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Emergency Preparedness and Response

Inputs: NIOSH Strategic Goals

The NIOSH EPR cross-sector program is developing strategic goals to guide its research and partnership efforts over the next decade.

NIOSH previously used "priority" topic areas (e.g., traumatic injury, hearing loss) to guide its research efforts. Strategic goals take this approach a step further by identifying specific outcomes that we want to target, performance measures for evaluating progress in meeting the outcome goals, and intermediate goals to describe the necessary steps that need to be performed to accomplish the goal.

Setting goals is challenging because it forces us to focus on the subgroup of issues where NIOSH can make the largest impact—a long list would spread our resources too thin to accomplish the goals. Not every worthwhile topic can be included.

Often it is difficult to develop performance measures, as available injury statistics have limitations, and exposure and health outcome measures are typically not available. For EPR, the myriad of potential scenarios potentially encountered with natural or man-made emergencies/disasters cannot be completely known.

NIOSH is ambitiously setting goals to achieve outcomes such as reductions in a national fatality rate. NIOSH is a research agency so we don't often directly influence outcomes; we must partner well and influence other groups to show results.

NIOSH Program Portfolio Approach

NIOSH has been organizing research, guidance, information, and service efforts into specific programs that can be readily communicated and strategically governed and evaluated. The eight NORA sector programs represent industrial sectors, and the fifteen cross-sector programs are organized around adverse health outcomes, statutory programs, and global efforts. In addition to these program areas, NIOSH has organized seven coordinated emphasis areas to support the sector and cross-sector programs.

The NORA sector programs intersect with cross-sector programs in a matrix-like fashion. This approach provides an added advantage and will allow multiple programs to work toward intersecting goals.

Each of the 30 programs in the NIOSH program portfolio has a manager and a coordinator. Each of the 8 NORA sector programs will have a research council to engage external stakeholders in the process of developing sector program goals and methods to measure the short-term, intermediate, and long-term outcomes arising from those goals. Each cross-sector program will have a steering committee which will also develop program goals and monitor outcome measures.

These planning efforts will align NIOSH with the most current governmental approach for evaluating program effectiveness: the Program Assessment Rating Tool (PART). PART is a mechanism to hold governmental agencies accountable for accomplishing results. As part of our comprehensive approach to performance measurement,

NIOSH Portfolio Program: Emergency Preparedness and Response



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NIOSH has engaged the National Academies to independently evaluate our sector and cross-programs for relevance and impact. See [National Academies](#) for additional information.

Draft Emergency Preparedness and Response Cross-Sector Program Goals

Background

As required by the Office of Management and Budget (OMB), NIOSH program strategic goals will be organized by outcomes such as reduction in injuries and illnesses instead of more general topic areas such as reducing all occupational mortality in the transportation industry. The NIOSH EPR cross-sector program goals are posted for review and comment. We will use [NIOSH eNews](#) to announce that draft goals are available for review. NIOSH is interested in your opinion about the relevance and value of strategic goals for the EPR program, and we encourage you to consider working with us on issues of interest to you and your organization.

Introduction

Emergency response workers must understand and assess potential exposures, conduct rescues, administer first-aid, decontaminate personnel and equipment, and attempt recovery activities in constantly changing and complex hazardous environments. Often the precise nature of the hazards cannot be initially described in such an intense and time-urgent setting, nor is exposure limited to only hazardous chemical, biological, or radiological materials; it may also involve fires, explosions, traffic hazards, and crowd control. Pre-event preparation, training, and access to readily available information, field assessment, and safety equipment are critical to minimizing consequent deaths, injuries, and illnesses, and to promote overall workforce resilience. It is not possible to delay or stop the response in order to restructure the organization, management, or approach during an emergency. The emergency environment places responders under a time-urgent, dual-cognitive demand: 1) they must attend to the hazards (including attention to self and crew members' safety and health), and 2) they must perform the work necessary to complete a rescue. The quality of the coordination among crew members as they carry out a rescue can define the probability of risk for death, injury, and illness to those responders.

Identifying serious problems in emergency response during or after an event indicates the failure of prevention and preparation. To be sure, specific problems will occur during any emergency. However, good preparation means that the organization will rapidly and smoothly adjust to the changing circumstances and will continue the rescue. A less-than-successful adaptation to such environmental changes indicates the need for improved preparation. Such failures on-scene must be translated into proactive training via "lessons learned" (see the [Outcomes](#) section). Preparedness also includes cognitive and emotional preparation, i.e., workforce resilience, to be able to function effectively in the face of emotionally-charged or highly disturbing circumstances; and adequate hydration, nutrition, rest, and sleep during an emergency response extending beyond a few hours or a shift.

Research, evaluation, and subsequent communication and training of emergency responders to maximize preparedness in all phases of a response are essential in reducing risks and promoting overall workforce resilience. Proactive use of lessons learned and a comprehensive assessment of emergency response activities, including management, organizational structure, crew-based collaboration, communication, preparation, training, equipment availability, and decontamination procedures, are key to improving safety and health outcomes. Focus on pre-event interventions that reduce the risk of exposure to hazards in the emergent environment offers the best approach to preventing loss.

DRAFT GOALS

1. SAFETY CLIMATE

Strategic Goal: Improve the organization of emergency response work to reduce exposure to risks and to enhance the health and safety of emergency responders.

Discussion: Improved preparation, better organization, and more consistent adherence to best practices during emergency operations will minimize exposures, prevent consequent injuries and illnesses, and promote workforce resilience. The overall safety climate in an emergency setting is influenced by many factors, including the nature of the hazards, management practices, crew-based collaboration, communication, preparation, and training, that address all phases of a response, from pre-event preparation to after-action review and treatment.

Overall Performance Measure: By 2016, develop and evaluate five new best practices or standards to improve the organization of emergency response activities and to promote a pro-active crew-based safety climate. Reduce exposures, illnesses, or injuries attributable to improvements in safety climate by an estimated 10%.

Goal 1.1: Increase the implementation of best management practices (BMPs), standard operating procedures (SOPs), and countermeasures through active partnerships with emergency response and support professions.

Areas of interest may include work hours, shift work, management structure, coordination and communication, safe work practices especially safety climate, and front-line worker control.

- **Performance Measure 1.1.1:** By 2011, work with at least three partners (professional organizations, trade associations, local, county, or state emergency responder agencies) to assess the effectiveness and potential gaps in SOPs, BMPs, and countermeasures.
- **Performance Measure 1.1.2:** By 2012, the program will develop two or more intervention studies to test new SOPs, BMPs, or countermeasures with partner organizations.
- **Performance Measure 1.1.3:** By 2014, develop, test, and transfer one or more SOP, BMP or countermeasures that improve emergency response and recovery personnel health and safety. Communicate training information.

Goal 1.2: Increase implementation of guidelines for hours of work, shift structure, and shift rotations to reduce fatigue and to promote individual and work crew safety and resilience.

- **Performance Measure 1.2.1:** By 2010, conduct research on shift hours and shift structure in the face of a constantly changing, hazardous work environment.
- **Performance Measure 1.2.2:** By 2012, develop two or more intervention studies to test recommendations for shift structure for different types of emergencies, durations, and workforce situations. Communicate training information.

Goal 1.3: Increase implementation of recommendations for workload demands and job autonomy.

- **Performance Measure 1.3.1:** By 2012, conduct research on workload demands, including stimulus detection and job autonomy and their relationship to health and safety at work.
- **Performance Measure 1.3.2:** By 2012, develop two or more intervention studies to test implementation of best practices regarding workload demands and job autonomy.
- **Performance Measure 1.3.3:** By 2014, transfer one or more practices for workload demands and job autonomy.

Goal 1.4: Improve the psychometrics of workforce resilience by improving measures of both resilience and traumatic stress.

- **Performance Measure 1.4.1:** By 2010, coordinate with partners to analyze existing measures to address workforce resilience.
- **Performance Measure 1.4.2:** By 2011, develop recommendations for the use of existing measures and the development of new measures.
- **Performance Measure 1.4.3:** By 2012, evaluate and disseminate improved or new measures of workforce resilience.

Goal 1.5: Improve knowledge about current safety climate.

- **Performance Measure 1.5.1:** By 2010, conduct research on the ability and willingness to report to work and compare the results to the literature on the military's return-to-duty treatment maxim, PIE: proximity, immediacy, expectancy.
- **Performance Measure 1.5.2:** By 2011, adapt existing measures of workplace safety climate to the emergency response work setting; conduct a validation study of the new instrument in collaboration with partner organizations.
- **Performance Measure 1.5.3:** By 2014, complete longitudinal assessments of safety climate in partner organizations, surveyed in conjunction with intervention evaluation studies to improve safe work practices in partner organizations. Correlate any changes in safety climate with other measured changes in workplace organization or safe work practices.

Goal 1.6: Develop appropriate medical screening and monitoring programs for workers involved in rescue and recovery at the location of the threat.

- **Performance Measure 1.6.1:** Using findings of performance measures listed under *Strategic Goal 6: Surveillance*, by 2014, issue a recommended medical screening/monitoring program with flexibility for tailoring to event-specific circumstances.

2. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Strategic Goal: Improve PPE assortment, proper selection and wear, and decontamination.

Discussion: During the earliest phases of response operations, before technical expertise can be brought to bear or supplemental safety equipment can be located, responders and safety managers need guidelines, checklists, or other decision-making tools to assist in developing appropriate initial and reevaluated protection strategies.

Overall Performance Measure: By 2016, reduce by 10% the number of injuries and illnesses to first responders as a result of improper selection or use (or non-use) of PPE.

Goal 2.1: Increase appropriate use of PPE by improving guidelines for selecting PPE during early phases of a response.

- **Performance Measure 2.1.1:** By 2010, complete an assessment and review of existing equipment guidelines and checklists, and identify associated gaps related to the selection and use of PPE in response operations.
- **Performance Measure 2.1.2:** By 2010, identify unusual conditions for which current standards are inadequate and propose additional equipment or procedures to improve protection for responders working in such environments.
- **Performance Measure 2.1.3:** By 2010, complete a survey of factors impacting compliant use of PPE using field data from actual events.

- **Performance Measure 2.1.4:** By 2011, develop new guidelines and checklists, including rapid risk assessment methodology for the appropriate selection and use of PPE during response and recovery events as determined by 3.1.1. Evaluate interventions and implement the guidelines.
- **Performance Measure 2.1.5:** By 2012, expand the guidelines from 2.1.4 to include methodology to support emergency responders' use of decision logic tools to determine exposures, adequacy of personal protective equipment, isolation distances, decontamination procedures, and re-entry.
- **Performance Measure 2.1.6:** By 2012, integrate emerging technologies in PPE and protective clothing into existing worker protection communications, trainings, procedures, guidance, and programs, such as PPE certification and system safety intelligence.
- **Performance Measure 2.1.7:** By 2012, complete a database and prioritization scheme for relevant exposure thresholds (IDLH, AEGL, TEEL) for disaster response conditions to ensure proper selection of PPE.

Goal 2.2: Evaluate the efficacy of decontamination procedures for PPE and equipment used by responders including the resulting deterioration and impact upon equipment life-cycle.

- **Performance Measure 2.2.1:** By 2010, categorize PPE and equipment by modes of decontamination—single-use disposable; multiple-use disposable; multiple-use reusable—and place the information on the NIOSH website.
- **Performance Measure 2.2.2:** By 2010, conduct an assessment (literature review, manufacturers' specifications, feedback from responders) of the efficacy of current decontamination procedures for PPE and equipment.
- **Performance Measure 2.2.3:** By 2011, evaluate interventions to improve the efficacy and cost-effectiveness of decontamination of PPE and equipment, including performance degradation and life-cycle impact.
- **Performance Measure 2.2.4:** By 2011, develop a NIOSH website to communicate training materials and clear, concise PPE and equipment decontamination procedures, including details regarding the efficacy, effectiveness, and range of applicability (contaminant agents, equipment substrates).

Goal 2.3: Improve procedures/guidance for estimating the PPE requirements (quantities) for disaster response.

- **Performance Measure 2.3.1:** By 2010, survey available procedures, guidance, and commercial (software) systems for estimating PPE requirements for disaster operations, and post the results on the NIOSH website.
- **Performance Measure 2.3.2:** By 2011, develop an online or computerized decision tree for estimating PPE requirements for disaster response operations to augment the results of 3.3.1.

Goal 2.4: Improve safety equipment logistics, including the inventory and dispersion of donated equipment following a disaster.

- **Performance Measure 2.4.1:** By 2010, survey lessons learned, after-action reports, and commercially available logistics software to identify systems to effectively manage the influx of donated equipment and place the results on the NIOSH website.
- **Performance Measure 2.4.2:** By 2011, develop an online or computerized logistics system to effectively manage the influx of donated safety equipment to augment the results of 2.3.1.

Goal 2.5: Identify best practices to prevent cross-contamination from victims to health care providers and support personnel.

- **Performance Measure 2.5.1:** By 2010, conduct a survey of best practices to prevent cross-contamination and post the results on the NIOSH website.
- **Performance Measure 2.5.2:** By 2011, institute a process to evaluate new and emerging technologies and their associated impact on the best practice identified in 2.4.1, and communicate findings and develop appropriate training materials if needed.

Goal 2.6: Evaluate the potential exposures associated with contaminated PPE.

- **Performance Measure 2.6.1:** By 2010, develop joint research protocols with CCID and CCIP to evaluate the potential exposure of workers to select agents from contact with contaminated PPE.
- **Performance Measure 2.6.2:** By 2012, initiate research in coordination with appropriate CDC partners to evaluate the potential exposure of workers to select agents from contact with contaminated PPE.

Goal 2.7: Reduce exposures to hazardous materials that may result in acute and chronic health effects.

- **Performance Measure 2.7.1:** By 2012, identify and evaluate new technologies for use in respiratory protective devices (RPD).
- **Performance Measure 2.7.2:** By 2012, establish voluntary standards for RPD in circumstances where engineering controls are not feasible in mitigating hazards during emergency response.
- **Performance Measure 2.7.3:** By 2012, collaborate with partners in the development of RPD for protection from hazards with high risk, frequency, or severity such as chemical, biological, and radiological hazards.
- **Performance Measure 2.7.4:** By 2012, investigate emergency responder populations for hazardous exposures and illnesses that could be prevented with the use of RPD.
- **Performance Measure 2.7.5:** By 2012, determine dermal exposure risks during emergency response to chemical, biological, and radiological incidents.

Goal 2.8: Develop new personal protective equipment that provides sufficient protection from physical, chemical, and biological hazards while minimizing any physiological burden.

- **Performance Measure 2.8.1:** By 2012, evaluate lighter-weight protective garments and technologies to protect firefighters during structural fires and hazardous-materials responses in order to reduce physiological stress (heat stress).
- **Performance Measure 2.8.2:** By 2012, identify and evaluate new technologies for physiological sensors to monitor impact of PPE on human performance.
- **Performance Measure 2.8.3:** By 2012, identify and evaluate new protective garment materials technologies and design configurations that enhance fit, form, and function (e.g., ergonomics and anthropometrics) to improve responder mission performance.

Goal 2.9: Identify and evaluate occupational risks that may increase the incidence or severity of cardiovascular and respiratory disease among firefighters.

- **Performance Measure 2.9.1:** By 2012, evaluate the effectiveness of wellness and fitness programs on cardiovascular and physical fitness of firefighters.

3. ENGINEERING/TECHNOLOGICAL INTERVENTIONS AND CONTROLS

Strategic Goal: Improve engineering controls, technology, and tools to

minimize responders' exposures to or hazards associated with CBRN, toxic industrial compound (TIC), and other hazardous materials.

Discussion: Poor integration of engineering controls during structural design and procedural development usually results in almost total dependence on PPE to minimize exposures or hazards during emergency response operations. Engineering control interventions should be evaluated and implemented, even though complete control of CBRN, TICs, and hazardous exposures may not be possible by engineering controls alone.

Overall Performance Measure: By 2012 reduce by 10% exposure through improved engineering/technological interventions and controls.

Goal 3.1: Conduct pilot/demonstration projects, cross-over technological applications, and applied-research investigations to mitigate or control worker health and safety threats from CBRN, natural and industrial disasters.

- **Performance Measure 3.1.1:** By 2010, identify applicable knowledge gaps related to detecting and assessing CBRN, TIC, and hazardous exposures as well as exposures in natural disasters.
- **Performance Measure 3.1.2:** By 2010, partner with other agencies, academia, and private industry to ensure that new and emerging technologies are evaluated and, where appropriate, made readily available for integration as engineering control solutions.
- **Performance Measure 3.1.3:** By 2011, target knowledge gaps identified in 3.1.1 and 3.1.2 for future research activities.
- **Performance Measure 3.1.4:** By 2011, develop a summary of engineering control principles to augment decontamination practices at hospitals and health care facilities that transport, receive, and treat disaster victims as well as the general public.
- **Performance Measure 3.1.5:** By 2012, establish a program/office to direct resources and coordinate pilot/demonstration projects, cross-over applications, communication/training, and applied research that focus on engineering controls, technology, and tools.

Goal 3.2: Improve engineering control methods to harden building construction to resist CBRN, TIC, and other hazardous exposure agents, e.g., "shelter-in-place" technology.

- **Performance Measure 3.2.1:** By 2010, evaluate building construction methods to identify ways to seal out airborne contaminants (windows, doors, etc.).
- **Performance Measure 3.2.2:** By 2010, evaluate building ventilation system technology to incorporate state-of-the-art technology that would remove airborne CBRN, TIC, and other hazardous airborne exposures from building ventilation systems, particularly in hospitals and health care facilities.
- **Performance Measure 3.2.3:** By 2010, partner with other agencies, academia, and private industry to ensure that protective guidance based upon consensus opinion and professional experience is quantitatively evaluated for its effectiveness under realistic surrogate event scenarios.

4. CHARACTERIZATION/ASSESSMENT OF POTENTIAL HAZARDS

Strategic Goal: Develop methods to evaluate the spatial and temporal distribution of gases, vapors, and aerosols, as well as liquids or particulates associated with surface contamination.

Discussion: Knowledge of the distribution, resuspension, and persistence of aerosol is extremely important in determining the risk from aerosol agents that are disseminated naturally (as in influenza), accidentally, or purposely through terrorist events. Therefore, developing methods to evaluate the spatial and temporal

distribution of biological and chemical aerosols is critical in identifying sampling strategies, predicting exposure-based risks, designing personal protective equipment and engineering controls, and identifying science-based clearance strategies for reoccupancy. In addition, increased information on distribution of gas and vapor hazards as well as distribution of surface contaminants should help reduce exposures to emergency responders and receivers and improve decontamination procedures.

Overall Performance Goal: By 2012, reduce by 10% severity and incidence of injuries and illnesses through better characterization/assessment of potential hazards.

Goal 4.1: Improve coordination internally and with partners to identify and prioritize relevant knowledge gaps and program needs in order to implement sampling and analytical research.

- **Performance Measure 4.1.1:** By 2008, form an ad hoc committee to inventory existing hand-held and near real-time equipment, identify new technologies likely to emerge commercially within the next 5 years, and determine research gaps.
- **Performance Measure 4.1.2:** By 2011, identify emergency response partners and obtain, review, and evaluate ten emergency response protocols in which CBRN contamination in the environment is anticipated.

Goal 4.2: Improve technologies used in near real-time and hand-held instruments to reduce response time and increase sensitivity, specificity, and reliability.

- **Performance Measure 4.2.1:** By 2010, develop a recommended protocol for validating hand-held and real-time analytic equipment.
- **Performance Measure 4.2.2:** By 2011, target specific technologic gaps in hand-held and near real-time technologies and initiate a research program to fill the gaps.
- **Performance Measure 4.2.3:** By 2012, develop a research program plan for the evaluation and validation of other sampling and analytical methods able to measure and characterize gas, vapor, and particulate CBRN threats.

Goal 4.3: Improve the ability of responders and government authorities to quickly and adequately identify the degree of contamination.

- **Performance Measure 4.3.1:** By 2010, develop tools, strategies or protocols to assist responders and governmental authorities in identifying the degree of contamination.
- **Performance Measure 4.3.2:** By 2011, develop and evaluate training programs or materials to improve (1) the skills to recognize and integrate sampling and analytical methods needed to perform rapid risk assessments and (2) the use of decision-logic tools to determine exposures, adequateness of personal protective equipment, isolation distances, decontamination procedures, and re-entry.
- **Performance Measure 4.3.3:** By 2011, develop and evaluate clear procedures and resources for regional public health officials to facilitate the rapid transport of samples of known or suspected hazardous agents from regional public health officials to analytical laboratories.

Goal 4.4: Reduce potential exposures by improving the implementation and communication of appropriate exposure criteria during emergency responses (i.e., appropriate implementation of OSHA PELs, NIOSH RELs, AEGLs, and IDLH values).

- **Performance Measure 4.4.1:** By 2011, research, evaluate, and survey existing exposure criteria to determine if available criteria are appropriate for use by emergency responders during responses.
- **Performance Measure 4.4.2:** By 2011, research and develop

recommendations on the proper implementation of exposure criteria during emergencies.

- **Performance Measure 4.4.3:** By 2012, publish emergency response criteria into the NIOSH Pocket Guide, NIOSH Emergency Response Safety and Health Database, or other appropriate references.

5. SUBGROUP-SPECIFIC STRATEGIES

Strategic Goal: Improve subgroup awareness, develop targeted messages, and expand subgroup-preferred channels.

Discussion: Generic protective guidance applicable to all groups within all environments is limited in its effective applicability, and as such the protective message may not reach all of its intended audience due to cultural and social differences. Further, subgroups may not fully understand or appreciate the importance of receiving and implementing protective guidance.

Overall Performance Goal: By 2014, reduce the injury and illness rate by 15% in underserved cultural/social subgroups of the response and recovery worker community.

Goal 5.1: Improve subgroup-specific health prevention awareness by focusing attention on targeted messages that consider cultural diversity, high-risk groups, and occupational settings.

- **Performance Measure 5.1.1:** By 2010, evaluate the current library of English-based protection/prevention literature for various emergency and response scenarios and translate them into multiple languages.
- **Performance Measure 5.1.2:** By 2011, develop and evaluate prevention strategies, communication materials, and training tools for population groups that have disproportionate vulnerabilities to particular health hazards.
- **Performance Measure 5.1.3:** By 2012, identify the special risks associated with certain occupational settings and develop educational materials to reduce the potential for health effects and disease transmission within the setting.
- **Performance Measure 5.1.4:** By 2014, develop and evaluate strategies to improve awareness of occupationally related health and safety issues among certain groups, such as first receivers, that have been conditioned to focus on patient health issues.

6. SURVEILLANCE

Strategic Goal: Develop surveillance reporting systems to improve emergency responder safety and health through the systematic collection, analysis, and interpretation of exposure, hazard, injury, and illness data.

Discussion: The systematic collection, analysis, and interpretation of health and exposure data can give decision makers valuable information for improving the safety and health of those called upon during disasters. Surveillance data can also be useful to identify subgroups at risk of exposure to specific hazards so that appropriate prevention can be implemented, follow-up can be planned, and possible intervention can be implemented. For example, the rapid identification of specific respiratory illnesses among emergency responders may allow for monitoring of other workers and facilitate the introduction of controls and risk management at the site, as well as for long-term surveillance of effected workers.

Overall Performance Goal: By 2014, reduce by 25% the development of long-term illnesses attributable to occupational exposure during disaster response through the use of prevention tools developed from information from short-and long-term surveillance reporting systems.

Goal 6.1: Develop a comprehensive inventory of current and planned U.S.

government and stakeholder emergency response surveillance and registry resources.

- **Performance Measure 6.1.1:** By 2010, complete catalog and description of the surveillance systems currently used by the U.S. Government and stakeholders. Issue a report based on the inventory results.
- **Performance Measure 6.1.2:** By 2011, issue a report describing major gaps and disparities in the existing preparedness surveillance systems of the U.S. government and its partners, and recommend improvements.

Goal 6.2: Develop standards that include quantitative and qualitative factors for NIOSH and its stakeholders to use in assessing and improving the timeliness, flexibility, and sensitivity of surveillance data. Interoperability with other national surveillance standards should be addressed.

- **Performance Measure 6.2.1:** By 2011, identify the necessary data and related data collection process for establishing both exposure and health-based surveillance databases.
- **Performance Measure 6.2.2:** By 2011, identify surveillance needs among emergency response subgroups such as recovery workers, clean-up crews, and medical personnel who receive and treat disaster victims, mortuary workers, etc.
- **Performance Measure 6.2.3:** By 2011, evaluate and make recommendations on the time required to accurately manage, analyze, and interpret worker surveillance data related to emergency preparedness and response.
- **Performance Measure 6.2.4:** By 2011, recommend reporting standards for emergency preparedness and response surveillance data.
- **Performance Measure 6.2.5:** By 2012, implement surveillance based on recommended standards in existing surveillance systems.
- **Performance Measure 6.2.6:** By 2014, implement improved or new surveillance systems as needed based on recommended standards and improvements. This may include the addition of chemical surveillance components and hazardous substance release surveillance components.

Goal 6.3: Improve the dissemination and application of public health preparedness surveillance information to reduce occupational injuries and health consequences associated with emergency response.

- **Performance Measure 6.3.3:** By 2011, routinely and rapidly (if indicated as during an event) provide national surveillance summaries via CDC or NIOSH communication mechanisms.
- **Performance Measure 6.3.4:** By 2012, use information gathered to identify and rank occupational health and safety exposures during disaster response. Both physiological and psychological health issues should be addressed.
- **Performance Measure 6.3.5:** By 2014, work with Federal, State, and private-sector partners to utilize surveillance data to establish revised emergency response protective procedures, personal protective equipment, and other measures to reduce worker illnesses and injuries.

Goal 6.4: Improve surveillance data on injury and illness rates in underserved cultural/social subgroups of the response and recovery community.

- **Performance Measure 6.4.1:** By 2010, conduct a literature review to determine all available surveillance information on injury and illness rates for these subgroups.
- **Performance Measure 6.4.2:** By 2012, conduct a survey to evaluate injury and illness rates not obtainable from current sources.

7. ENVIRONMENTAL MICROBIOLOGY

Strategic Goal: Improve the understanding of environmental microbiology of threat agents, including environmental factors that influence the introduction, spread, and control of these agents.

Discussion: Critical gaps exist in the knowledgebase of environmental microbiology and the relationship to public health emergency caused by microbial agents. Microbial pathogens are considered to include bioterrorism agents, emerging infectious pathogens, and nonselect agents. Establishing the presence of threat agents in the environment ideally would be supported by validated and effective sampling, detection, and quantification of the target agents, as well as specific identification of pathogens and their antimicrobial susceptibilities. It would be desirable to have the capability to estimate risk of infection to human populations using data such as number and viability of organisms in an environment, persistence of agents in the environment, dose-infection relationships through various environmental media, and antimicrobial resistance patterns. Finally, it would be desirable to develop and understand the efficacy and effectiveness of a range of risk reduction strategies for contaminated environments, including environmental controls, personal protective equipment, and disinfection strategies.

Overall Performance Goal: By 2016, improve the ability to evaluate, understand risk of infection, and improve risk reduction strategies for five threat agents, with focus on those agents within the BioWatch program.

Goal 7.1: Improve the ability to sample and analyze a range of threat agents in a variety of media with high sensitivity and specificity.

- **Performance Measure 7.1.1:** By 2009, complete a literature review of currently available detection technology, gaps in the science, and areas where research funding could be best utilized.
- **Performance Measure 7.1.2:** By 2012, conduct focused research to improve sampling and recovery of a minimum of one environmental microorganism with threat potential. Conduct research on one additional threat agent each year through 2016.
- **Performance Measure 7.1.3:** By 2012, conduct research to improve detection and quantification of at least one microbial threat agent in a sample. Conduct research on one additional threat agent each year through 2016.
- **Performance Measure 7.1.2:** By 2012, initiate focused research on near real-time detection technology with specific emphasis on at least one promising technology that could be used by emergency responders and others involved in high-hazard biological agent contamination events.

Goal 7.2: Improve understanding of the risk of infection by focusing on selected factors contributing to virulence, transmissibility, aerobiology, and persistence of microbes in the environment. For this goal, focus on science-based approaches to evaluating a microbe's potential for airborne transmission and environmental persistence to improve exposure-preventive interventions for workers.

- **Performance Measure 7.2.1:** By 2012, initiate research to improve the understanding of aerobiology of at least one threat environmental microbe in the environment. This may include factors that influence aerosolization of microbial agents, the ability to retain infectivity after drying, and deposition factors. Conduct research on one additional threat agent each year through 2016.
- **Performance Measure 7.2.2:** By 2012, initiate research to improve the understanding of environmental persistence of at least one threat microbe present in the environment. Conduct research on one additional threat agent each year through 2014.

Goal 7.3: Improve the understanding and implementation of techniques and procedures for risk reduction of individuals in biological agent contaminated environments.

- **Performance Measure 7.3.1:** By 2010, in coordination with activities under the "Personal Protective Equipment" section, develop a guidance document discussing best practices for individuals in contaminated environments, to include information on personal protection, environmental decontamination, and decontamination of workers.

Goal 7.4: To ensure appropriate worker preparedness and appropriate levels of personal protective equipment, improve the database on the presence of enzootic threat agents in the environment, with prioritization of those microorganisms included within the BioWatch program.

- **Performance Measure 7.4.1:** Conduct research on the environmental presence and relative quantities of one threat microbe under various environmental conditions. Conduct research on one additional threat agent each year through 2014.

8. ENVIRONMENTAL AND BIOLOGICAL MONITORING OF TERRORISM AGENTS

Strategic Goal: Improve the identification and characterization of terror agents to reduce exposures to response and remediation workers.

Discussion: When a terror event occurs, the causative agent, whether chemical, physical, or biological, needs to be quickly identified. At times, the terror event could be the result of multiple agents either simultaneously or subsequently. Better methods to identify these agents are needed. In some cases, it may be preferable to measure what or how much agent is actually absorbed into the body using biomonitoring techniques. This would be especially true if the chemical was dermally absorbed as air concentrations would not give a good indication of exposure. For other hazards, the only way to measure exposure is by looking at changes in the body that occur after exposure. Rapid and field deployable methods that can be used for either environmental or biological assessment of exposure will be essential to quickly identify the causative agent. In addition, one method of augmenting the effect of exposure to biothreat agents is vaccination. Emergency responders, decontamination workers, health care workers, laboratory personnel, and others have the potential for short-term or long-term exposure to biothreat agents or mixtures of biothreat agents at doses which can range from low levels to overwhelming doses which potentially could even overcome immunity from vaccination. Successful vaccination results in measurable biothreat agents antibody titers. Exposure to biothreat agents also can induce natural immunity which can serve as a biological marker of exposure. Cumulative sub-clinical exposures to biothreat agents over time may lead to frank disease status. Critical gaps exist in the efficient measurement of antibodies to numerous biothreat agents as existing methods can measure only one analyte per assay. Array assay methods are needed to measure numerous analytes simultaneously so as not to overwhelm the country's analytical capacity after a multiple bioterrorism event.

Overall Performance Measure: By 2010, ten new methods for identifying environmental contamination or internal dose will be available in case of a terror event. These methods would reduce the numbers of workers exposed since more rapid identification of the terror agent would occur and appropriate protection and workplace controls would be instituted. Note: It is anticipated that much of the proposed research may occur in collaboration with external organizations, including the Environmental Protection Agency and CDC's National Center for Environmental Health.

Goal 8.1: Develop methods to identify exposure to chemical terror agents.

- **Performance Measure 8.1.1:** By 2010, develop three methods to selected chemical terror agents in the environment.
- **Performance Measure 8.1.2:** By 2010, develop three biological monitoring methods to selected chemical terror agents.
- **Performance Measure 8.1.3:** By 2010, develop three rapid, field-deployable

methods to selected chemical terror agents.

- **Performance Measure 8.1.4:** By 2010, develop one multiplex method to detect multiple chemical terror agents.

Goal 8.2: Improve the ability to rapidly sample for antibodies to multiple biothreat agents and toxins simultaneously.

- **Performance Measure 8.2.1:** By 2009, complete a literature review of currently available biothreat agent and toxin multiplex detection technologies, gaps in the science, and areas where research funding could be best utilized.
- **Performance Measure 8.2.2:** By 2012, conduct focused research to improve multiplex serum antibody detection technology of 5 select agents/toxins.
- **Performance Measure 8.2.3:** By 2014, initiate focused research on near real-time multiplexed serum antibody detection technology with specific emphasis on at least one promising technology that could be used by emergency responders and others involved in high hazard biological agent contamination events to detect exposure to 5 select agents/toxins.

Goal 8.3: Improve the ability to rapidly sample for multiple serum antibodies to biothreat agents and toxin vaccines simultaneously.

- **Performance Measure 8.3.1:** By 2009, complete a literature review of currently available biothreat agent and toxin multiplex vaccine detection technologies, gaps in the science, and areas where research funding could be best utilized.
- **Performance Measure 8.3.2:** By 2014, conduct focused research to improve multiplex serum antibody detection technology of biothreat agent and toxin vaccines with 5 select agents/toxin vaccines.
- **Performance Measure 8.3.3:** By 2014, initiate focused research on near real-time multiplexed serum antibody detection technology with specific emphasis on at least one promising technology that could be used by emergency responders and others involved in high hazard biological agent contamination events to detect vaccination to 5 select agents/toxins.

Goal 8.4: Evaluate the efficacy of personal protective equipment (PPE) by employing to reduce exposure emergency responders, health care personnel and decontamination workers to terror agents.

- **Performance Measure 8.4.1:** By 2010 conduct a needs assessment of the types of PPE, and manufacturers' specifications of the efficacy to prevent exposure to select biological and chemical terror agents.
- **Performance Measure 8.4.2:** By 2011 evaluate PPE to determine which PPE is most effective to select chemical and biological terror agents by using methods developed in 8.1.

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