Appendix 1. Proposed Recommendations and Activities

1. Develop Standardized Terms and Definitions
   - 1.1. Through a consensus process involving the industrial hygiene, infectious diseases, and healthcare communities, develop standardized terms, definitions, and appropriate classifications to describe transmission routes and aerodynamic diameter of particles associated with viral respiratory disease transmission.
2. Develop and Implement a Comprehensive Research Strategy to Understand Viral Respiratory Disease Transmission
   - 2.1. Animal studies (ferrets and guinea pigs) should be done to determine which interventions (e.g., increased air exchange, antimicrobial treated surfaces, and UV treatment of air) are likely to be the most effective.
   - 2.2. Environmental studies (in multiple locations, e.g., schools, public transportation, healthcare facilities) should be done to assess the effect of UV light and humidity on influenza transmission and whether the identified influenza RNA in aerosol samplers are viable and reflect the extent to which individuals are exposed to aerosols of influenza within these environments.
   - 2.3. Statistical and mathematical models should be developed and evaluated for their utility in prediction and inferences regarding the relative contributions of different transmission modes in varying environmental/community contexts.
   - 2.4. Clinical studies should be conducted to examine all possible modes of transmission, including environmental levels (air sampling and surface swabs) of contamination, serological studies of exposure to influenza virus in family members or roommates, and the size distribution of patients' respiratory particles to which healthcare personnel are exposed and some measure of the intensity of the exposure to patients that might include distance from, time in contact with, and specific procedures performed on the infected patients.
3. Continue and Expand Research on PPE for Healthcare Personnel
   - 3.1. Conduct studies to improve and evaluate the effectiveness of respirators for healthcare personnel in preventing the transmission of influenza or other viral respiratory diseases.
     - 3.1.1. Assess impact of various strategies for reuse / extended use of respirators during a respiratory disease outbreak, including conducting studies to assess promising respirator decontamination methods, their impact on protection, and their effectiveness using either influenza virus or a suitable surrogate.
     - 3.1.2. Develop and assess the efficacy and effectiveness of protocols (e.g., respirator donning and doffing) and new technologies (e.g., antiviral-coated respirators) to minimize self-inoculation from handling contaminated PPE.
     - 3.1.3. Conduct research to examine the features of N95s, PAPRs, and elastomeric respirators that impact comfort and tolerability among healthcare personnel and identify alterations in respirator design and construction that show promise in improving problem features that adversely impact comfort and tolerability.
     - 3.1.4. Assess respirator total inward leakage (TIL) of very small particles (< 100 nm).

3.1.5. Conduct workplace protection studies to assess protection during typical tasks over time, determine how using typical instruments impact protection, and to identify/mitigate possible integration issues.

3.1.6. Conduct human factors (field of view, visual acuity, communication) and operational performance studies on respirators to assess the ability of healthcare personnel to perform medical procedures in typical healthcare-specific PPE ensembles and to identify/mitigate possible issues.

3.1.7. Develop technologies and test methods to support new air-purifying respirators that specifically address the needs of healthcare personnel, including new materials to improve fit, comfort, and tolerability.

3.1.8. Develop technologies and test methods to support a new low-noise, lightweight PAPR and a face shield for healthcare personnel that are reusable and easy to clean.

3.1.9. Develop and validate accelerated N95 respirator aging tests and test methods to assess performance of respirator components (e.g., straps).

3.2. Conduct studies to improve and evaluate the effectiveness of non-facial PPE (e.g., gloves, gowns) in preventing the transmission of influenza or other viral respiratory diseases.

3.2.1. Conduct research to identify factors (duration of use, material properties) affecting the comfort and usability of non-facial PPE, and identify/implement changes having the potential to positively influence comfort, tolerability, or integration with other healthcare specific PPE ensemble components.

3.2.2. Conduct studies to quantify the role of non-facial PPE on droplet spray and direct-contact (fomite) transmission.

4. Examine the Effectiveness of Face Masks and Face Shields as PPE and Source Control

4.1. Conduct studies to investigate the effectiveness of goggles, face masks, and face shields in preventing aerosol transmission of viral respiratory diseases.

4.2. Perform manned and unmanned studies to investigate the effectiveness of goggles, face masks, and face shields in preventing droplet-spray and direct-contact transmission of viral respiratory diseases.

5. Improve Respirator Fit-Test Methods and Evaluate User Seal Checks

5.1. Perform research leading to the development and adoption of novel, simpler fit-test methods.

5.2. Conduct research to improve and evaluate the effectiveness of performing user seal checks on filtering facepiece respirators.

6. Explore Healthcare Safety Culture and Work Organization

6.1. Conduct research to better understand the role of safety culture and other behavioral and organizational factors on PPE compliance in healthcare settings.

6.2. Conduct human factors and ergonomics research relevant to the design and organization of healthcare work tasks to improve worker safety by reducing hazardous exposures and effectively using PPE (e.g., reduce unnecessary PPE donning and doffing).

6.3. Conduct studies to explore the links between patient safety and healthcare worker safety and health that are relevant to the use of PPE, identifying and evaluating strategies to mitigate organizational barriers that limit the proper use of PPE by healthcare personnel.

7. Identify and Disseminate Effective Leadership and Training Strategies and Other Interventions to Improve PPE Compliance
    7.1. Support intervention effectiveness research to assess strategies, including innovative participatory approaches to training, for healthcare and supervisory staff at all levels to improve PPE compliance and other related outcomes across the range of healthcare settings.
    7.2. Conduct observational studies of PPE usage by healthcare personnel in different types of work settings.
    7.3. Develop, implement, and evaluate comprehensive leadership and training strategies and interventions that go beyond simple knowledge-based training.
    7.4. Design training interventions specifically for supervisory and managerial personnel in different types of healthcare settings.
    7.5. Examine long-term practice change and safety culture implementation related to educational interventions.
    7.6. Develop strategies to improve use and understanding of PPE by home and community healthcare personnel
    7.7. Develop assessment tools and metrics that take a broader approach to PPE and acknowledge the interaction of worker, task, and environmental factors
    7.8. Conduct a lessons-learned summit on PPE use by healthcare personnel during the 2009 H1N1 experience.
8. Develop and Certify PAPRs for Healthcare Personnel
    8.1. Conduct studies to evaluate and develop certification requirements for a low noise, loose-fitting PAPR for healthcare personnel.
9. Move Forward on Better Fitting Respirators
    9.1. Continue rulemaking for TIL regulations that require respirators to meet fit criteria.
    9.2. To improve consumer and purchaser information on fit capabilities, establish a website to disseminate fit-test results for specific respirator models on an anthropometric (NIOSH) test panel, where such data exist.
10. Clarify PPE Guidelines for Outbreaks of Novel Viral Respiratory Infections
    10.1. Conduct and evaluate case studies on implementing 2009 H1N1 PPE related policies, including federal, state, and regional stockpiling options. Develop requirements, taking into account the national need, domestic manufacturing surge capacity and sourcing of raw materials, and a stockpile management system for allocation and distribution of respirators.
    10.2. Develop and validate methods and models for estimating quantities of PPE used/needed.
    10.3. Develop and deploy systems to monitor safety, effectiveness, and shortages of PPE.
    10.4. Conduct research into cost effectiveness issues relevant to PPE, including issues of disposable vs. reusable equipment.
    10.5. Perform prospective research efforts to examine the impact of public health guidance on PPE compliance by state, local, and health system policy; clinical practice; and costs.
    10.6. Develop, revise, and evaluate guidelines to prolong existing and surge capacity supplies of respirators including minimizing the number of individuals who need to use respiratory protection (e.g., preferential use of engineering and administrative controls), use of

alternatives to N95 respirators, extended use and/or limited reuse of N95 respirators, and prioritized use of N95 respirators.

10.7. Support the development of a coordinated process to make, announce, and revise consistent guidelines regarding the use of PPE to be worn by healthcare personnel during a verified, sustained national/international outbreak of a novel viral respiratory infection.

10.8. Develop and assess strategies for rapid implementation of respiratory protection programs that can accommodate an increased need for respiratory protection.

11. PPE Standards and Certification

11.1. Support the development of voluntary consensus standards and assess the need for independent third-party testing and certification processes for non-respiratory PPE (gowns, gloves, face shields, face masks, etc.) for wearer protection and source control, with specific tests for assessing prevention of transmission of viral respiratory diseases.

11.2. Improve current policies to provide an ample supply of respirators during a respiratory disease outbreak.

11.3. Collaborate with the FDA to develop harmonized standard operating procedures and explore strategies to more efficiently coordinate approvals of surgical N95 respirators.

12. Establish PPE Regulations for Healthcare Personnel

12.1. Support the development of aerosol-transmissible diseases standards that would include prevention of the transmission of influenza and other viral respiratory diseases.