection Model (CHIVIM)

Stacey Schultz-Cherry served as facilitator for the *Animal Models and CHIVIM* session, which focused on the 8 high-priority milestones across 2 strategic goals.

Milestone Status

Table 10. Number and status of milestones in the *Animal Models and the Controlled Human Influenza Virus Infection Model (CHIVIM)* IVR topic area.

	All Milestones (n[d])	High-Priority Milestones (n[d])
Accomplished[a]	1	0
In Progress[b]	25	8
No Progress[c]	0	0
Total	26	8

[a]Accomplished: Milestone has been accomplished, fully or partially
[b]In Progress: Relevant research outcomes reported, indicating progress toward the milestone
[c]No Progress: No relevant research outcomes identified, indicating no progress toward the milestone
[d]Table reflects the numbers included in slides and printed materials distributed to participants at the time of the meeting.

Key Highlights and Advances

The following items were highlighted in slides as examples of key advances in this topic area:

Animal Models

- CIVICs and CEIRR networks developing data standards and reagents.
- NIAID CEIRR provides access to >1,000 free and unique reagents for the ferret model.
- Validated reagents and high-throughput assays for ferrets and hamsters becoming available globally.
- 15 funded projects identified.

CHIVIM

- NIAID convened a workshop: *CHIVIM studies: current status and future directions for innovation (Nov 13-14, 2023).*
- 2 funded projects identified.

Discussion Highlights

Table 11. Discussion highlights for the *Animal Models and the Controlled Human Influenza Virus Infection Model (CHIVIM)* IVR topic area; includes high-priority milestones discussed during ME&A taskforce meeting and associated strategic goals.

Strategic Goal 5.1: Optimize animal models for influenza vaccine research.	
High-Priority Milestone	**Discussion Highlights**
Milestone 5.1.b: Ensure that validated reagents, updated viral stocks, and harmonized assays are available to improve understanding of the innate and adaptive immune	● Concern that researchers, especially those outside of the US, are not aware of available resources, such as Biodefense and Emerging Infections Research Resources Repository and the UK Human Challenge Model Network (HIC-Vac) network.

responses in ferrets and other animals such as hamsters and to facilitate comparison of studies across laboratories.	● Consider adding this information to publications, websites, and newsletters to highlight the availability of these tools; consider adding to the IVR website. ● Concern that Material Transfer Agreements (MTAs) restrict access to resources. Potential to explore standardized or prototype MTA to ensure equitable access.
Milestone 5.1.d: Convene a workshop on the development of pre-exposure animal models to address the fact that humans generally have pre-existing immunity to influenza.	● NIAID is planning an animal models workshop; the workshop will include both influenza and COVID, and will likely include components related to milestone.
Milestone 5.1.f: Complete and publish a comprehensive analysis of the predictive value of different animal models, including natural hosts such as pigs and horses, for influenza vaccine studies (both seasonal and broadly protective vaccines).	● Consider different endpoints for different animal models, and consider new innovations as opposed to continuing with older models while keeping in mind natural hosts for influenza; important to determine the key animal models that are appropriate for the research questions being asked and for the modes of transmission.
Milestone 5.1.g: Develop and validate novel animal models for evaluating immune responses—including durability—to broadly protective influenza vaccines.	● Milestone continues to be a priority for the field, including high risk models, wild-caught or pet store (i.e.,“dirty”) mice, etc.
Strategic Goal 5.2: Address steps needed to further develop and refine the CHIVIM.	
High-Priority Milestone	**Discussion Highlights**
Milestone 5.2.a: Determine the use cases for the CHIVIM and generate guidance, including ethical and safety considerations, for using the model.	● Consider additional non-US collaborations relevant to this milestone, e.g., the European Innovative Health Initiative and the European Union (EU)-India Collaborative). ● Need for standardized model, explore whether there is currently a place which houses list of current studies. If so, disseminate information.
Milestone 5.2.b: Ensure that virus strains for the CHIVIM are broadly available.	● Potential to combine milestones 5.2.b and 5.2.c ● Extremely important that virus strains are not only available, but information on access is widely disseminated.
Milestone 5.2.c: Ensure that a bio-repository of diverse, accessible, and well-characterized challenge stocks is generated and made available to investigators.	● Concern for who would own this biorepository, be responsible for and pay for it. Need to ensure samples are accessible and affordable. ● Similar concerns for availability and dissemination of information. ● Ethical concerns when sharing samples internationally, including adherence to good clinical practice (GCP) standards; need to examine if and how information can be included on consent forms.

Milestone 5.2.d: Further develop the CHIVIM to ensure that it can be widely used by different investigators.	• Milestone continues to be a high priority.

Priority Focus Areas for Investment and/or Potential Actions to Catalyze Progress

Meeting participants indicated that all milestones discussed in this section are critical to advancing R&D for next generation influenza vaccines and should retain their high-priority status. Two high-priority milestones, 5.2.b and 5.2.c, could be combined. A number of priority areas were identified. These areas include:

- Conduct an animal models workshop for COVID and influenza (being planned by NIAID).
- Communicate and disseminate information regarding the availability of animal model resources available to improve awareness outside the US.
- Complete and publish a comprehensive analysis of the predictive value of different animal models for influenza vaccine studies.
- Define use cases for CHIVIM using global data.

Session 7: Policy, Finance, and Regulation

Ann Moen served as facilitator for the *Policy, Finance, and Regulation* session, which focused on 7 high-priority milestones across 4 strategic goals.

Milestone Status

Table 12. Number and status of milestones in the *Animal Models and the Controlled Human Influenza Virus Infection Model (CHIVIM)* IVR topic area.

	All Milestones (n[d])	High-Priority Milestones (n[d])
Accomplished[a]	3	1
In Progress[b]	9	6
No Progress[c]	7	0
Total	19	7

[a]Accomplished: Milestone has been accomplished, fully or partially
[b]In Progress: Relevant research outcomes reported, indicating progress toward the milestone
[c]No Progress: No relevant research outcomes identified, indicating no progress toward the milestone
[d]Table reflects the numbers included in slides and printed materials distributed to participants at the time of the meeting.

Key Highlights and Advances

The following items were highlighted in slides as examples of key advances in this topic area:

- CIDRAP developed and maintains the IVR funding tracker to assess where funding is being allocated and identify gaps in funding for priority research.
- CIDRAP developed and maintains the Universal Influenza Vaccine Technology Landscape.

- WHO is developing the FVIVA, which is expected to be completed by late 2024. It will include communication tools and advocacy strategies.
- The National Academies of Science, Engineering, and Medicine convened a workshop focused on lessons learned from COVID-19 to inform and advance pandemic and seasonal influenza vaccine preparedness.
- US CDC is supporting work assessing the Nagoya protocol through WHO working groups and input to the WHO World Health Assembly.
- 22 funded projects identified.

Discussion Highlights

Table 13. Discussion highlights for the *Policy, Finance, and Regulation* IVR topic area; includes high-priority milestones discussed during ME&A taskforce meeting and associated strategic goals.

Strategic Goal 6.1: Catalyze broad support and sustained funding for developing improved seasonal influenza vaccines and broadly protective or universal influenza vaccines.	
High-Priority Milestone	**Discussion Highlights**
Milestone 6.1.a: Develop and disseminate a full value of vaccine assessment (FVVA; also referred to as the full value of vaccine assessment [FVIVA]) for improved seasonal and broadly protective, universal influenza vaccines that addresses different vaccine use cases and includes an assessment for LMICs.	● WHO is developing the FVIVA, which is expected to be completed by late 2024. ● FVIVA includes information on disease burden, economic impact of vaccine, implementation strategies, and potential ROI for manufacturers. WHO plans to include recap on current vaccines and use cases.
Milestone 6.1.b: Develop targeted and creative communications and advocacy strategies and necessary communication tools that build on the FVIVA and provide information on economic costs, the risk of future influenza pandemics, and the need for investment in influenza vaccine R&D.	● WHO is developing the FVIVA, which is expected to be completed by late 2024. It will include communication tools and advocacy strategies.
Strategic Goal 6.2: Promote innovation for developing improved seasonal influenza vaccines and broadly protective or universal influenza vaccines.	
High-Priority Milestone	**Discussion Highlights**
Milestone 6.2.a: Distill lessons learned for influenza vaccines from experience with COVID-19 vaccine R&D, including clinical research and study designs, manufacturing, distribution, advocacy, financing, and global collaboration.	● Milestone continues to be a priority for the field.

Strategic Goal 6.3: Promote information sharing aimed at moving influenza vaccine development forward.	
High-Priority Milestone	**Discussion Highlights**
Milestone 6.3.c: Assess the impact of the Nagoya protocol, and possibly related national ABS legislation, on sharing of influenza isolates and gene sequences in relation to influenza vaccine R&D and determine strategies to address potential unintended consequences.	● Consider revising this milestone to reflect ongoing challenges with virus sharing, which impacts influenza vaccine R&D. ● Continued assessment and documentation of the impact of the Nagoya Protocol is important, as well as sharing that information with agriculture, trade, and health officials, and encouraging resolution of the issues.
Milestone 6.3.h: Develop strategies for the international data sharing that take into account the impact of the Nagoya protocol and other limitations on data sharing.	● Consider revising as strategies are being monitored, advocated for, and refined.
Strategic Goal 6.4: Further explore regulatory challenges associated with development and manufacturing of improved seasonal and broadly protective or universal influenza vaccines.	
High-Priority Milestone	**Discussion Highlights**
Milestone 6.4.a: Conduct one or more workshops that includes regulators and vaccine manufacturers to: (1) clarify regulatory processes related to the development and evaluation of broadly protective or universal influenza vaccines, (2) develop a regulatory science agenda that anticipates the challenges of evaluating and licensing these new vaccines, (3) review the regulatory experience with COVID-19 vaccines and identify ways to streamline the process for new influenza vaccines, (4) generate additional recommendations regarding how best to provide guidance on vaccine development, manufacture, approval, and delivery, and (5) create a timeline of critical dependencies needed to produce new regulator guidance for approval of improved seasonal and broadly protective or universal influenza vaccines.	● Suggest these topics could be included in other planned workshops (e.g., incorporate regulatory sessions into a CHIVIM workshop). ● CEPI-NIAID meeting in September 2023 focused on broadly protective coronavirus vaccines may be applicable; discussion and findings will be published. ● Consider a forum dedicated to regulatory updates.
Milestone 6.4.b: Identify a framework to address post-marketing assessment of safety and effectiveness of new broadly	● Framework for correlates of protection in development, which includes influenza.

protective or universal influenza vaccines.	

Priority Focus Areas for Investment and/or Potential Actions to Catalyze Progress

Meeting participants indicated that all milestones discussed in this section are critical to advancing R&D for next generation influenza vaccines and should retain their high-priority status. There was discussion surrounding the language and current status of some milestones. After careful examination of the discussion and the identified key obstacles to progress in this area, a number or priority areas were identified. These areas include:

- Catalyze support and funding for both seasonal and improved influenza vaccines in LMICs through the FVIVA.
- Monitor and assess the impact of the Nagoya protocol.
- Develop a forum to clarify regulatory guidance for vaccine development and approval.

Session 8: Catalyzing Progress toward Improved Influenza Vaccines: Challenges and Opportunities for R&D and Beyond

The moderated panel discussion included representatives from governments, non-governmental organizations, academia, philanthropy, and industry. These representatives were brought together and presented with questions to achieve the following aims:

1. Synthesize the key needs of various governments, non-governmental organizations, academia, philanthropy, and industry to achieve improved influenza vaccines;
2. Highlight taskforce recommendations that are critical for catalyzing progress from various perspectives; and
3. Discuss key needs to ensure global availability, access, distribution, and/or demand of a next-generation or universal influenza vaccine.

This session was moderated by Joseph Bresee (Task Force for Global Health) and Michael Osterholm (CIDRAP), and included the following panelists: William Ampofo (National Vaccine Institute, Ghana), Jing Chen (National Natural Science Foundation of China), Keith Klugman (BMGF), Sonja Olsen (US CDC), Punnee Pitisuttithum (Vaccine Trial Centre, Faculty of Tropical Medicine, Mahidol University), Diane Post (NIAID), and Tiago Rocca (Instituto Butantan).

Panel Questions

The following questions were posed to the entire panel and panelist answers are summarized below.

1. *What are the challenges and opportunities for R&D and beyond?*

   Each panelist had an opportunity to identify challenges and opportunities for R&D based on their experience and their organization's perspective. Funding was mentioned often as a priority challenge for not only research but implementation, infrastructure, training, and new technology. Limited funding was also mentioned as a challenge for competing R&D priorities. Many problems exacerbated, exposed, or created by the recent pandemic were mentioned as significant

challenges. These problems include misinformation, vaccine fatigue, misconceptions, resistance to new technology, and pandemic fatigue. Vaccine equity and barriers to access were additional critical challenges identified. A lack of incentive for new vaccine development, competing priorities for vaccine programs, reduced vaccine demand and acceptance, and high costs were also included.

Though there are many barriers identified for R&D, recognizing the accomplishments and potential opportunities are equally important. Recent events have forced many organizations to adapt, which generated new communication strategies and tools, such as dashboards, to increase public education and awareness. Programs and collaborations that were developed or refocused to address COVID could be leveraged for use against influenza; the influenza field should ensure that lessons learned from COVID are applied to the influenza world where possible. New innovations, such as mRNA vaccine platform technology, may provide opportunities for next-generation influenza vaccines.

2. *From your perspectives, if there was an interest among the scientists and public health crowd to invest more in flu, prevent flu better, and do more research, how can you convince your superiors to do that?*

   Panelists were invited to share their suggestions. One panelist stated that some funding and programs were a direct result of increased advocacy. Multiple panelists highlighted the need to create and maintain momentum or enthusiasm to address a topic such as influenza. Additionally, the group emphasized that collecting data and evidence on disease burden, vaccine efficacy, economic benefit from vaccine programs and more is crucial, as it allows scientists to present a strong case for influenza vaccine R&D and can help change public perception of influenza.

3. *Could you comment on how NIAID's working group with CEPI on the COVID vaccine came about and how that might be translated to a similar work group with influenza?*

   This question was answered by a participant who directly serves on the working group. The working group collaboration was created to ensure both organizations are optimizing efforts, expediting efforts, and reducing duplicative efforts. The organizations share information but also have meetings with other stakeholder, such as developers. This collaboration allows them to guide awardees on best practices. The working group is truly innovative as it is focused on short-term and long-term goals shared by both governmental and philanthropic organizations.

4. *From your organizational perspective and your experience, what barrier are you going to help us break?*

   Each panelist was asked to briefly describe the barrier their organization could help break with regard to influenza vaccine R&D. As panelists represented a variety of organizations, their answers varied greatly. Barriers to be overcome included a lack of international collaboration in some regions, unequitable vaccine access, and seasonal vaccines with limited efficacy. Insufficient surveillance, especially in animals, and a lack of pandemic preparedness were also mentioned. Other barriers identified were limited funding, insufficient vaccine testing, and other gaps identified by the IVR.

Meeting Summary and Future Actions

In closing the meeting, Michael Osterholm and Josie Golding thanked the IVR steering group, taskforce, and participants for the time and energy devoted to IVR efforts. The IVR ME&A Taskforce Meeting concluded with the following themes and future actions:

- Important progress is being made: over 90% (34/37) of the high-priority milestones are in progress or accomplished.
- Opportunities exist for influenza experts to learn from the COVID-19 experience, which is both a cautionary tale and an opportunity to leverage programs, innovation, and momentum.
- Communication is essential to influenza vaccine R&D activities:
    - Communication among academia, government, and industry
    - Communication with policy makers
    - Communication with the public
- Other influential actors and funders should be brought to the table and solicited for support to meet IVR milestones.
- The CIDRAP team welcomes ideas on how to track information on funding and research outcomes.

APPENDIX A: IVR ME&A Taskforce Meeting Agenda

BACKGROUND

The Influenza Vaccines Research and Development (R&D) Roadmap (IVR), which was launched in September 2021, is aimed at accelerating progress toward the improvement of seasonal influenza vaccines and the development of new universal or broadly protective influenza vaccines. By highlighting key research gaps, identifying strategic goals and milestones, and encouraging synergistic R&D activities, the roadmap will serve as a valuable tool to advance the complex field of vaccine research over the next 10 years and stimulate overall investment in influenza vaccine R&D.

CIDRAP, with generous support from Wellcome, has recently embarked on a 3-year project aimed at: (1) tracking progress in meeting the IVR goals and milestones (Monitoring, Evaluation, and Adjustment [ME&A]) and (2) assessing funding trends for influenza vaccine R&D. The IVR expert taskforce plays a critical role in guiding and informing this effort. This is the second of three anticipated annual meetings that will be convened for this project.

The Influenza Vaccines R&D Roadmap is organized into the following sections; progress in each of these areas will be discussed during the meeting:

- Vaccinology for Seasonal Influenza Vaccines
- Vaccinology for Universal Influenza Vaccines
- Immunology and Immune Correlates of Protection
- Virology
- Animal Models and the Controlled Human Influenza Virus Infection Model
- Policy, Finance, and Regulation

MEETING OBJECTIVES

1. Highlight key advances that have been made in next-generation influenza vaccines R&D.
2. Identify activities essential to advance R&D for next-generation influenza vaccines.
3. Examine priority milestones; Describe key underlying reasons for lack of progress.
4. Determine opportunities to catalyze progress in priority areas of influenza vaccines R&D.

FORMAT

The meeting is by invitation only and will be geared toward interactive participation. All presentations will be in English. Some participants will be in person while others will join the meeting via Zoom. The meeting is organized into 8 sessions and will include:

- Two sessions that focus on highlighting strategic initiatives, major challenges, and key recommendations from various perspectives.
- Six sessions of facilitated discussions with the large group of taskforce members, focused on each of the six topic areas of the IVR. During these discussions, all taskforce members will be encouraged to participate and provide feedback.
- Meeting participants are encouraged to share any additional important progress relevant to the IVR strategic goals and milestones beyond what the CIDRAP team has identified in the public domain.

AGENDA

Times below are in Greenwich Mean Time (GMT); Attendance may be in-person or virtual

8:30 am Coffee/tea

9:00 am Welcome and introductions (*Michael Osterholm, Josie Golding*)

9:40 am Session 1: Strategic Initiatives for Advancing Influenza Vaccines
Moderated Panel
- Panel (*Martin Friede, Chan Harjivan*, *Michael Ison, Melanie Saville*)
- Moderated Discussion (*Michael Osterholm*)

11:00 am **BREAK**

11:15 am Session 2: Vaccinology for Seasonal Influenza Vaccines
- Discussion (*Joseph Bresee*)

11:50 am Session 3: Vaccinology for Broadly Protective or Universal Influenza Vaccines
- Discussion (*Jennifer Gordon*)

12:30 pm **LUNCH**

1:30 pm Session 4: Immunology and Immune Correlates of Protection
- Discussion (*Rebecca Cox*)

2:15 pm Session 5: Virology Applicable to Vaccine Development
- Discussion (*John McCauley*)

2:45 pm Session 6: Animal Models and the Controlled Human Influenza Virus Infection Model
- Discussion (*Stacey Schultz-Cherry*)

3:15 pm **BREAK**

3:30 pm Session 7: Policy, Finance, and Regulation
- Discussion (*Ann Moen*)

4:00 pm Session 8: Catalyzing Progress toward Improved Influenza Vaccines: Challenges and Opportunities for R&D and Beyond
Moderated Panel Discussion
- Panel (*William Ampofo, Jing Chen, Keith Klugman, Sonja Olsen, Punnee Pitisuttithum, Diane Post, Tiago Rocca*)
- Moderators (*Joseph Bresee & Michael Osterholm*)

4:45 pm Wrap up and closing remarks (*Michael Osterholm and Josie Golding*)

5:00 pm **SOCIAL HOUR**

APPENDIX B: Summary of IVR Funding Tracker Dashboard

Influenza Vaccines R&D Roadmap

The IVR Funding Tracker Dashboard

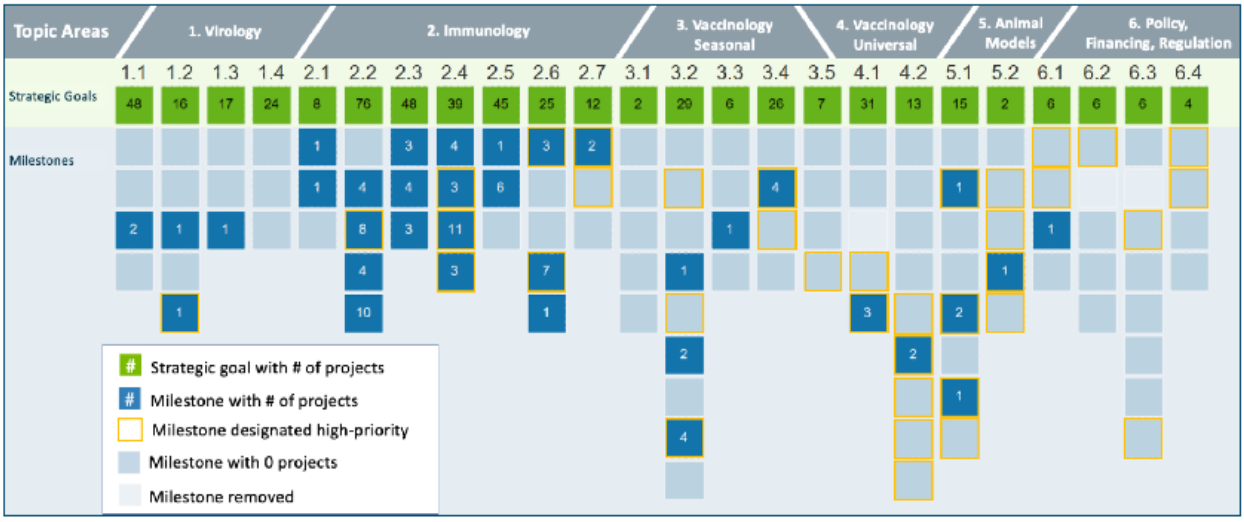
An Interactive Tool to Monitor Funding & Investment Related to Influenza Vaccine R&D

The purpose of the funding tracker is to:

- Illustrate how global funding and investment aligns with critical research priorities identified in the IVR.
- Track progress toward achieving improved seasonal influenza vaccines and/or broadly protective, universal influenza vaccines.
- Consolidate, index, and organize publicly available information about funded projects relevant to the IVR.
- Map funded projects to the IVR topic areas, strategic goals, and milestones.
- Identify gaps in funding that may impede progress toward improved influenza vaccines.

The funding tracker is divided according to the organization of the IVR:

- 6 topic areas (top section, shown in gray)
- 24 strategic goals numbers 1.1 through 6.4 (middle section, shown in green)
- 112 milestones indexed by letters a-i (lower section, shown in blue)



Screenshot from the IVR funding tracker dashboard. Clicking on each box displays detailed information for each project mapped to a strategic goal or milestone including project title, funder, funding amount PI/institution, and project ID.

Data was collected from multiple sources: funder websites, published literature, clinical trial registries, online sources, the Universal Influenza Vaccine Technology Landscape, industry websites and news sources, and conference abstracts. Outreach directly to funders, researchers, and IVR taskforce members was also conducted. Project titles and abstracts were reviewed to identify which topic areas, strategic goals, and milestones were relevant and validated by the funder when possible.

Visit the IVR funding tracker for additional details, to download the dataset, or to provide feedback on the mapping of funded projects to IVR goals and milestones to ensure accuracy and completeness of the data.

ivr.cidrap.umn.edu/ivr-funding-tracker-dashboard

APPENDIX C: Acronym List for the IVR ME&A Meeting

ADCC	Antibody-dependent cellular cytotoxicity
AI	Artificial intelligence
BEI Resources	Biodefense and Emerging Infections Research Resources Repository
BMGF	Bill & Melinda Gates Foundation
CDC	Centers for Disease Control and Prevention
CEIRR	Centers for Excellence for Influenza Research and Response
CEPI	Coalition for Epidemic Preparedness Innovations
CHIVIM	Controlled human influenza virus infection model
CIDRAP	Center for Infectious Disease Research and Policy
CIVICs	Collaborative Influenza Vaccine Innovation Centers
COVID / COVID-19	Coronavirus Disease 2019
ELISA	Enzyme-linked immunosorbent assay
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FVIVA	Full value of influenza vaccine assessment
FVVA	Full value of vaccine assessment
GCP	Good Clinical Practice
HHS	US Department of Health and Human Services
HIC-Vac	Human Challenge Model Network
IIV	Inactivated influenza vaccine
ISIRV	International Society for Influenza and other Respiratory Diseases
IVPM	Influenza virus protein microarray
IVR	Influenza Vaccines R&D Roadmap

LAIV	Live-attenuated influenza vaccine
LMICs	Low- and middle-income countries
ME&A	Monitoring, evaluation, and adjustment
mRNA	Messenger ribonucleic acid
MTA	Material Transfer Agreement
NA	Neuraminidase
NIAID	National Institute for Allergy and Infectious Diseases
NIH	National Institutes of Health
OFFLU	OIE/FAO Network of Expertise on Animal Influenza
OIE	World Organisation for Animal Health
OPPR	Office of Pandemic Preparedness and Response Policy
PPCs	Preferred product characteristics
R&D	Research & development
SG	Steering group
TF	Taskforce
UK	United Kingdom
US	United States
WHO	World Health Organization