Regionalized Emergency Medical Care Services: Emergency Department Crowding and Boarding, Healthcare System Preparedness and Surge Capacity - Performance Measurement Gap Analysis and Topic Prioritization

DRAFT REPORT FOR REVIEW

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Contents

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DRAFT REPORT

Introduction

The Institute of Medicine highlighted the strain on the nation's emergency medical care systems in 2006 and called for analysis and improvement. [1,2] Some of the major issues highlighted in the report included emergency department (ED) crowding with ED boarding as a major cause for crowding, and the need for hospitals to prepare for potential surges of patients during a disaster. Since that time, the ED literature has consistently reported associations between crowding, boarding and negative patient-oriented outcomes.[3,4,5,6,7] In addition, there have been several naturally occurring disasters that have resulted in surges of patients, such as Hurricane Katrina in 2005 and H1N1 in 2009, and non-naturally occurring disasters such as the World Trade Center bombing on September 11, 2011, that highlight the critical role of our nation's healthcare infrastructure in the safe delivery of medical care during both local and national crises.

These events highlight the importance of measuring and improving crowding in U.S. EDs, not only to improve patient care, but also to ensure that hospitals are prepared for and can respond to surges of patients during a disaster. The possibility of mass casualty incidents or medical surges in a hospital or healthcare system was also recently reemphasized as a threat to the nation's emergency medical systems. In January 2012, the Office of the Assistant Secretary for Preparedness and Response (ASPR) released national guidance for system preparedness which sought to provide guidance and prepare hospitals, healthcare systems and their Emergency Support Function (ESF) #8 partners (Public Health and Medical Services Annex) to prevent, respond to, and rapidly recover from these threats; such preparation is critical for protecting and securing our Nation's healthcare system and public health infrastructure.[8,9]

Along with crowding, one of the major issues in emergency care is the lack of connection between hospitals when supply outstrips demand requiring diversion of critically ill patients to other hospitals and also when critically ill patients require transfer to other facilities when time-critical illness is identified (i.e. stroke, trauma, acute myocardial infarction, post cardiac arrest).[10,11] Many other issues can also come into play between hospitals during a disaster, such as information management, strategic coordination, integration with public safety, and resource management. Regionalization has been identified as a potential method of connecting hospitals and addressing these issues through efficient resource utilization.[12] The concept of "regionalization" is the process of tying hospitals together with regional-level performance measures with the goal of reducing system-wide crowding, promoting timely care for all patients at the population-level, ensuring that patients with time-critical illness receive the highest quality care, and holding hospitals accountable for system-wide performance during a disaster.[13] Holding both hospitals and regions accountable for acute care quality, population health, and

emergency management through performance measurement is vital to promoting the cooperation necessary to achieve these goals.

During the course of developing this report, the Regionalized Emergency Medical Care Services Expert Panel had many discussions about the differences and similarities between daily crowding and disaster surge. The Panel agreed that there are unique aspects of disasters and disaster management, however, that there are many areas that link daily surge and disaster surge. During a disaster response period, a facility must be capable of achieving several goals, including the safety and security of its personnel and patients under care, continuity of operations, and medical surge. Medical surge can be further broken down into increased number of patients (i.e. surge capacity) and dealing with patients with unusual or specific needs (i.e. surge capability). Another functional area that healthcare facilities need to consider during a disaster but not during daily surge is the responsibility to outside entities. This may include providing information to outside sources or in the most extreme, providing resources such as personnel to assist other organizations (e.g. pre-arranged mutual aid). In addition, during a disaster the Secretary of Health and Human Services can act under section 1135 of the Social Security Act to suspend certain regulatory requirements, such Emergency Medical Treatment and Active Labor Act (EMTALA), which requires facilities to perform a medical screening examination on every patient who requests one. Hospitals may also have fewer restrictions with regard to the use of unlicensed beds that would allow them to surge to accommodate large volumes of patients that may present during a disaster. Calling an event a "disaster" allows for a hospital or healthcare systems to respond with all available resources to a disaster while recognizing that care standards may need to be changed during a crisis. In addition, the Panel felt it important to differentiate between preparedness and response, and focused on the importance of these separate concepts in the context of measurement. Preparedness might be measured through tabletop exercises or simulation, while response would be measured as the actual effectiveness of a specific response to a disaster.

It was also recognized by the Panel that operations during a disaster and normal operations are different, but related in the sense that any disaster will likely be superimposed on an already crowded system and that having processes and protocols in place to react to daily surge may be vital during a disaster. Therefore, many on the Panel felt that disaster surge and daily surge were intimately linked. It was also recognized that many measures of preparedness are designed to be independent of crowding itself. An example is the measure of "Immediate Bed Availability" where the ASPR Hospital Preparedness Program (HPP) has created a measure for hospital coalitions requiring hospitals to have the ability to have 20 percent or more of their bed capacity available within four hours of a disaster. While this may be more of an issue in a hospital that is already crowded, the expectation is independent of crowding itself. However, for hospitals to be able to do this and still maintain a similar standard of care, a hospital may have to take a more active, daily approach to operational performance, which may improve daily operations. This may involve using the concept of "reverse triage" where hospitalized patients would be prioritized with regard to their relative need for hospital services and patients with the most minor needs would be discharged first. A five-level system of reverse triage has been developed by researchers at Johns Hopkins University.[14]

The purpose of this report is to discuss priority areas and review issues to consider in the development of candidate voluntary consensus standards for hospitals and healthcare systems in the areas of ED crowding, boarding and diversion, emergency preparedness, and surge capacity. This report will connect the concepts of ED crowding, preparedness and regionalization, specifically with regard to how these concepts are measured and reported at the facility or health system level, and rolled up to the

regional or hospital coalition level for shared accountability, and how disaster surge is similar and different from daily surge. The report makes recommendations for measure developers to explore existing measure concepts and current measures, and identify gaps in measurement to inform the development of future metrics that could be used for both quality improvement and public reporting. The intent of the report is to inform development of performance measures in this topic area that could be submitted to NQF for consideration.

Emergency Department Crowding and Boarding

In 2006, the Institute of Medicine identified ED crowding as a nationwide crisis.[1] Crowding within EDs occurs when there is a mismatch between the supply of resources (i.e. beds or space) and demand for services. Across the U.S., crowding is a problem in over 90 percent of EDs.[15] There are several causes of ED crowding, including progressively higher ED volume in the face of shrinking ED capacity, higher complexity care in the ED, and the boarding of admitted patients, where often patients spend prolonged periods of time in the ED long after the decision has been made to admit them to the hospital.[16]

Despite calls for reducing crowding and the IOM's call to end the boarding of admitted patients, ED crowding continues to worsen in U.S. hospitals. While there has been a proliferation of proven interventions to reduce ED crowding and boarding, many hospitals have failed to create a strategy to address the crowding issue locally. Therefore, developing, measuring and publicly reporting ED crowding and boarding in order to hold hospitals accountable, and creating incentives for improvement are vital to our nation's health.

Emergency Preparedness and Response

Over the last decade, the federal government has invested more than $21 billion to help local and state public health departments prepare for national and regional emergencies, such as bioterrorism, disease outbreaks, and inclement weather that may paralyze the healthcare system.[17] The National Incident Management System clearly describes the expectation that every emergency drill or exercise and every actual emergency activation, should be followed by a critique of performance, thus the need for performance measures.[18] Many levels of organizations, from government agencies to healthcare facilities, have developed emergency plans and protocols, and invested in supplies and equipment, and trained personnel to respond in the event of a public health emergency. Despite these investments, many parts of the U.S. remain unprepared for emergencies. Given the daily crowding of hospital facilities, there may be inadequate resources to care for the potential surges of patients that might seek care during an emergency or a disaster. However, some recent experience has suggested that existing systems may be able to accommodate higher numbers of patients during a short-term disaster as happened during the recent major storm that hit the Eastern U.S. in October 2012 that required the evacuation of several hospitals in New York. Developing validated measures for emergency preparedness and understanding their link to daily crowding are important to improve the nation's capacity and capability to respond to, and recover from a disaster.

In 2008, the Institute of Medicine released a report titled, "Research Priorities in Emergency Preparedness and Response for Public Health Systems" which concluded that "…the future of public health preparedness requires validated criteria and metrics that enable public health systems to achieve continuous improvement and to demonstrate the value of society's investment." [19] The report called for new quantitative and qualitative approaches to measuring public health systems' activities and

associated outcomes, and to assessing whether healthcare systems' performance meets the relevant standards.

Existing metrics such as the Health Resources and Services Administration's critical benchmarks and sentinel indicators for its Bioterrorism Hospital Preparedness Program have not been fully validated and are not evidence based.[20] Similarly, while the revamping of The Joint Commission's emergency management standards is a step towards strengthening hospital emergency management performance measures, the standards lack specific guidance.[21] These efforts exemplify the inherent measurement issues in the development of national performance measures for emergency health system preparedness. Preparedness measurement by itself, presents several challenges; unlike disease specific quality measures, the evidence-base behind preparedness capacities and linking processes to specific health outcomes is underdeveloped. The structure-process-outcome link is also difficult to assess due to the variation between different types of incidents (e.g. bioterrorist attacks, extreme weather, disease outbreaks) as well as the rarity of events making it challenging to apply traditional epidemiological methods necessary to demonstrate valid linkages between processes and outcomes.

Current Measures

NQF's most recent Regionalized Emergency Medicine Care Services (REMCS) Emergency Preparedness Environmental Scan, included in Appendix A, informs this work. The scan yielded 81 performance measures mapped to Domain 1 (Capability, Capacity and Access) of the NQF REMCS Framework, which also includes REMCS measurement definitions, key terms to establish a common vocabulary for understanding constructs within REMCS, and guiding principles regarding future development of structural, process and outcome measures. The scan also included measure concepts within regionalized emergency care systems. The majority of the 81 measures in the environmental scan were developed by federal or state agencies and focus on preparedness and response: responder safety and timing, medical material distribution, and local health department collaborations. None of these measures have been endorsed by NQF. There are a few developed and specified measures of ED crowding some of which have been endorsed by NQF, but only measure concepts in the areas of diversion and boarding.

The scan also confirmed that the measurement of regionalization of emergency care is still in its infancy. Regionalization has important implications to quality of care, hospital economics, and ensuring that critically ill patients receive the care they need in a timely manner. The ability to measure these concepts in the EDs at a national level is critical to understanding the emergency care system's baseline level of preparedness and potential capacity to respond in crises. There is general agreement that grounding these measures geographically—at the hospital, health system, community and regional level—would be a key enabler, but how to define that geography remains an open question.

Condition-specific measures related to cardiac care, stroke, trauma and pediatrics were previously identified in the REMCS Phase I Final Report. Gaps were noted in the areas of toxicology and psychiatric care measures, and it was recommended that future measurement efforts focus on creating or identifying measures of REMCS that focus on time-sensitive, high-acuity or life-threatening care, and identifying measures that evaluate systems of care. Identification of measure owners and stewards to facilitate rigorous development and testing of measures was also recommended as part of an intentional process to ensure rigor and standardization of measures for implementation.

This work also expands on NQF's previous consensus development process work in the emergency care arena (Emergency Care: Phase I and II) which endorsed consensus standards for emergency care providers and system performance. As part of Phase I, NQF endorsed 12 national voluntary consensus standards related to ED transfers. In Phase II, NQF endorsed additional national voluntary consensus standards that addressed timeliness, access, communication, care coordination, and efficiency in hospital-based EDs. Endorsed measures that begin to specifically address the issues around crowding and boarding at the facility level included:

- 0495: Median Time from ED Arrival to ED Departure for Admitted ED Patients (CMS)
- 0496: Median Time from ED Arrival to ED Departure for Discharged ED Patients (CMS)[1]; and
- 0497: Admit Decision Time to ED Departure Time for Admitted Patients (CMS)[2]

Measures that were not endorsed included:

- *ED-007-08*: ED Length of Stay (LSUHCSD): This measure examined the mean time between patient presentation to the ED and departure from the ED via admission, discharge, or transfer. The Steering Committee believed that the measure is easy to collect and addresses an important safety issue but lacks granularity. Ultimately, the Steering Committee concluded that the patient population and the intent of the measure were subsumed by other measures and, therefore, did not recommend the measure for endorsement.
- *ED-004-08*: Inpatient Admission (LSUHCSD): This measure examined the time from first contact in the ED to when the patient first sees the physician (provider). This time period is viewed as important because it is when the patient may leave without being seen. The Steering Committee believed that this measure did not assess the quality of care in the ED because of the varying types of patients seen. The Steering Committee noted that the measure could be routinely collected and that it could be used as part of a cohort stratification methodology for comparing EDs. Ultimately, the Steering Committee concluded that this measure would serve well as an internal hospital quality improvement initiative rather than for hospital comparison to assess the intensity or severity of the condition of its ED patients.

The Panel suggested endorsed measures could be adapted to assess crowding and boarding variability across hospitals. However, a key consideration would be how to stratify performance using a uniform severity adjustment, or alternatively the development of a separate risk-adjustment or severity-adjustment methodology by measure developers. These issues are discussed in greater detail later in this report.

Measurement Issues in Emergency Department Crowding

A widely accepted conceptual framework of crowding and the acute care system is the input–throughput–output model.[22] (Figure 1) The acute care system refers to unscheduled ambulatory care in physician's offices or ambulatory care clinics, urgent care centers, and ED care. This also includes on-call physicians required for acutely ill and injured patients, inpatient services for ED admissions, and out-of-hospital care. In this framework, input factors are the demand for emergency services. These services

[1] Time-Limited Endorsed Measure
[2] Time-Limited Endorsed Measure

fall into three categories: (1) emergency care, (2) unscheduled urgent care that occurs within EDs, and (3) safety net care for vulnerable patient populations with poor access or other barriers to non-ED care. Throughput factors include care that is received in the ED (i.e. initial triage and evaluation of patients) ED care, and treatment decisions. Throughput also encompasses ambulance diversion which occurs when EDs are overcrowded. ED boarding, which occurs when no inpatient beds are available or there are slow and inefficient transitions of care between the ED and inpatient beds, is also a throughput factor. Lastly, the model includes output factors such as patient disposition or transfer to other hospitals.

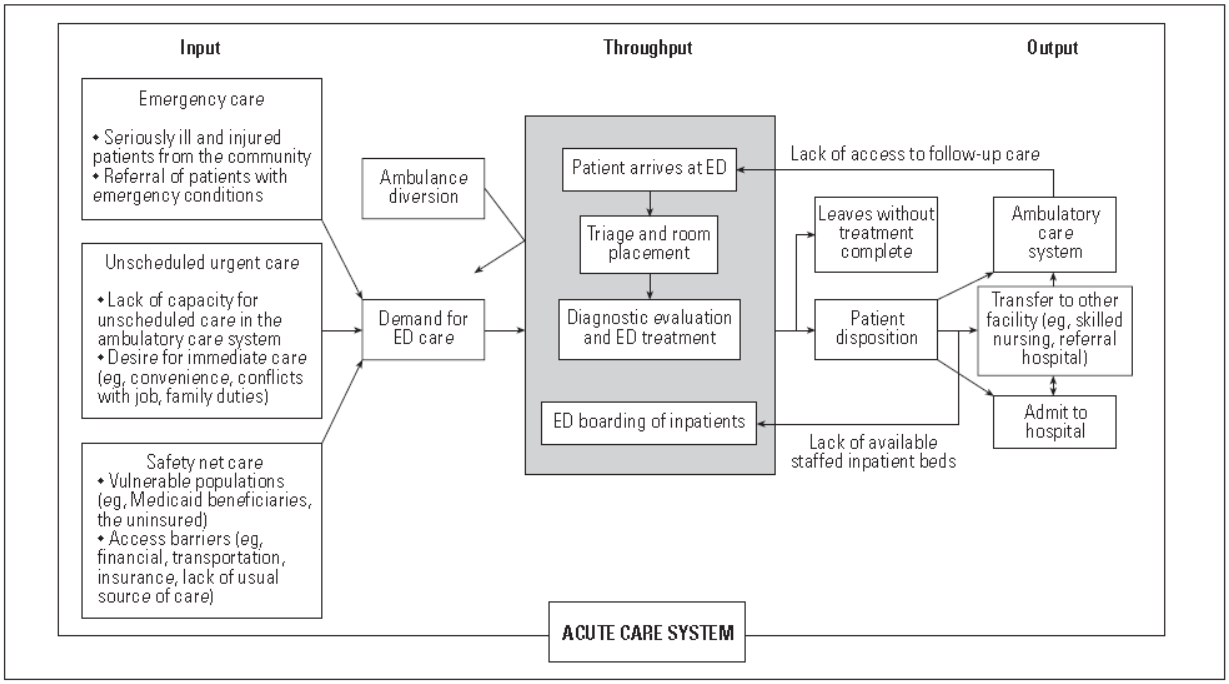


Figure 1: The input-throughput-output model of ED crowding (from Asplin et al. Ann Emerg Med 2003)

The majority of current measures and measure concepts of ED crowding focus on ED throughput: detailing the movement of patients from ED arrival, boarding, and transfer to an inpatient bed. For existing throughput measures, however, several panelists also thought it was important to differentiate value-added versus non-valued added time in the ED, particularly for measures of ED throughput. Value-added time was seen as time that provided direct benefit to the patient (i.e. initial work-up and treatment) while other time increments such as spending time in the waiting room or boarding after admission were not seen as value-added.

However, based on Asplin's conceptual model of ED crowding, it becomes apparent that input and output measures still need to be developed. Measures that capture broader concepts in crowding would be helpful in defining upstream causes and downstream impacts of ED crowding and boarding. Specifically, measure developers may want to consider developing input measures that examine ED input metrics of volume per day, by community or region and measures that are specified to look at triage acuity. Demand for ED services or the "inputs" into the system may serve as a barometer to monitor quality of care and access in medical community outside of the ED. Examining these inputs would also provide an indicator of the degree to which local outpatient clinics care for low-acuity

patients, and their ability to provide care and prevent complications from chronic disease. Care for these patients is often provided in the ED when complications arise.

Regional performance measures assessing the safety net care burden population could also be developed. These output measures could include the number of visits by uninsured patients, or homeless patients. Alternatively, direct measures of access could be developed, such as waiting times for doctor's appointments, or proportion of the population with a regular source of medical care. Better data systems for output measures would be able to capture measures of follow-up for ED patients, ultimately impacting both ED and hospital crowding. For example, measures assessing the proportion of patients referred for short-term follow-up after ED care, who were able to successfully attend a follow-up appointment could be useful. Another example is measuring the quality of care for transfers from EDs to other facilities or alternatively, measures of ED revisit or readmission. Given the limitations of current data platforms, however, it may be difficult to gather data on some measures of input and output in the ED that may contribute or exacerbate ED crowding. Future systems may capture some of these data elements needed to support such measures, which then could be considered in future measure development efforts.

During the Expert Panel discussion, several members expressed concern over the unintended consequences of ED crowding measurement in hospitals, one of which could be rushed dispositions. Specifically, the Panel felt that hastening the decision to admit rather than taking more time to coordinate care so that a patient could be discharged could, would lead to an increase in admissions for patients who could be effectively managed in the community. In order to address potential unintended consequences, it was suggested that balancing measures be developed to address transitions of care: particularly in the older adult population, behavioral health patients, and patient transfers to outside facilities.

A recent systematic review, separate from the Environmental Scan performed by NQF, identified 71 unique measures of ED crowding in the medical literature, demonstrating the wide variability in metrics and perspective.[23] The review suggested that time intervals and numerical counts of patients in the ED (i.e. waiting room number or ED census) are the most prominent in the literature, along with observable results of a crowded ED such as 'left–without-being-seen' rates or diversion hours. Broadly, the former two types of crowding measures diverge into two categories: patient flow and nonflow. Patient flow relies on time intervals (i.e. ED length of stay, door-to-provider time, or boarding time), but are limited in that they are difficult to observe in real-time and objectively assess how crowded an ED is at a point-in-time. However, time interval measures were found in the review to be more generalizable across sites, in part because timestamps in the ED have been shown to accurately reflect care times.[24]

Nonflow measures, by comparison, are the more traditional concept of crowding as this is often what the staff observes during episodes of crowding (i.e. a fully occupied ED with a packed waiting room). Nonflow measures have primarily been used in hospital-based studies associating the crowded state with patient-oriented outcomes such quality of care examining items such as time to antibiotics or pain medication; or downstream outcomes such as complications, errors, or mortality.[25,26,27] Examples of these measures include ED patient census, number of waiting patients, and number of boarders. The major advantage of these measures is that they are easier to observe in real-time. Nonflow measures are however, difficult to observe across settings and are not comparable among similar settings.[28]

Despite this, a major theme of the review was that simpler measures, rather than measures that rely on detailed calculations are more desirable and feasible for the end user.

Joint Commission Patient Flow Standard

In May 2012, the Joint Commission revised its patient flow standard (Standard LD.04.03.11).[29] The standard requires several elements including that hospitals must have processes to support flow of patients throughout the hospital; and plan for the care of admitted patients in temporary bed locations or overflow locations, such as the ED. Hospitals must also have criteria to guide ambulance diversion decisions. They must also set goals and components for the patient flow process; including the safety of areas where patients receive treatment, and provide results to individuals who manage flow processes. Three elements that will go into effect in January 2014 include EP 6-9, which specifically recommends hospitals set goals for managing the boarding of admitted patients in the ED. According to the standard, "it is recommended that boarding timeframes not exceed 4 hours in the interest of patient safety and quality of care."[30] In addition, results should be reported and reviewed by leadership to assure that goals are achieved, and actionable steps to improve processes are taken when they are not achieved. Finally, if the hospital has a population at risk for boarding due to behavioral health emergencies, leaders must communicate with behavioral health providers or authorities in the community to foster care coordination.[31]

Data Sources

There are several data sources available for use as sources of crowding data such as timestamps. Using timestamps would allow measures such as length of stay to be calculated, ED patient volume, or left-without-being-seen rates. These data sources include hospital-based paper systems where time-stamps or patient volume can be extracted, electronic patient tracking systems where time-stamps are commonly found, and claims-based systems that currently capture many output related crowding data elements. However, current data systems are not designed to capture many of the data elements for the upstream causes of crowding and downstream consequences. For example, data that integrates information across settings such as from pre-hospital settings to the ED, and between EDs and skilled nursing facilities may be helpful in facilitating communication or care coordination measurement across settings. Also, data that explores not just that poor access exists in the community, but provides more detailed information, such as referral patterns to the ED from primary care physicians, or information on waiting times for appointments in ambulatory settings could support such measures.

To measure the upstream causes and downstream effects of ED crowding, other types of data may also be helpful, i.e. data exploring access to care, acute unscheduled care, safety net care, or transitions of care back to the community. Current data systems are not designed to capture many of these elements readily and may explain why most current measures are focused on throughput measures. Connecting EMS data systems and the ED as well as creating common data platforms to facilitate care coordination is important for future measure development that focuses on input and output. Such efforts are actively being developed at the Agency for Healthcare Research and Quality.

Recommendation 1: Measure developers should ensure the validity and reliability of data used for ED crowding and boarding measurement.

Definition of Terms in ED crowding and Boarding

Two recent reports have described lexicons for ED crowding. The definitions are similar but not identical within the two documents and the differences reflect minor discrepancies rather than fundamental differences.[32,33] An area of controversy, however, has been the definition of the ED boarding time. In the 2008 NQF endorsed® measures, ED boarding time was defined as the median decision to admit to departure time. Rather than defining the start of boarding per se, the American College of Emergency Physicians (ACEP) has defined a "boarded patient" as a one who "remains in the ED after the patient has been admitted to the facility, but has not been transferred to an inpatient unit."[34] In 2010, the Emergency Department Benchmarking Alliance (EDBA), at its Second Performance Measures and Benchmarking Summit defined the concept of boarding more broadly as "[t]he practice of holding patients who have been admitted to the hospital in the ED for prolonged periods. Defined as a time interval, it encompasses the admit decision time to the departure time" in its Emergency Department Operations Dictionary.[35] This definition is similar to the NQF definition from 2008. However, other groups have defined the start of "boarding" differently. The most recent version of the Joint Commission's Patient Flow Standard, defines "boarding" as four hours or more after the decision to admit. The Panel agreed that given the differences in the definition of when boarding starts, sharing a common language will be essential for quality measure development in this area. The Panel agreed that the time of the decision to admit should be the start of the ED boarding time, which would continue until the patient physically departs the ED.

One of the reasons for the Joint Commission setting a specific time interval as "allowable" for boarding was the potential for any boarding to be construed as a failure of the system. During the Panel discussion, the group felt that any boarding should not be construed as a failure, as opposed to a prolonged boarding time. Because there is limited evidence about how long an appropriate boarding time should be, the committee felt that because of its link to crowding and outcomes however, boarding should be measured and reported consistently across hospitals. The Panel agreed that boarding was "non-value-added" time for the patient and should be minimized.

The Panel also recommended that measure developers focus on outcomes related to boarding. Such could include medical errors during the boarding time, and measures assessing other complications that may arise after the decision is made to admit and prior to departure from the ED, as well as patient experience. The Panel also highlighted the need for balancing measures to reduce the ability to "game" any boarding measure. For example, a very short average boarding time and a very long overall ED length of stay could indicate gaming.

Recommendation 2: Measure developers should explicitly define the time stamps used to calculate ED crowding and boarding measures. These time stamps should be used consistently across hospitals.

Recommendation 3: Measure developers should define the boarding time as the time from the decision to admit to departure from the ED. Decision to admit time should be defined explicitly and documented in the medical record.

Recommendation 4: Measure developers should develop balancing measures to accompany board measures that address transitions of care: particularly in the older adult population, behavioral health patients, and patient transfers to outside facilities. This would help avoid potential unintended consequences.

Recommendation 5: Measure developers should consider measuring boarding times at the level of the local community or region in order to foster increased cooperation across hospitals.

Risk-Adjustment

The Panel discussed in detail the need for risk adjustment to measure ED crowding and boarding at the level of hospital and healthcare system. Current NQF-endorsed® measures of ED crowding, including ED length of stay and ED boarding time, are not specified with risk-adjustment methodology yet studies have shown that many factors predict length of stay including: ED volume, metropolitan statistical area, teaching hospital status, age-mix and case-mix.[36, 37] Similarly there are disparities in care with regards to race and ethnicity.[38]

There are several pros and cons to reporting unadjusted versus adjusted data. Reporting unadjusted data is the most accurate representation of the patient experience. For example, if the average length of stay is five hours, that is most easily understandable by patients and important to patients. However, because exogenous factors are major determinants of length of stay, this may unfairly penalize hospitals with more complex patient populations. The benefit of risk-adjustment is that it allows for a fairer comparison of hospital performance after adjusting for intrinsic patient factors. However, risk-adjusted measures may be less meaningful to patients and a complex risk-adjustment system that takes into account patient characteristics has yet to be developed and validated.

The Panel also discussed potential stratification using hospital comparison groups based on Socioeconomic Status (SES) category (comparing hospitals with similar percentages of low SES). Several members of the Panel felt that stratifying results by SES (or a proxy such as Medicaid status) may help to: 1) surface any disparities of care, and 2) provide information which might better inform policy decisions especially with regard to the possible unintended consequences associated with diverting resources away from vulnerable populations based on factors beyond the control of an individual institution.

NQF measure evaluation criteria indicate that in general, factors associated with disparities in care (i.e., race, ethnicity, SES) should not be included in risk adjustment models because it assumes that differences in outcomes based on those factors are acceptable. In order to address disparities, measures should allow users to highlight differences in performance based on population groups across hospitals. Further, SES is an extremely difficult construct to measure in a reliable and valid way using administrative claims data. [39]

Socioeconomic status continues to be an extremely complex construct that is difficult to capture in a reliable and valid fashion. The experts agree that there is no established methodology in the literature that could be used by the developer community, further limiting the ability of developers to include and SES variable in the measure. Similarly, developers have explained that the use of SES is further complicated by its interpretability, that the differences in SES may be attributed to the intrinsic characteristics of a patient, or the hospital's ability to treat various types of patients (i.e. health literacy materials provided by the hospital, or social support/community relationships built by the hospital).

Other potential ways to stratify the data may include using ED visit volume or metropolitan statistical area (MSA) versus non-MSA status; however, creating a simple stratification system that accounts for factors outside of a hospital's control such as case-mix has not yet been done.

Time Targets

Several countries have set specific time-targets for ED length of stay, including the United Kingdom, Canada, New Zealand and parts of Australia. The potential benefit of time targets include holding a hospital accountable for a specific time that patients spend in the ED and limiting prolonged ED-based work-ups and boarding times. In the UK, the National Health Service instituted a maximum length of stay of four hours in the ED in 2004."[40] The standard was phased in over the next year; as of January 2005 98 percent of ED patients were to be treated and discharged or admitted within four hours. By 2008 and 2009, about 97 percent of all UK ED patients spent less than four hours in the ED.[41] In January 2012, the UK de-emphasized the 4-hour standard due to a combination of concerns about unintended consequences, a desire to focus more on quality measures, and a change in government. Some studies had shown potential risks to patients, such as an increase in dispositions in the 20 minutes prior to when patients' four-hour time limits were expected to expire.[42] This raised the possibility that hasty decisions to meet the four-hour standard were occurring. The measure was controversial because no specific data existed to justify a time limit of four-hours in the ED and the very limited number of 2-percent exceptions deemed too small to account for all clinical exigencies. The unintended consequences of a time targets may be to force a decision (admission or discharge) within a specific time-frame and may result in either early discharge or early admission to the hospital or another setting. However, an alternative argument would be that time targets may be appropriate, and the experience in the UK may reflect that four-hours may have been too short a time to expect a decision to be made, or that time targets should be stratified by acuity. New data suggests that quality was not compromised by the target.[43]

In Canada, there is currently a series of time targets, where low-acuity patients should stay less than four hours while higher acuity patients should stay less than 8 hours.[44] Western Australia currently has a four-hour target, similar to the UK.[45] New Zealand recommends that 95 percent of ED patients be treated and discharged within six hours.[46] Neither Western Australia nor New Zealand stratifies time targets by severity or acuity. When developing the next phase of crowding measures for U.S. hospitals, consideration may be given to setting specific time targets.

The Panel discussed the differences between the UK approach and the Canadian approach, which uses a standard triage system. The Panel felt that time targets should be considered, although a standard, specific time (e.g. the four–hour time target) might not be an appropriate performance measure, without a method of stratifying patients. The Panel expressed a desire for stratification of patients by severity; however, there is no broad, validated approach to stratification that has been developed using claims data. In addition, because of the heterogeneity in triage scales used in the U.S., it is currently impossible to use triage acuity for this explicit purpose. One solution to stratify for severity and resource utilization may be stratifying time targets by patient disposition.

The Panel considered a recommendation relating to standardizing triage acuity scales in the U.S. The recommendation was not pursued as discussion revealed that EDs are increasingly redesigning their input strategies to remove the triage step in order to improve timeliness. Making a recommendation around triaging patients at this juncture could discourage this improvement trend, and potential

measures would fall outside the workflow of EDs and hospitals that have moved away from the triage step. The Panel noted that there still is a need to assess severity of illness in a standard way. Suggestions include: an algorithm based on ICD codes related to ED discharge diagnoses and reasons for visit, and standardized "reverse triage" strategies (hospitalized patients prioritized with regard to their relative need for hospital services; patients with the most minor needs would be discharged first).

Recommendation 6: Additional research should be conducted to define appropriate boarding times given the disagreement in the field, with the understanding that value-added versus non-value added transition times should be considered.

Recommendation 7: Measure developers should report unadjusted data for ED crowding and boarding metrics, and should consider setting time-specific recommendations. Adjusted or stratified data should also be considered. Before measures in this topic area can move to reporting adjusted or stratified data, a valid risk-adjustment methodology must be developed and validated, or there should be evidence that strata are sufficiently similar to justify stratification.

Measures of Central Tendency

When reporting ED crowding data, current NQF-endorsed® measures recommend reporting the median time, as opposed to the mean, due to the skewed nature of length of stay data,. However, the Panel agreed that reporting the median alone may not capture the variation of crowding within a hospital, healthcare system, or region. Specifically, because of the periodic nature of crowding, the average or median time may appear relatively short while outlier times (such as the 90th percentile) may be much longer, especially on days of high volume or severity. When reporting ED crowding data, presenting median data along with measures of variance should be considered.

Recommendation 8: When reporting time-based data, developers should consider reporting of both measures of central tendency (i.e. median), and also include a measure of variance (i.e. 90th percentile values).

Structural measures

Several ED-based interventions to help alleviate crowding and boarding have been associated with improvements in crowding and patient safety.[47] These include the presence of an ED-based fast-track, a physician-in-triage, immediate bed availability and other downstream interventions such as a full-capacity protocol, early hospital discharge protocols, and surgical schedule smoothing. The presence of these interventions within an ED or hospital may serve as structural measures to assess ED crowding. There is some evidence that these interventions are underused, particularly to reduce ED boarding.[48]

Recommendation 9: Structural measures of ED design that have been shown to be associated with improved flow can be considered as potential measures for ED crowding and boarding.

ED and hospital flow metrics

Studies have documented that ED crowding and hospital flow are intimately linked because one of the major causes for ED crowding and boarding is hospital crowding. Specifically, delays in hospital throughput can cause ED crowding and boarding as the ED is commonly used for hospital overflow.

Measuring hospital-flow such as average length of stay for specific conditions may serve as an indirect measure of ED crowding.

Recommendation 10: Measures of ED outflow for admitted patients beyond boarding, such as hospital-length of stay for specific conditions may be considered by measure developers in order to impact ED flow, and potentially be included in future ED crowding or boarding measure development efforts.

Reframing the Issue of Crowding

During the panel discussion, it was suggested that it may be time to "sunset" the term ED crowding. The reasoning is that ED crowding is misnamed because it may suggest inherently that ED crowding is an ED problem and that the solution lies within the ED. Because ED crowding is tightly linked with ED boarding, ED crowding is the end result of hospital-wide flow problems, rather than ED problems themselves. Other suggestions considered by the panel were reframing the issue as hospital crowding, or alternatively framing the issue as ED and hospital flow, which may more correctly characterize the causal relationship.

Recommendation 11: Measure developers should consider moving away from references to "ED crowding" and use terms that may more accurately reflect the relationship between ED and hospital patient flow.

Measurement Issues in Emergency Preparedness and Response

Health systems face multiple challenges in caring for surges of patients during a disaster. Effective response requires robust systems in place to be prepared at a local level. Specifically, resiliency at the level of the hospital, health system, and healthcare coalition is vital to ensure effective deployment of resources during a surge of patients. A healthcare coalition is defined as, "a formal collaboration among hospitals, public health departments, emergency management and response agencies, and possibly other types of healthcare entities in a community that are organized to prepare for and respond to mass casualty and catastrophic health events."[49]

During the Panel discussion, there was considerable debate over the best definition for a healthcare coalition, and how the boundaries should be drawn, geographically, self-determined, functionally, or otherwise. It was noted that in the ASPR HPP program, the healthcare coalitions are self-defined. While there are already many different measures of geography available, such as county, healthcare service area, and larger regions, these geographical boundaries may be insufficient to describe the local healthcare utilization across the U.S. The Panel thought it would be useful for exploratory research to empirically define appropriate coalitions that take into account regional demand for time-sensitive emergency services, geography, information systems, and local competition. There was also great concern for the potential for "white space" or hospitals or regions that may not be included in coalitions, particularly in self-defined coalitions. Furthermore, the existence of "white space" within the geography of current voluntary hospital coalitions created as part of the ASPR Hospital Preparedness Program, may also threaten the ability to develop valid performance measures at the regional level.

Recommendation 12: Additional research is needed to define the ideal geographical boundaries for a healthcare coalition, or whether self-determined coalitions are the most effective in organizing preparedness and response efforts. Coalition boundaries should, if possible, locally include all hospitals

within the geographic boundaries of health systems and nationally include all hospitals in the United States.

ASPR Hospital Preparedness Program

The Hospital Preparedness Program has defined a set of healthcare preparedness capabilities which may be useful to Measure Developers in this area to identify gaps in performance measurement, prioritize measures, and develop plans to build and sustain healthcare infrastructure for effective disaster response. These were developed from the Centers for Disease Control and Prevention Public Health Emergency Preparedness capabilities. It is important to note that the measure concepts in this document are not explicitly designed for facilities. In addition, they are not specifically for broader non-facility concepts in public health preparedness.

The following eight (8) capabilities have been identified at the level of the hospital and health system, which notably require variable levels of within and across healthcare facility cooperation to achieve.

1. Healthcare System Preparedness
2. Healthcare System Recovery
3. Emergency Operations Coordination
4. Fatality Management
5. Information Sharing
6. Medical Surge
7. Responder Safety and Health
8. Volunteer Management

The table below describes measures developed by HPP that may be useful for broader development of measures in the area of preparedness and response (Table 1).[50]

Table 1: HPP Performance Measures

HPP PERFORMANCE MEASURES		
HPP 1.1	Healthcare System Preparedness	Percent of healthcare coalitions (HCCs) that have established formalized agreements and demonstrate their ability to function and execute the capabilities for healthcare preparedness, response, and recovery as defined in Healthcare Preparedness Capabilities: National Guidance for Healthcare System Preparedness
HPP 2.1	Healthcare System Recovery	Percent of healthcare coalitions (HCCs) that have developed processes for short-term recovery of healthcare service delivery and continuity of business operations
HPP 3.1	Emergency Operations Coordination	Percent of healthcare coalitions (HCCs) that use an integrated Incident Command Structure (ICS) to coordinate operations and sharing of critical resources among HCC organizations (including emergency management and public health) during disasters
HPP 5.1	Fatality Management	Percent of healthcare coalitions (HCCs) that have systems and processes in place to manage mass fatalities consistent with their defined roles and responsibilities
HPP 6.1	Information Sharing	Percent of healthcare coalitions (HCCs) that can continuously monitor essential elements of information (EEIs) and demonstrate the ability to electronically send data to and receive data from coalition members to inform a common operating picture

HPP PERFORMANCE MEASURES		
HPP 10.1	Medical Surge	Percent of healthcare coalitions (HCCs) that have a coordinated mechanism established that supports their members' ability both to deliver appropriate levels of care to all patients (including pre-existing patients [both inpatient and outpatient], non-disaster-related patients, and disaster-specific patients), as well as to provide no less than 20% bed availability of staffed members' beds, within 4 hours of a disaster
HPP 14.1	Responder Safety and Health	Percent of healthcare coalitions (HCCs) that have systems and processes in place to preserve healthcare system functions and to protect all of the coalition member employees (including healthcare and non-healthcare employees)
HPP 15.1	Volunteer Management	Percent of healthcare coalitions (HCCs) that have plans, processes and procedures in place to manage volunteers supporting a public health or medical incident

Joint Commission Compliance standards

The Joint Commission has a standard of care for Disaster Preparedness and Response for hospitals. These may serve as additional examples of potential performance measures that could be developed in this area. The Joint Commission guidelines center on (1) managing the consequences of, and providing safe and effective care during an emergency, (2) ensuring that staff roles are clearly defined, and(3) ensuring that staff sustain compliance over time. There are a total of six focus areas that accredited hospitals need to demonstrate for plans and response mechanisms during a disaster. Specifically, during planned exercises, a hospital must monitor six areas:

1. Communications (i.e. both internal and external communication with local partners and state or federal agencies).
2. Supplies (i.e. supplies should be at adequate levels)
3. Security (i.e. hospital operations should be secure to protect staff and property).
4. Staff (i.e. there should be defined roles and responsibilities in a standard Hospital Incident Command Structure)
5. Utilities (i.e. facilities should be able to be self-sufficient for as long as possible: goal = 96 hours)
6. Clinical Activity (i.e. standards of care should be maintained, and vulnerable populations supported, there should be clear guidelines when alternative standards of care can be used).

In addition, organizations must regularly test its emergency operations plans twice per year, and at least once a year there should be simulated patients. Additionally, facilities should perform annual evaluations to see how the organization performs when it is unable to be supported by the local community. Further, organizations with a role in community-wide emergency management need to participate in at least one community-wide exercise per year. Exercises should reflect realistic scenarios for the organization and should not only identify the effectiveness of the current plan but also identify opportunities for improvement. Finally, strengths and weaknesses should be communicated within the entire organization.

Conceptual Models of Public Health Preparedness

There have been several conceptual models of public health preparedness. It is important however, to state again that this document refers to measure development concepts for hospital and health system measurement, not necessarily the wider topic of public health preparedness that some of the conceptual models were designed to measure. A recent document compared public health

preparedness models were recently compared and developed the "Common Ground" Preparedness Framework (Figure 2) presents a way to conceptualize preparedness measurement and is designed to specifically identify the business process required when a disaster threatens to overwhelm the daily capabilities of a system.[51] These processes are grouped into six categories: prepare, monitor, investigate, intervene, manage, and recover. These fall into three time periods pre-incident, incident, and post-incident. During the Panel discussion, participants reiterated the importance of dividing measurement concepts specifically into preparedness and response, which would cover pre- to post-incident.

Prior to an incident, organizations can prepare by developing a capacity for response and use surveillance to identify any new incidents early. When an incident happens, there should be an investigation of the problem or problems, and an intervention to control the problem or any downstream effects. During an incident, organizations should appropriate manage their activities, and have a mechanism to synthesize information for the business intelligence on how to prepare and respond to future incidents. Finally, the recovery period includes processes that deal with downstream effects of the incident and returns operations to normal while integrating the knowledge of the previous incident. During the Panel discussion, the importance of differentiating concepts of preparedness as would occur "pre-incident" in this framework should be clearly differentiated from response which would occur during and after an incident. This will be important for measure developers in this area.

A 2009 scan of the field found a that there is no single widely accepted, validated framework related specifically to health care emergency management capabilities (HEMCs) that health care facilities can use to guide their preparedness and response to a disaster or mass casualty event.[52] "Despite differences in the conceptualization of health care emergency management, there is considerable overlap among the agencies regarding major capabilities and capability-specific elements. Of the five agencies, four identified occupant safety and continuity of operations as major capabilities. An additional five capabilities were identified as major by three agencies. Most often the differences were related to whether a capability should be a major one versus a capability-specific element (e.g., decontamination, management of resources). All of the agencies rely on multiple indicators and data sources to evaluate HEMCs. Few performance-based tools have been developed and none have been fully tested for their reliability and validity. Consensus on a framework and tools to measure HEMCs is needed."[53]

Reconciling Daily Crowding and Disaster Surge

In order to accurately characterize whether an organization is able to respond to an emergency, it is important to reconcile the relationship between daily crowding and emergency response. As described in the Introduction, this was discussed at length by the Panel. Reconciling the two is important because an organization that is already overcrowded or may not have the processes in place to run efficiently on a daily basis may be less prepared when a disaster or mass-casualty event occurs and it is required to respond. Therefore, measures of ED crowding and boarding can be seen one way to measure preparedness and response; however, it is important to recognize that operations during a disaster are different than daily operations. This is primarily because there are many other concerns that arise during a disaster that may not be issues in daily operations, such as an overwhelming surge of patients or the inciting event itself (i.e. bioterrorism) compromising staff security and safety. In addition, some

organizations that are critically overcrowded on a daily basis may be able to increase capacity and surge in a disaster situation, as was seen recently in the October 2012 storm that hit the Eastern U.S.

The Panel discussion focused on the definition of a disaster, and whether a disaster was a binary phenomenon or was just an extreme version of daily surge. In preparedness terms, a public health emergency or a "disaster" is a situation where health consequences of a specific incident may overwhelm routine local capabilities to address them. In those cases, a facility might need outside resources to effectively handle a disaster and should have a specific plan in place to work with local partners to share resources. By contrast, a surge of patients locally that may cause a facility to become overwhelmed may more frequently require that an organization reconfigure local resources, but by definition, that facility may not need to contact outside entities or state/federal agencies.

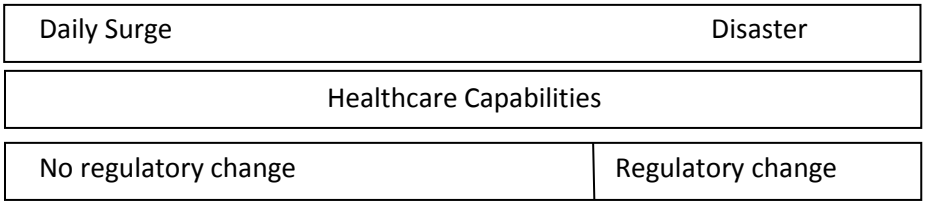
A local facility may have specific protocols that would be deployed in the event of a surge of patients that can still be handled internally. However, the link between daily surge and disaster surge as described above, is that organizations that have internal processes in place to handle daily surges may use some of those same resources (or roles of staff) in the event of disaster. Therefore, preparedness to handle daily surge may a strong indicator of how a facility might perform in a disaster.

One of the issues raised by the group was that creating a link between disaster surge and daily surge would involve developing a more robust framework to grade a spectrum of disasters from the smaller to larger ones. That way, it would be possible to better link disaster or local surge response to outcomes and would allow facilities to design interventions to respond to both small increases in demand and much larger ones that would be required in a major disaster. The concept of system "flexibility" was discussed which would be a measure of how a system might perform during various patient loads, or even a disaster. A flexible system, defined at either the facility-level, health system-level or hospital-coalition level would be able to maintain the same level of service when there were greater demands for services. That is, the systems would be in place to accommodate both daily surge and disaster surge.

Recommendation 13**:** A system to measure both daily surge and disasters would be helpful in creating the link between these two concepts as well as informing response.

Recommendation 14: Additional research is needed to develop a reliable and valid scalable model that allows disasters to be graded from the micro- to the macro- disaster. Table top exercises could be used to extrapolate potential response based on ordinary crowding data, and data from tabletop exercises could be adapted to assess potential response at the regional level, based on what happens in a single hospital in the region.

One of the ways to conceptualize this would be to state that during both a daily surge and a disaster surge that the same capabilities are called upon. However, what differentiates a disaster is that facilities might invoke different rules and regulations, such as an 1135 waiver. Therefore, it becomes clearer that developing a system to grade daily surge and disasters on the same scale might be helpful in informing what healthcare capabilities might be necessary to manage both types of incidents.



There are several additional concepts that differentiate disasters from daily surge that were mentioned by the Panel:

(1) Real disasters are rare while daily surge is common

(2) In a disaster, it is difficult to measure outcomes directly because there is no "counterfactual" of what would have happened if a specific intervention had or had not been implemented. By comparison, the repeated nature of daily surge enables us to directly measure interventions and differentiate between those that are effective and ineffective.

(3) In a disaster, many hospitals may be asked to coordinate together, so there may be issues with accountability, information sharing, and issues with coordinating with "within system" hospitals and with hospitals outside of a health system. Daily crowding and surge are typically contained and managed within a hospital; however, system-wide measures at the level above the hospital may provide incentives for hospitals to better manage the regional demands of patients (i.e. throughput interventions to reduce system-wide diversion).

The variability of infectious disease agents such as influenza, provide an example of some the challenges that may occur during a disaster. Preparation for H1N1 for example, which involved a high volume of less critically ill patients, was managed differently than severe acute respiratory syndrome (SARS), where the case fatality rate was dramatically higher and volume of patients was lower. By comparison, an H5N1 virus, where the case fatality rate and the patient volume are high, may require different resources. In addition, the rarity of public health emergencies leaves minimal objective outcome data from which to conduct assessments of quality. Adding to that, there is no "counterfactual" evidence, making it difficult to conduct retrospective examination of an emergency response without a comparison group.

Additional challenges include regional variability. Disasters and health system emergencies impact communities differently based on issues like geography, population density, and local health infrastructure. As such, an ideal response in one community may be different than another. Finally, the issue of accountability is a major concern, because of the shared and diffused responsibility of public and private stakeholders within a region.

Moving from measure concepts to NQF-approved quality measures for preparedness will require a careful consideration of the aforementioned issues. Application of the Donabedian model may provide additional guidance to measure developers by providing a conceptual framework for emergency

preparedness measurement and assessment and adapting the traditional structure-process-outcome model to structures-capacities-capabilities for healthcare system emergency preparedness.[54]

Definition of Terms in Emergency Preparedness and Response

Hospital, healthcare system, and hospital coalition emergency preparedness and response can be assessed in two broad categories: capabilities and capacities and data can be gathered through several approaches: drills and exercises, assessing the response to actual events, and process observation and mapping. A systematic review in 2005 assessed 27 instruments that assessed public health preparedness and found a good deal of overlap between the various definitions of preparedness, but little consistency.[55] Nelson et al. argue that the lack of measures is not the reason there is a shortage of preparedness measures, but rather the numerous definitions of preparedness have become a barrier for performance measure implementation.[56] As one example, Nelson et al. used a panel of experts to define "public health emergency preparedness" as "the capability of the public health and health care systems, communities, and individuals, to prevent, protect against, quickly respond to, and recover from health emergencies, particularly those whose scale, timing, or unpredictability threatens to overwhelm routine capabilities."[57] In order to assess preparedness for measurement purposes, it is necessary to define emergency preparedness and response explicitly and to reconcile the various definitions of preparedness.

In this framework, ultimately measures of emergency preparedness and response may fall into more subjective measures surveys, or exercises and quantitative process or outcomes measures. Surveys, exercises, or simulations can be designed to assess preparedness both offline (i.e. preparedness) and response (i.e. post-incident) and take into account the heterogeneity and variable resource needs behind a disaster response that must, by definition, be tailored directly to the unique issues in a specific disaster. In order to meet NQF criteria, these instruments must be sufficiently reliable and valid so that they are reproducible across hospitals, health systems, and coalitions. In addition, quantitative measures of process and outcome should be combined with the more subjective assessments of preparedness and response and focus on specific objectives (i.e. were the goals of immediate bed availability met objectively) or outcomes, such as having similar risk-adjusted outcomes during a disaster, which would indicate that a facility would having the flexibility to maintain the same standard of care during a crisis.

Recommendation 15: Preparedness measures should be standardized so they are reliable and valid, and can be compared against a desired performance threshold. Specification should include the NQF measurement unit (i.e. hospital, healthcare system, individual, or region) and the time frame for measurement. For measures that are reported per capita, population counts are needed for the denominator. In addition, operationalizing measures involves identifying the data elements required and setting up the mechanisms to obtain consistent, reliable data. The first step is to identify the unit of measurement, and from there measures may be rolled up to higher levels.

Recommendation 16: The measurement of preparedness and response requires multiple strategies (valid qualitative surveys and quantitative process and outcome data) to adequate capture the heterogeneity of the disasters, the targeted processes, and patient outcomes.

Recommendation 17: There may be a group of best practices available for local preparedness that could serve as structural measures. Such measures could be evaluated using some concepts created by the composite measure evaluation framework.

Recommendation 18: Measure developers should also consider how a group of performance measures for emergency preparedness and response will work together, and how they may prioritize a local organization's resources. For example, organizations may focus only on measured activities at the detriment of unmeasured activities that may similarly be required for emergency preparedness.

Recommendation 19: Measure developers should consider measures assessing the ability of an organization to adapt following a disaster. Measures around adapted implementation strategies using the information learned from an actual event, having a disaster committee or team in place are possible areas of measurement.

Capabilities and Capacities

From a measurement perspective, it is important to distinguish between capacities (i.e. structural elements) and capabilities (similar to process measures) in to begin the measurement discussion for emergency preparedness. [58,59] Capacities are resources, such as the infrastructure, trained personnel, and response mechanisms that are utilized for an emergency response. Building capacity through planning, acquisition of equipment, or training of personnel involves what it will take to be "ready" for the next incident. However, capacity alone is insufficient to ensure preparedness. By comparison, capabilities are the functional actions that an organization is capable of taking to identify and respond to a specific incident. This includes surveillance, epidemiology, event mitigation and surge capacity for healthcare services, public communication, and coordination through incident management. Capacities can be measured outside of an emergency while capabilities can only really be truly tested when a system encounters and incident, or potentially through drills and exercises.

Data Sources

As part of the AHRQ Healthcare Cost Utilization Project (HCUP), data is available relating to ED and inpatient flows over time across facilities, facility patient populations and chief complaints in participating states. The HCUP data could be linked to facility of level data from the American Hospital Association (AHA) survey or other federal surveys such as the Area Resource File to begin to identify areas where measurement of capacity should focus. This might be helpful in defining geographic boundaries for coalitions, providing static assessments of system capacity, or measuring an actual response to a disaster and how a particular hospital, health system, or coalition responded and system-wide outcomes.

Drills conducted by ASPR as part of the Hospital Preparedness Program will also generate data. In addition, utilizing qualitative assessments of health system performance following local disasters such as mass the casualty incident in Aurora, Colorado or natural phenomena like Hurricane Sandy will also help assess system performance.

Drills and exercises

Several studies have described the use of tabletop exercises to evaluate emergency preparedness.[60,61] A tabletop exercise simulates "…community response to major emergencies, which familiarize personnel with emergency plans, allow different agencies to practice working together, and identify gaps and shortcomings in emergency planning."[62] One group developed a 37-item questionnaire designed to assess five public health functional capabilities: (1) leadership and management, (2) mass casualty care, (3) communication, (4) disease control and prevention, and (5) surveillance and epidemiology. In an evaluation of 38 emergency preparedness exercises, one study found usefulness in clarifying workers' responsibilities, facilitating knowledge transfer, and identifying challenges.[63] However, the difficulty in using tabletop exercises as preparedness measures lies in whether they really measure preparedness for disasters or mass casualty events.

Recommendation 20: Rather than measuring "drill completion," future measure developers should specify standard drills with standard measures to quantify actual drill performance. Measure developers should ensure the drills are as closely linked to desired outcomes as possible.

Actual events

Several studies have examined the response to specific incidents. [64,65,66,67,68] For example; one paper assessed the performance in North Carolina to Hurricane Floyd (1999) and Hurricane Isabel (2003). During the intervening years, North Carolina had but new capacity, including infrastructure, enhanced laboratories, and better communications.[69] According to the authors, this "facilitated implementation of functional capabilities through effective centralized communication, command and control incident management, and a rapid needs assessment and medical surveillance during Hurricane Isabel." They concluded that, "measuring and implementing functional capabilities during exercises or real events facilitates achievement of preparedness performance standards, goals, and objectives." Assessing the response to specific incidents or a series of incident with specific performance measures for preparedness may be an effective way to assess hospital or healthcare system response.

Process evaluation and mapping

In order to improve quality, process maps are a key tool to identify the steps in a process and develop measures for testing and targets for improvement. Key inputs or triggers for a process and desired outcomes are included and help identify performance goals and measures. In assessing the reliability of response systems defining and mapping the system to identify the different parts of the response operation and articulate what it means for them to function well is particularly useful. For example, incident command at a response could be mapped as made up of several parts, including building situational awareness about the incident, making decisions about resource allocation among response functions, and dispatching response resources. Researchers at RAND adapted a fault tree analysis and failure mode, effects and criticality analysis (FMECA) and four steps for analysis of response systems for large-scale incidents.[70] The goal was to show that such analysis can help evaluate preparedness and anticipating the likely future performance of emergency response systems in large-scale events. Their results showed that this type of analysis "can potentially contribute to preparedness planning and evaluation in different but complementary ways."[71]

Accountability and Regionalization

When considering both ED crowding and preparedness measurement, it is vital to closely consider the level of measurement (i.e. individual, hospital, healthcare system, healthcare coalition, or region). In order to ensure accountability at multiple levels, it is important that measures of ED crowding, boarding, and preparedness and response also include some measures of region so that hospitals and health systems engage in cooperation, where they may continue to compete but have an incentive to work together for the greater cause of improving ED quality and flow, and helping ensure a local area is prepared in the event of a disaster or mass casualty event. As discussed earlier in the report by the Panel, more research is needed to appropriately define regional units of measurement which would become the basis for hospital coalitions or other measure of regional emergency preparedness and response. One example that was mentioned by the panel was the use of EMS jurisdictions as a way to define region. Many current preparedness efforts are measured at publically defined boundaries such as cities, counties or states due to the public infrastructure that supports preparedness. The Panel, however, noted that emergency care systems may rarely map well to such traditionally defined public boundaries, and thus the development of new measures may be necessary to create new collaborative frameworks.

A Pathway to Development for ED Crowding, Boarding, Preparedness and Response Measures

There are several measurement issues in this report that measured developers will need to consider in the development of NQF-endorsed performance measures for ED crowding, boarding, and emergency preparedness. Issues raised in the development of crowding measures include details of how the data should be presented, and also raise important broader issues in emergency care, such as the lack of a validated severity-adjustment system. While it may be desirable for all EDs in the U.S. to use the same triage system, this is not currently the case. Therefore, measure developers will need to work collaboratively to develop a standardized methodology for risk-adjustment and stratification, if these are components of ED crowding measures. In addition, the development of input measures at a regional level may be very challenging given that pre-hospital systems are organized very distinctly across local communities. This makes the creation of measure specifications that can be universally applied for accountability very difficult.

The pathway to NQF-endorsed performance measures for emergency preparedness will be a challenge, but one that is potentially surmountable through the guidance in this document. Specific issues include the fact that the evidence-base for preparedness measures may not be sufficient to conform to NQF requirements for endorsement, that process and outcome measures of preparedness are not assessed by direct observation unless a disaster occurs, and accountability is diffuse. [72,73]

With regard to the basis of evidence, the ideal measure will be either a desired outcome (i.e. an effective system wide response to a disaster – which is difficult to know based on there being no counterfactual evidence), or processes or structures that are directly related to an effective response. Because of the inherent nature of emergency preparedness, it is very difficult to define an effective response, and even more difficult to decompose what factors did or did not lead to an effective response. Therefore, the evidence-base for emergency preparedness measures ultimately submitted to NQF may likely involve expert consensus. Ideally, measures without an evidence-base will be generated

using known expert consensus methodologies with underlying scientific rigor, such as Delphi Panels. In addition, proposed process measures could use an evidence base that includes outcomes from drills and exercise as well as expert consensus that demonstrate "consistency," which is an NQF standard that could be modified to serve an important role in evaluation preparedness measures.

Importance Criteria

Impact

Measures assessing crowding, boarding and preparedness and response in the setting of surge or large-scale disaster are a high-impact aspect of healthcare (e.g. affects large numbers of patients and/or has a substantial impact for a smaller population; leading cause of morbidity/mortality; high resource use (current and/or future) severity of illness and severity of patient/societal consequences of poor quality). It is also important for developers to consider impact in the context of the National Quality Strategy (NQS) and understand where measure concepts and the NQS align.[74] The NQS pursues three broad aims around better care, healthy people and communities, and affordable care in six priority areas:

- Working with communities to promote wide use of best practices to enable healthy living
- Promoting the most effective prevention and treatment practices for the leading causes of mortality, starting with cardiovascular disease
- Ensuring that each person and family is engaged as partners in their care.
- Making care safer by reducing harm caused in the delivery of care
- Promoting effective communication and coordination of care, and
- Making quality care more affordable for individuals, families, employers, and governments by developing and spreading new health care delivery models.[75]

Developers could consider measurement in particular around the NQS priority to promote effective communication and care coordination, as suggested measure concepts include: experience of care transitions, complete transition records, chronic disease control, care consistent with end-of-life wishes, experience of bereaved family members, care for vulnerable populations, community health outcomes, and shared information and accountability for effective care coordination. Measure concepts in the other NQS priority areas should also be considered where issues of access, hospital admissions and readmissions and ED interactions intersect with healthy living and well-being, person- and family-centered care, safer care and affordability. Finally, the body of evidence demonstrating the effect of crowding on delays in care and less effective interventions suggests that many crowding measures can also be framed as initiatives to improve the safety of the delivery system.

A potential measure might be modeled after the HPP Structural Measure assessing surge capacity, #10.1 Medical Surge (pp. 38-43): "Percent of HCCs that have a coordinated mechanism established that supports their members' ability both to deliver appropriate levels of care to all patients (including pre-existing patients [both inpatient and outpatient], non-disaster-related patients, and disaster-specific patients), as well as to provide no less than 20 percent bed availability of staffed members' beds, within four hours of a disaster."

Performance Gap

As developers establish the opportunity for improvement they could marshal data showing, for example, that there is variation amongst hospitals regarding the ability to create 20 percent more bed

capacity above daily operating ability at a certain level of disaster surge, within a certain defined time window. In a surge environment, reverse triage—the process of determining risk for discharge of inpatients—assumes a critical role and is one of the greatest challenges of emergency response. Data demonstrating considerable variation, or overall less-than-optimal performance across providers and/or population groups could include prior studies of drills and exercises with a concordant and consistent systematic assessment (e.g., expert panel rating) that judges a measure focus to be a performance problem.

Evidence

Evidence to support the measure focus is frequently insufficient in the area of preparedness and response.[76] Developers seeking to create measures in this topic area should measure those aspects with greatest potential of driving improvements; if not important the other criteria are less meaningful. NQF looks at the extent to which the specific measure focus is evidence-based, important to making significant gains in healthcare quality and improving health outcomes for a specific high-impact aspect of healthcare where there is variation in or overall less-than-optimal performance.[77] Specifically the criteria examine the structure-process-outcome relationship. If the measure focus is one step in such a multistep process, the step with the strongest evidence for the link to the desired outcome should be selected as the focus of measurement or all steps should be included in a composite measure that measure a program of capacity and capabilities related processes that are considered necessary for performance in combination. Composite measures should attempt to demonstrate evidence in support of each component as well as of the global composite measure in concordance with the NQF Composite Measure Evaluation Criteria.

The levels of analysis focused on for this topic area are facility, integrated delivery system, and population: community, county or city, regional, state or national. As described above, measures may also be targeted at a healthcare coalition. The data requirements for these levels of analysis may be distinct as the processes measured at each level are different. For example, a hospital's immediate bed availability represents a process that is as important as statewide incident command structures; however the data requirement and sources will be considerably different suggesting that such measures should be distinctly evaluated with different evidence criteria for each level of measurement.

With regard to measure types, because process and outcomes are not readily assessed by direct observation in this topic area, structural measures (e.g. HPP 10.1: Medical Surge) have the advantage of being most responsive to policy changes but perhaps least related to outcome; process measures are most responsive to QI efforts by the service providers and are more proximally related to outcomes. Outcomes in the area of preparedness are problematic, as public health emergencies are rare and averted morbidity and mortality difficult to ascertain.[78]

Framing questions for developers include:

- What outcomes are expected if preparedness is improved, or effective? (e.g., adequate surge needs, most vulnerable patients identified, drug availability, reduced avoidable mortality)?
- What evidence based processes exist that impact desired outcomes?

- What types of tools or methods may be used or adapted to create measures that could be endorsed by NQF?

In preparedness and response, few tools rely on scientific studies supporting specific measures; other expert bodies are relied on – this becomes an issue when assessing the quality of the body of evidence to support a measure. One possibility is to look to the Hospital Preparedness Program capabilities in the way developers would look to the USPTF guidelines in a clinical context. Another possibility is for developers to think in terms of how the potential measure will lead to the outcome(s) that are desired, and qualitatively assess for face and content validity using an expert consensus Panel. Empirical data might be looked at in a systematic way and used to show that performance is adequate or inadequate in response to past disasters; that, for example, greater availability of beds led to improved outcomes. However, relying solely on historical examples could create concerns with consistency of results of the body of evidence, given the variation of past disasters.

The goal of regionalized emergency care services is largely to improve population-level outcomes, rather than patient-level performance within an ED. NQF's recent work on evaluation of population health measures lays an important foundation for regionalized measures of emergency care.

Consistency is an important NQF must-pass criterion, but given that few actual studies will have been conducted for many preparedness concepts, it will be tough to demonstrate that multiple rigorous investigations came to the same conclusion with the same measure focus. Because statistical studies are not available yet, developers should consider whether consistency can be measured in ways different than those used for clinical measures. For example, the ability to demonstrate consistency between evidence from drills and exercises, observations from historical examples and concordant systematic assessments of expert consensus could be used to demonstrate consistency in this framework. Similarly, developers may need to triangulate findings from distinct applications and settings to demonstrate the consistency of a "level of measurement" as most empirical analysis have used differently defined regions for measures at higher than the facility level.

Reliability and Validity Criteria: Scientific Acceptability of Measure Properties

One of the characteristics of good measures is that they encode clear standards, with required data elements clearly detailed. NQF will be looking at the extent to which each measure is precisely specified, with the specifications consistent with evidence cited in support of focus, and whether testing of the measure produces consistent (reliable) and credible (valid) results about the quality of care when implemented.

Because process and outcomes are not readily assessed by direct observation In this topic area, structural measures have the advantage of being most responsive to policy changes but perhaps least related to outcome; process measures are most responsive to QI efforts by the service providers and are more proximally related to outcomes.

Reliability

Given that many of the potential measures for preparedness are structure or process measures and that crowding is covered by many process measures, these are all very amenable to reproducible electronic methods. However, many measures applicable to preparedness are tied to instruments, survey tools,

checklists that could be subjective and time windows are unclear.[79] Methods of reliability assessment (inter-observer agreement, data source reliability assessments between paper and electronic sources, etc.) should still be applied when developing preparedness measures.

Validity

This will be challenging for a CDP focused on Preparedness measures since it is unclear what the "authoritative source" for comparison would be to demonstrate that the measure reflects quality care. An inherent challenge in evaluation is created by having an expert group define a potential measure as Important and having a Performance Gap while also having an expert group evaluate that measure as a valid measure of a desired outcome. In order to best ensure that intellectual conflicts of interest do not impair measure development, potential developers should utilize existing disclosure practices as well as ensure that measure validity if based on face validity is evaluated by a distinct group of experts.

Measures should also clearly identify accountable entities; however in this topic area accountability is often distributed across several entities. For example, the Medical Surge measure distributes accountability across a coalition for the following data elements:

- Do the surge plans of the HCC hospitals and other HCC members include written clinical practice guidelines for Crisis Standards of Care for use in an incident, including triggers that delineate shifts in the continuum of care from conventional to crisis standards of care?
- Has the HCC successfully tested its coordinated mechanism to both deliver appropriate levels of care to all patients, as well as able to provide no less than 20% immediate availability of staffed members' beds, within 4 hours of a disaster?
- Has the HCC successfully implemented lessons learned and corrective action from this exercise or event within the past year?
- Has the HCC demonstrated the ability to communicate regional healthcare surge status in an exercise or event within the past year?
- Does the HCC have the ability to expand its coalition-wide surge capacity according to the scope and magnitude of the incident?; as

As a result, accountability and division of labor is not clear in many current evaluation instruments. Use of Face Validity to support application of accountability upon new level s of measurement should include expert consensus groups that can be shown to be compromised of multiple stakeholders.

Usability

NQF will consider the extent to which intended audiences (e.g., consumers, purchasers, providers and policy makers) can understand the results of the measure and are likely to find them useful for decision making.

For this topic area it appears this criterion is very accessible. Potential audiences, in this case, ASPR, CDC and others should be expected to find that the information produced by these measures are

meaningful, understandable and useful, as they are already using or could use the performance results for both accountability and performance improvement.

Feasibility

NQF will consider the extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement. Developers must demonstrate that data elements are available in electronic form and there is not susceptibility to inaccuracies or unintended consequences. Developers in this topic area may have a hurdle in demonstrating that the data collection strategy can be implemented – this could be a challenge depending on cooperation of hospitals, system and regions in the collection of data.

Additional recommendations for measure developers

Recommendation 21: Develop the evidence base in this topic area to determine how much or what kind of preparation is enough; particularly with respect to completeness and timeliness.

Recommendation 22: Developers have the flexibility to define what "region" means when specifying measures and should empirically definite regional boundaries. Local, multistate, and geopolitical definitions might be used. Research may need to be conducted to define what a region(s) is, and have those definitions widely accepted. Suggestions:

- AHRQ prevention quality indicators, and NQF endorsed population health measures around late-stage presentation for HIV provide good examples of how to approach measurement at the community and population level.
- Dartmouth Atlas work around regions and geographic variations may be instructive in determining how to best define regions.
- Developers could consider movement of unplanned critical care patients within a coalition or community; observed variations could indicate opportunities for improvement.
- Players in the system that are not part of a coalition of cooperating facilities and that overlap coalition partners present an issue that must be considered, especially in urban areas.

Recommendation 23: NQF Serious Reportable Events, provide a possible construct for preparedness measure developers to adapt. Generally, rare event outcomes do not provide adequate information for improvement or discrimination; however, serious reportable events that are compared to zero are appropriate outcomes for public reporting and quality improvement.

Recommendation 24: Developers should consider existing measures that may be scaled up for assessment at facility, integrated delivery system, and population: community, county or city, national, regional, and state levels.

A Pathway from REMCS Concept to REMCS-based NQF-endorsed Performance Measure (REMCS-PM)

NQF has endorsed a number of consensus standards to evaluate the quality of care for topic areas related to Emergency Medicine over the past decade. As quality measurement has matured, better data systems have become available, electronic health records are closer to widespread adoption, and the

demand for meaningful performance measures has prompted development of more sophisticated measures of healthcare processes and outcomes at the regional level for emergency preparedness.

A future Consensus Development Project would seek to identify and endorse new performance measures for accountability and quality improvement that specifically address regionalized emergency medical care services. These measures would be used for accountability and public reporting in the following topic areas related to regionalized emergency medical care services:

- Boarding
- Crowding
- Disaster preparedness, and
- Response

NQF is particularly interested in composite and outcome measures; measures applicable to more than one setting; measures at the regional level that capture a broad population, including children and adolescents where applicable; measures of chronic care management and care coordination for these conditions; and measures sensitive to the needs of vulnerable populations, including racial/ethnic minorities and Medicaid populations. Finally, to the extent possible, NQF encourages the inclusion of electronic specifications for the measures submitted to this project.

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Appendix A: Regionalized Emergency Medicine Care Services (REMCS): Measures and Concepts

Measures

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Medical and public health surge outcome	Percentage of volunteers trained to provide mass prophylaxis (e.g. mass vaccinations or mass antibiotic distribution in the event of a public health emergency)		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
HRSA	surge capacity: beds	Number of additional beds for which a recipient could make patient care available within 24 hours		Hospital, Clinic		1.3 - Real-time capacity information	Boarding
EMSC-Emergency Medical Services for Children	Performance Measure 73(formerly PM 66b)	The percent of patient care units in the state/territory that have essential pediatric equipment and supplies as outlined in national guidelines. NUMERATOR (BLS (basic life support) patient care units): Number of BLS patient care units that have the essential pediatric equipment and supplies according to the data collected. DENOMINATOR (BLS patient care units): Total number of BLS patient care units for which data was collected. NUMERATOR (ALS-Advanced life support- patient care units): Number of ALS patient care units that have the essential pediatric equipment and supplies according to the data collected. DENOMINATOR (ALS patient care units): Total number of ALS patient care units for which data was collected.	All EMSC grantees (including 49 states and 6 territories)	Hospital, Pediatric, All EMSC grantees	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
EMSC-Emergency Medical Services for Children	Performance Measure 74(formerly PM 66c medical)	The percent of hospitals recognized through a statewide, territorial, or regional standardized system that are able to stabilize and/or manage pediatric medical emergencies. NUMERATOR: Number of hospitals with an ED that are recognized through a statewide, territorial or regional standardized system that are able to stabilize and/or manage pediatric medical emergencies. DENOMINATOR: Total number of hospitals with an ED in the State/Territory.	All EMSC grantees (including 49 states and 6 territories)	Hospital, Pediatric, All EMSC grantees	Specified	1.3 - Real-time capacity information	Access
EMSC-Emergency Medical Services for Children	Performance Measure 75(formerly PM 66c trauma)	The percent of hospitals recognized through a statewide, territorial, or regional standardized system that are able to stabilize and/or manage pediatric traumatic emergencies. NUMERATOR: Number of hospitals with an ED that are recognized through a statewide, territorial or regional standardized system that are able to stabilize and/or manage pediatric traumatic emergencies. DENOMINATOR: Total number of hospitals with an ED in the State/Territory.	All EMSC grantees (including 49 states and 6 territories)	Hospital, Pediatric, All EMSC grantees	Specified	1.3 - Real-time capacity information	Access
University of Louisville	Emergency Medical Services	Composite: Average Response Time, Number of available hospital/clinic beds, Number of medical personnel (per thousand population)		EMS, Hospital		1.3 - Real-time capacity information	Boarding

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Pre-identified staff notified to fill all eight Incident Command System (ICS) core functional roles due to a drill, exercise, or real incident	The intent of this performance measure is to demonstrate the capability to rapidly notify staff with incident management functional responsibilities that the EOC (Emergency Operations Center) is being activated (see Activations below). States and localities are required to report details on a minimum of two notification drills, exercises, or real incidents. States and localities can report an unlimited number of drills, exercises, or real incidents, but can only provide details for a maximum of 12 for the entire year (a maximum of six for each of the two reporting periods within the entire year). This CDC report provides information on the detailed notification drills, exercises, or incidents. States and localities may have conducted additional notifications.		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Pre-identified staff acknowledged notification within the target time of 60 minutes	This performance measure, related to the measure above, considers the time for staff with public health agency ICS functional responsibilities to acknowledge the notification.		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Conducted at least one unannounced notification outside of normal business hours	States and localities must be able to demonstrate that all eight core ICS functional roles can be staffed rapidly outside of normal business hours without advance warning.				1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Public health EOC (Emergency Operations Center) activated as part of a drill, exercise, or real incident	The intent of this performance measure is to demonstrate the capability for all eight staff having core ICS functional responsibilities to report for duty at the public health EOC. States and localities are required to report a minimum of two activations. States and localities can report an unlimited number of activations, but can only provide details for a maximum of 12 for the entire year (a maximum of six for each of the two reporting periods within the entire year). This CDC report provides information on the detailed activations. States and localities may have conducted additional activations.		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Pre-identified staff reported to the public health EOC within the target time of 2.5 hours	This performance measure, related to the measure above, considers the time for staff with public health agency Incident Command System functional responsibilities to report for duty at the public health agency's EOC.		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Conducted at least one unannounced activation	States and localities must be able to demonstrate that all eight core ICS functional role scan be staffed rapidly outside of normal business hours without advance warning.				1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	AAR/IPs developed following an exercise or real incident. After Action Reports/Improvement Plans (ARR/IPs)	The intent of this performance measure is to demonstrate the capability to analyze response actions, describe needed improvements, and prepare a plan for making improvements. States and localities are required to report details on a minimum of two AAR/IPs. States and localities can report an unlimited number of AAR/IPs, but can only provide details for a maximum of 12 for the entire year (a maximum of six for each of the two reporting periods within the entire year). This CDC report provides information on the detailed AAR/IPs. States and localities may have developed additional AAR/IPs.		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	AAR/IPs developed within target time of 60 days	Development of an AAR/IP within 60 days is calculated using the date following the end of the exercise or public health emergency response operations as determined by the incident commander, and the date the draft AAR/IP was submitted for clearance within the public health agency.		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Re-evaluated response capabilities following approval and completion of corrective actions identified in AAR/Ips	The systematic reevaluation of response capabilities is critical for providing evidence that planned corrective actions have been effective in improving response.				1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Time for pre-identified staff covering activated public health agency incident management lead roles (or equivalent lead roles) to report for immediate duty. Performance Target: 60 minutes or less	Activate public health emergency operations		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Production of the approved Incident Action Plan before the start of the second operational period	Develop incident response strategy				1.5 - Preparedness, monitoring, and data sharing	
CDC	Time to complete a draft of an After Action Report and Improvement Plan	Demobilize and evaluate public health emergency operations				1.5 - Preparedness, monitoring, and data sharing	
CDC	Time to issue a risk communication message for dissemination to the public	Issue public information, alerts, warnings, and notifications		Public Health Agency		1.1 - Public Health initiatives	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Activate dispensing modalities		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Dispense medical countermeasures to identified population		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Direct and activate medical material management and distribution		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Acquire medical material		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Maintain updated inventory management and reporting system		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Establish and maintain security		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Distribute medical material		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
CDC	Composite performance indicator from the Division of Strategic National Stockpile in CDC's Office of Public Health Preparedness and Response	Recover medical material and demobilize distribution operations		Public Health Agency		1.5 - Preparedness, monitoring, and data sharing	
Premier, Inc.	Risk-Adjusted Average Length of Inpatient Hospital Stay	Percentage of inpatient & outpatients with excessive in-hospital days. Numerator: Number of excess in-hospital days in a given inpatient population. Denominator: Patients admitted to a hospital. Patient population can be aggregated as any grouping of patients (e.g., by hospital, physician, diagnosis code, procedure, DRG, etc.)	Electronic Clinical Data : Electronic Health Record		Specified	1.3 - Real-time capacity information	NQF endorsed

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
United Health Group	Inpatient Hospital Average Length of Stay (risk adjusted)	Overall inpatient hospital average length of stay (ALOS) and ALOS by medical service category. Numerator: Total number of inpatient days of care for the admissions in the denominator. Denominator: •Denominator 1: Total number of inpatient admissions during the reporting period. •Denominator 2: Total number of inpatient admissions for the selected APR-DRG or DRG service category during the reporting period. oAPR-DRG and DRG service categories: medical, surgical, neonatal intensive care unit, mental health, substance abuse, obstetrics, and transplants (see Table 1 for DRG statistics and service categories).	Administrative claims	Hospital, Clinic	Specified	1.3 - Real-time capacity information	NQF endorsed

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
Leapfrog Group	Severity-Standardized Average Length of Stay -- Routine Care (risk adjusted)	Standardized average length of hospital stay (ALOS) for routine inpatient care (i.e., care provided outside of intensive care units). Numerator: Number of accommodation days in Routine Care hospital units for discharges in the denominator. Denominator: Number of inpatient hospital discharges (for respective condition) Inclusions: 1. Global time period = Cases with discharge dates falling within six-month measurement time period 2. Cases meeting global Clinical Criteria for Acute Myocardial Infarction (AMI), Coronary Artery Bypass Graft (CABG), Percutaneous Coronary Intervention (PCI), or Pneumonia, respectively 3. Patients aged 18-64 years at admission 4. Primary source of payment = private/commercial health insurance plan 5. Cases with Routine Care accommodation Days 0 or more, whole number values, defined by UB-92 revenue codes	Administrative claims	Adult/Elderly Care	Specified	1.3 - Real-time capacity information	NQF endorsed

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Time for sentinel clinical laboratories to acknowledge receipt of an urgent message from the CDC Public Health Emergency Preparedness (PHEP)-funded Laboratory Response Network biological (LRN-B) laboratory	Manage laboratory activities		Laboratories		1.5 - Preparedness, monitoring, and data sharing	
CDC	Time for initial laboratorian to report for duty at the CDC PHEP-funded laboratory	Manage laboratory activities		Laboratories		1.5 - Preparedness, monitoring, and data sharing	
CDC	Percentage of Laboratory Response Network (LRN) clinical specimens without any adverse quality assurance events received at the CDC PHEP-funded LRN-B laboratory for confirmation or rule-out testing from sentinel clinical laboratories	Perform sample management		Laboratories		1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Percentage of LRN non-clinical samples without any adverse quality assurance events received at the CDC PHEP-funded LRN-B laboratory for confirmation or rule-out testing from first responders	Perform sample management		Laboratories		1.5 - Preparedness, monitoring, and data sharing	
CDC	Ability of the CDC PHEP-funded Laboratory Response Network chemical (LRN-C) laboratories to collect relevant samples for clinical chemical analysis, package, and ship those samples	Perform sample management		Laboratories		1.5 - Preparedness, monitoring, and data sharing	
CDC	Measure 1: Proportion of reports of selected reportable diseases received by a public health agency within the jurisdiction required time frame288	– Numerator: Number of reports of selected reportable disease received by a public health agency within the jurisdiction-required time frame Denominator: Number of reports of selected reportable disease received by a public health agency		Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Measure 1: Percentage of infectious disease outbreak investigations302 that generate reports	– Numerator: Number of infectious disease outbreak investigation reports generated Denominator: Number of infectious disease outbreak investigation reports investigated		Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Measure 2: Percentage of infectious disease outbreak investigation reports that contain all minimal elements303	– Numerator: Number of infectious disease outbreak investigation reports generated containing all minimal elements Denominator: Total number of infectious disease outbreak investigation reports generated		Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Measure 3: Percentage of acute environmental exposure304 investigations that generate reports	– Numerator: Number of acute environmental exposure investigation reports generated Denominator: Number of acute environmental exposures investigated		Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Measure 4: Percentage of acute environmental exposure reports that contain all minimal elements	– Numerator: Number of acute environmental exposure reports generated containing all minimal elements Denominator: Number of acute environmental exposure investigation reports generated		Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Measure 1: Proportion of reports of selected reportable diseases for which initial public health control measure(s) were initiated within the appropriate time frame309	– Numerator: Number of reports of selected reportable diseases for which public health control measure(s) were initiated within an appropriate time frame Denominator: Number of reports of selected reportable diseases received by a public health agency		Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC-NIOSH	Safety Climate: Overall Performance Measure: Develop and evaluate a set of new best practices or recommended performance measures 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	Strategic Goal: Reduce injuries and enhance the health, safety, and resilience of emergency responders by improving the organization of emergency response work. 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.		EMS		1.2 - Prehospital capabiltiies	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC-NIOSH	Personal Protective Equipment(PPE): Overall Performance Measure: Reduce the number of injuries and illnesses to first responders as a result of improper selection or use (or non-use) of PPE.	Strategic Goal: Emergency response organizations with responsibilities associated with hazardous materials response will reduce exposures to inhalation and dermal hazards. 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.		EMS		1.2 - Prehospital capabiltiies	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC-NIOSH	Surveillance: Overall performance measure:Reduce the development of illnesses or injuries attributable to occupational exposure during disaster response through the use of prevention tools developed from information from short and long-term surveillance reporting systems.	Strategic Goal: Emergency response organizations will use the results from analyses of data from a surveillance system(s) developed by NIOSH to improve emergency responder safety and health. The surveillance system will identify problems for corrective action 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 affected workers.		EMS		1.2 - Prehospital capabiltiies	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC-NIOSH	Characterization/Assessment of Potential Hazards:Overall Performance Goal: Reduce the incidence and severity of injuries and illnesses through improved and more rapid characterization/assessment of potential hazards.	Develop new methods for identifying environmental contamination in case of a terror event. These methods would reduce the number of workers exposed and injured since more rapid identification of the terror agent would occur and the appropriate protection, workplace controls would be instituted.		EMS		1.2 - Prehospital capabiltiies	
CDC-NIOSH	Engineering/Technological Interventions and Controls: Overall Performance Measure: Reduce exposure through improved engineering/technological interventions and controls.	Strategic Goal: As appropriate and feasible, improve engineering controls, technology, and tools to reduce responder's exposures to or hazards associated with CBRN, toxic industrial compounds, 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, toxic industrial compounds, and hazardous exposures may not be possible by engineering controls alone.		EMS		1.2 - Prehospital capabiltiies	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC-NIOSH	Environmental Microbiology: Overall Performance Goal: Improve the ability to evaluate, understand risk of infection, and improve risk reduction strategies for biological threat agents.	Strategic Goal: Emergency response organizations will improve their understanding of environmental microbiology threat agents, including environmental factors that influence the introduction, spread, and control of these agents. Emergency responders will enhance their capability to respond to a biological threat, whether naturally occurring or deliberately introduced. Discussion: Critical gaps exist in our knowledge about environmental microbiology, and these disparities impede the ability of public health responders to take appropriate action in emergency situations that involve microbial agents. Microbial agents are considered to include bioterrorism agents, emerging infectious pathogens, and non-select agents. Establishing the presence and level 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 is also critical to have the capacity 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 is important to develop and understand the effectiveness of a range of risk reduction strategies for contaminated environments, including environmental controls; personal protective equipment; disinfection strategies; and, when Available and indicated, medical countermeasures like immunization or antimicrobial prophylaxis.		EMS		1.2 - Prehospital capabiltiies	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC-NIOSH	Biological Monitoring of Terrorism Agents develop new methods for evaluating internal doses following a terror event.	These methods would reduce the number of workers affected since more rapid and accurate identification of those with significant absorption of the terror agent would occur, and appropriate treatment would be instituted for those who need it. In addition, such methods would permit better monitoring of the effectiveness of exposure protections and more precise identification of those needing further medical follow-up or monitoring. Strategic Goal: Emergency response and remediation workers will reduce the potential impact of exposures to terror agents by utilizing improved biological monitoring methods. Discussion: When a terror event occurs, the causative agent, whether chemical, biological, or radiologic/nuclear, needs to be quickly identified and exposures assessed. At times, the terror event may entail multiple agents released either simultaneously or sequentially. Better methods to identify absorbed chemical or biological agents and to quantify internal exposure are needed. In particular, rapid methods for measuring what or how much agent is actually absorbed into the body using various biomonitoring techniques would be beneficial, especially when clinical evaluation is needed. Cumulative exposures to chemical agents (and perhaps some biological agents) at levels insufficient to produce acute symptoms or illness may over time lead to frank disease or other adverse health effects, and biomonitoring is an important tool for early identification and monitoring of such exposures. Additionally, vaccination can augment protection against some biothreat agents. Successful vaccination results in measurable antibody titers. Exposure to		EMS		1.2 - Prehospital capabiltiies	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	CP – Identification of key organizations Annual	Median number of community sectors in which local health departments (LHDs) identified key organizations to participate in public health, medical, and/or mental/behavioral health-related emergency preparedness efforts. Measurement Specifications: When the numbers of community sectors engaged by each participating LHD are arranged from highest to lowest [maximum is 11, minimum is zero], the median is the midpoint number where half of the LHDs engaged a number of sectors at or above the midpoint and the other half of the LHDs engaged a number of sectors at or below it.	Self-reported data from local health departments	Public Health Agency	Specified	1.4 - Categorization of participating agencies, organizations and facilities	
CDC	CP – Community engagement in risk identification Annual	Median number of community sectors that LHDs engaged in using hazards, and vulnerabilities assessment (HVA) data to determine local hazards, vulnerabilities, and risks that may impact public health, medical, and/or mental/behavioral health systems and services. Measurement Specifications: When the numbers of community sectors that each LHD engaged to determine local hazards, vulnerabilities, and risks are arranged from highest to lowest [maximum is 11, minimum is zero], the median is the midpoint number where half of the LHDs engaged a number of sectors at or above the midpoint and the other half of the LHDs engaged a number of sectors at or below it.	Self-reported data from local health departments	Public Health Agency	Specified	1.4 - Categorization of participating agencies, organizations and facilities	Boarding and/or Access

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	CP – Community engagement in public health preparedness activities Annual	Proportion of key organizations that LHDs engaged in a significant public health emergency preparedness activity. Measurement Specifications: Numerator: Number of key organizations that LHDs engaged in one or more of the following significant public health emergency preparedness activities: Development of key organizations' emergency operations or response plans related to public health, medical, and/or mental/behavioral health Exercises containing objectives or challenges (e.g. injects) related to public health, medical, and/or mental/behavioral health. Competency-based training related to public health, medical, and/or mental/behavioral health emergency preparedness and response. Denominator: Total number of key organizations identified by LHDs (as specified in data element #2 for CP 1)	Self-reported data from local health departments	Public Health Agency	Specified	1.4 - Categorization of participating agencies, organizations and facilities	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	CP – Community engagement in recovery planning Annual	Median number of community sectors that LHDs engaged in developing and/or reviewing a community recovery plan related to the restoration and recovery of public health, medical, and/or mental/behavioral health systems and services. Measurement Specifications: When the numbers of community sectors that each LHD engaged in developing and/or reviewing their community recovery plan are arranged from highest to lowest [maximum is 11, minimum is zero], the median is the midpoint number where half of the LHDs engaged a number of sectors at or above the midpoint and the other half of the LHDs engaged a number of sectors at or below it.	Self-reported data from local health departments	Public Health Agency	Specified	1.4 - Categorization of participating agencies, organizations and facilities	
CDC	EOC – Staff Assembly Annual	Time for pre-identified staff covering activated public health agency incident management lead roles (or equivalent lead roles) to report for immediate duty. Measurement Specification: Start time: Date and time that a designated official began notifying staff to report for immediate duty to cover activated incident management lead roles. Stop time: Date and time that the last staff person notified to cover an activated IM lead role reported for immediate duty.	health department. Self-reported data on exercises or real incidents.	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	EOC – Priority Goal (50 states only) Annual	Time for pre-identified staff covering activated public health agency incident management lead roles (or equivalent lead roles) to report for immediate duty. Performance Target: 60 minutes. Measurement Specification: Start time: Date and time that a designated official began notifying staff to report for immediate duty to cover activated IM lead roles. Stop time: Date and time that the last staff person notified to cover an activated IM lead role reported for immediate duty.	health department. Self-reported data on exercises or real incidents.	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	EOC - IAP	Production of the approved Incident Action Plan (IAP) before the start of the second operational period. Measurement Specifications: Was a written IAP approved before the start of the second operational period [Yes/No]?	health department. Self-reported data on exercises or real incidents.	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	EOC - AAR and IP Annual	Time to complete a draft of an After Action Report (AAR) and Improvement Plan (IP). Measurement Specifications: Start time: Date exercise or public health emergency operation completed (may be prior to or during current BP). Stop time: Date the draft AAR and IP were submitted for clearance within the public health agency.	health department. Self-reported data on exercises or real incidents.	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	EPIW - Public Message Dissemination	Time to issue a risk communication message for dissemination to the public. Measurement Specifications: Start time: Date and time that a designated official requested that the first risk communication message be developed. Stop time: Date and time that a designated official approved the first risk communication message for dissemination.	health department. Self-reported data on exercises or real incidents.	Public Health Agency	Specified	1.1 - Public Health initiatives	
CDC	Communication between PHEP-funded Laboratory and Sentinel Clinical Laboratories Bio Only	Time for sentinel clinical laboratories to acknowledge receipt of an urgent message from PHEP-funded laboratory. Measurement Specifications: Start time: Time PHEP-funded laboratory sends urgent message to first sentinel clinical laboratory. Intermediate stop time 1: Time at least 50% of sentinel clinical laboratories acknowledged receipt of urgent message. Intermediate stop time 2: Time at least 90% of sentinel clinical laboratories acknowledged receipt of urgent message. Stop time: Time last sentinel clinical laboratory acknowledged receipt of urgent message	self-reported data from real incidents or exercises	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Laboratorian Reporting Bio & Chem	Time for initial laboratorian to report for duty at the PHEP-funded laboratory. Measurement Specifications: Start Time: Date and time that a public health designated official began notifying on-call laboratorian(s) to report for duty at the PHEP-funded LRN laboratory. Stop Time: Date and time that the first laboratorian reported for duty at the PHEP-funded LRN laboratory	self-reported data from real incidents or exercises	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	LRN-EPI 24/7 Emergency Contact Drill Bio & Chem Annual	Time to complete notification between CDC, on-call laboratorian, and on-call epidemiologist Performance Target: 45 minutes. Measurement Specifications: Start Time: Date and time that CDC Emergency Operations Center official began notification to on-call laboratorian. [In BP11, this applies only to LRN-B in this direction.] Stop Time: Date and time on-call epidemiologist (after receiving notification from on-call laboratorian) notifies CDC Emergency Operations Center that notification drill is complete.	CDC-initiated drills and CDC EOC, DSLR (Division of State and Local Readiness)	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	LRN-EPI 24/7 Emergency Contact Drill Bio & Chem Annual	Time to complete notification between CDC, on-call epidemiologist, and on-call laboratorian Performance Target: 45 minutes. Measurement Specifications: Start Time: Date and time that CDC Emergency Operations Center official began notification to on-call epidemiologist. Stop Time: Date and time on-call laboratorian (after receiving notification from on-call epidemiologist) notifies CDC Emergency Operations Center that notification drill is complete. [In BP11, this applies only to LRN-C in this direction.]	CDC-initiated drills and CDC EOC, DSLR (Division of State and Local Readiness)	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	LRN Emergency Response Pop Proficiency Test (PopPT) Exercise Chem Only Annual	Ability of PHEP-funded LRN-C Level 1 and/or Level 2 laboratories to detect and quantify biomarkers of chemical agents in clinical samples during the LRN Emergency Response Pop Proficiency Test (PopPT) Exercise. Measurement Specifications: Numerator: Number of biomarkers of chemical agents detected by Level 1 and/or Level 2 laboratories. Denominator: Number of biomarkers of chemical agents in the exercise.	Data are collected internally by the LRN-C program. Results will be shared with DSLR.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Notification Drill associated with Proficiency Testing Bio Only Annual	Ability of PHEP-funded LRN-B reference laboratory to contact the CDC Emergency Operations Center within 2 hours during LRN notification drill. Measurement Specifications: Notification drill results [Passed/did not pass/did not participate]	Data will be collected by LRN-B program. Results will be shared with DSLR. Notification drill data must be validated in PERFORMS by the awardee's preparedness office.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Notification to Partners Bio & Chem Annual	Time for PHEP-funded laboratory to notify public health partners of significant laboratory results. Measurement Specifications: Start time: Time PHEP-funded laboratory obtains a significant laboratory result. Stop time: Time PHEP-funded laboratory completes notification of public health partners of significant laboratory results (i.e., time when last public health partner was notified, if partners were not simultaneously notified)	self-reported data from real incidents or exercises	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Proficiency Testing Bio Only Annual	Proportion of LRN-B proficiency tests successfully passed by PHEP-funded laboratories. Measurement Specifications: Numerator: Number of LRN-B proficiency tests successfully passed by PHEP-funded laboratory(ies). Denominator: Total number of LRN-B proficiency tests participated in by PHEP-funded laboratory(ies)	Data are collected internally by the LRN-B program. Awardees will submit information for Reported Data Element 4. Results will be shared with DSLR. Proficiency testing data must be validated in PERFORMS by the awardee's preparedness office.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Proficiency Testing - Chemical Additional Chem Only Annual	Proportion of LRN-C proficiency tests (additional methods) successfully passed by PHEP-funded laboratory. Measurement Specifications: Numerator: Number of LRN-C additional methods successfully proficiency tested by the PHEP-funded laboratory. Denominator: Total number of LRN-C additional methods for which the PHEP-funded laboratory is qualified to test	Reported Data Elements 1-4 are collected internally by the LRN-C program. Awardees will submit information for Reported Data Element 5. Results will be shared with DSLR.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Proficiency Testing - Chemical Core Chem Only Annual	Proportion of LRN-C proficiency tests (core methods) successfully passed by PHEP-funded laboratory. Measurement Specifications: Numerator: Number of LRN-C core methods successfully proficiency tested by the PHEP-funded laboratory. Denominator: Total number of LRN-C core methods (9)	Reported Data Elements 1-4 are collected internally by the LRN-C program. Awardees will submit information for Reported Data Element 5. Results will be shared with the Division of State and Local Readiness.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Sample Collection, Packing, and Shipping (SCPaS) Chem Only Annual	Ability of PHEP-funded LRN-C laboratory to collect, package, and ship samples properly during LRN exercise. Measurement Specifications: SCPaS Exercise Results [Passed/Did not pass]	Data are collected internally by the LRN-C program office at CDC. Results will be shared with DSLR.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Sample Quality-First Responders Bio Only Annual	Percentage of LRN nonclinical samples received at the PHEP-funded laboratory for confirmation or rule-out testing from first responders without any adverse quality assurance events. Measurement Specifications: Numerator: Number of LRN nonclinical samples received at the PHEP-funded laboratory for confirmation or rule-out testing from first responders without any adverse quality assurance events. Denominator: Total number of LRN nonclinical samples received at the PHEP-funded laboratory for confirmation or rule-out testing from first responders	Self-Reported. Data are to be reported on the quality of LRN nonclinical samples received from first responders on a day-to-day basis (i.e., not via exercises).	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	Specimen Quality-Sentinel Clinical Laboratories Bio Only Annual	Percentage of LRN clinical specimens received at PHEP-funded laboratory for confirmation or rule-out testing from sentinel clinical laboratories without any adverse quality assurance events. Measurement Specifications: Numerator: Number of LRN clinical specimens received at PHEP-funded laboratory for confirmation or rule-out testing from sentinel clinical laboratories without any adverse quality assurance events. Denominator: Total number of LRN clinical specimens received at CDC PHEP-funded laboratory for confirmation or rule-out testing from sentinel clinical laboratories	Self-Reported. Data are to be reported on the quality of LRN nonclinical samples received from first responders on a day-to-day basis (i.e., not via exercises).	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	Surge Capacity Exercise Chem Only Annual	Ability of each PHEP-funded LRN-C Level 1 laboratory to process and report results to CDC for 500 samples during the LRN Surge Capacity Exercise. Measurement Specifications: Start Time: Date and time of delivery of 500 samples to LRN-C Level 1 laboratory. Stop Time: Date and time result from last sample was reported to CDC	Data are collected internally by the LRN-C program. Results will be shared with DSLR.	Laboratories	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	SURV – Disease Reporting Annual	Proportion of reports of selected reportable diseases received by a public health agency within the awardee-required timeframe. Measurement Specifications: Numerator: Number of reports of selected reportable disease received by a public health agency within the awardee-required timeframe. Denominator: Number of reports of selected reportable disease received by a public health agency	Self-reported data from local health departments	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	SURV – Disease Control Annual	Proportion of reports of selected reportable diseases for which initial public health control measure(s) were initiated within the appropriate timeframe. Measurement Specifications: Numerator: Number of reports of selected reportable diseases for which public health control measure(s) were initiated within an appropriate timeframe. Denominator: Number of reports of selected reportable diseases received by a public health agency	Self-reported data from local health departments	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
CDC	EI – Outbreak Investigation Reports Annual	Percentage of infectious disease outbreak investigations that generate reports. Measurement Specifications: Numerator: Number of infectious disease outbreak investigation reports generated. Denominator: Number of infectious disease outbreaks investigated	Self-reported data from local health departments from real reports, not exercises	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	EI – Outbreak Reports with Minimal Elements Annual	Percentage of infectious disease outbreak investigation reports that contain all minimal elements. Measurement Specifications: Numerator: Number of infectious disease outbreak investigation reports containing all minimal elements. Denominator: Number of infectious disease outbreak reports generated	Self-reported data from local health departments from real reports, not exercises	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	EI – Exposure Investigation Reports Annual	Percentage of EI of acute environmental exposures that generate reports. Measurement Specifications: Numerator: Number of EI reports of acute environmental exposures generated. Denominator: Number of EI of acute environmental exposures	Self-reported data from local health departments from real reports, not exercises	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CDC	EI – Exposure Reports with Minimal Elements Annual	Percentage of EI reports of acute environmental exposures that contain all minimal elements. Measurement Specifications: Numerator: Number of EI reports of acute environmental exposures containing all minimal elements. Denominator: Number of EI reports of acute environmental exposures generated	Self-reported data from local health departments from real reports, not exercises	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	

DEVELOPER/ STEWARD	MEASURE TITLE	MEASURE DESCRIPTION	DATA SOURCE (IF AVAILABLE)	TARGET POPULATION (IF AVAILABLE)	SPECIFIED	MAPPING TO NQF REMCS FRAMEWORK	NOTES
HHS-OASH	Ensure that State and District of Columbia health departments establish training, plans, and protocols and conduct annual multi-institutional exercises to prepare for response to natural and technological disasters.	Topic or Condition: Population Sub-Topic or Sub-Condition: Environmental Health Domain: Process Care Setting: Health System Numerator: Number of States including District of Columbia that have established preparedness plans and scheduled exercises Denominator: Not applicable Explanation If No Numerator/Denominator: Number, not a rate	Association of State and Territorial Health Officials (ASTHO); CDC, Division of State and Local Readiness (DSLR)	Public Health Agency	Specified	1.5 - Preparedness, monitoring, and data sharing	
CMS	Median time from ED arrival to ED departure for Discharged ED patients	Median time from emergency department arrival to time of departure from the emergency room for patients discharged from the emergency department	Electronic Clinical Data; Paper Medical Records	Hospital	Specified	1.3 - Real-time capacity information	NQF endorsed
CMS	Admit decision time to ED departure time for admitted patients	Median time from admit decision time to time of departure from the emergency department for emergency department patients admitted to inpatient status	Electronic Clinical Data; Paper Medical Records	Hospital	Specified	1.3 - Real-time capacity information	NQF endorsed
CMS	Median time from ED arrival to ED departure for admitted ED patients	Median time from emergency department arrival to time of departure from the emergency room for patients admitted to the facility from the emergency department	Electronic Clinical Data; Paper Medical Records	Hospital	Specified	1.3 - Real-time capacity information	NQF endorsed

Concepts

MEASURE CONCEPT DESCRIPTION	DOMAIN	INPUT, THROUGHPUT, OUTPUT, OR STAFFING	MAPPING TO NQF REMCS FRAMEWORK, PART 1
ED beds at capacity > 6 hours or hallways filled > 6 hours	Boarding	Output	1.3 - Real-time capacity information
No. of full rooms	Boarding	Output	1.3 - Real-time capacity information
No., mean no., or % of boarders	Boarding	Output	1.3 - Real-time capacity information
Boarding time	Boarding	Output	1.3 - Real-time capacity information
Boarding time components	Boarding	Output	1.3 - Real-time capacity information
Inpatient occupancy level	Boarding	Output	1.3 - Real-time capacity information
ED volume ⁄ inpatient bed capacity	Boarding	Output	1.3 - Real-time capacity information
Number of staffed acute care beds	Boarding	Output	1.3 - Real-time capacity information
Alternate level of care bed availability	Boarding	Output	1.3 - Real-time capacity information
Percentage of open appointments in ambulatory care clinics	Crowding	Input; Output	1.3 - Real-time capacity information
Staff Present	Crowding	Staffing	1.3 - Real-time capacity information
ED workload Rate (# of daily ED visits x mean LOS / number of ED beds available)	Crowding	Throughput	1.3 - Real-time capacity information
Physicians feel rushed	Crowding; Clinician Opinion	Throughput	1.3 - Real-time capacity information
Clinician opinion of crowding	Crowding; Clinician Opinion	Throughput	1.3 - Real-time capacity information
Emergency Physician satisfaction	Crowding; Clinician Opinion	Staffing	1.3 - Real-time capacity information
Waiting time	Crowding; Input	Throughput	1.3 - Real-time capacity information
Waiting room filled > 6 hours ⁄ day	Crowding; Input	Throughput	1.3 - Real-time capacity information
Time to physician	Crowding; Input	Throughput	1.3 - Real-time capacity information
No. of ED arrivals	Crowding; Input	Input	1.3 - Real-time capacity information
No. of pts in ED waiting room	Crowding; Input	Input	1.3 - Real-time capacity information
No. of pts registered	Crowding; Input	Input	1.3 - Real-time capacity information

MEASURE CONCEPT DESCRIPTION	DOMAIN	INPUT, THROUGHPUT, OUTPUT, OR STAFFING	MAPPING TO NQF REMCS FRAMEWORK, PART 1
No. or % of ambulance patients registered	Crowding; Input	Input	1.3 - Real-time capacity information
No. of pts awaiting triage	Crowding; Input	Input	1.3 - Real-time capacity information
No. of low-complexity pts	Crowding; Input	Input	1.3 - Real-time capacity information
No. of pts at each acuity level	Crowding; Input	Input	1.3 - Real-time capacity information
Average triage acuity level	Crowding; Input	Throughput	1.3 - Real-time capacity information
No. of new pts by usual care	Crowding; Input	Input	1.3 - Real-time capacity information
LWBS (Left Without Being Seen)/reneging	Crowding; Input	Input	1.3 - Real-time capacity information
Average or % of pts who leave without treatment complete	Crowding; Input	Input	1.3 - Real-time capacity information
Average EMS waiting time	Crowding; Input	Throughput	1.3 - Real-time capacity information
No. or % of admissions	Crowding; Output	Throughput	1.3 - Real-time capacity information
ED Observation unit census	Crowding; Output	Output	1.3 - Real-time capacity information
No. of pts waiting discharge ambulance pick-up	Crowding; Output	Output	1.3 - Real-time capacity information
ED admission transfer rate	Crowding; Output	Output	1.3 - Real-time capacity information
Hospital admission source	Crowding; Output	Output	1.3 - Real-time capacity information
Hospital supply ⁄ demand forecast	Crowding; Output	Output	1.3 - Real-time capacity information
No. of inpatients ready for discharge	Crowding; Output	Output	1.3 - Real-time capacity information
Inpatient processing times	Crowding; Output	Output	1.3 - Real-time capacity information
Inpatient laboratory, radiology, CT orders	Crowding; Output	Output	1.3 - Real-time capacity information
Time from request to bed assignment	Crowding; Output	Throughput	1.3 - Real-time capacity information
Time from bed ready to ward transfer	Crowding; Output	Throughput	1.3 - Real-time capacity information
Agency nursing expenditures	Crowding; Output	Staffing	1.3 - Real-time capacity information
Local home care service availability	Crowding; Output	Output	1.3 - Real-time capacity information
Percentage of time ED > or = to stated capacity	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
Total no. of pts in ED	Crowding; Throughput	Throughput	1.3 - Real-time capacity information

MEASURE CONCEPT DESCRIPTION	DOMAIN	INPUT, THROUGHPUT, OUTPUT, OR STAFFING	MAPPING TO NQF REMCS FRAMEWORK, PART 1
ED occupancy rate	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of hallway pts	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of resuscitations in past 4 hours	Crowding; Throughput	Input	1.3 - Real-time capacity information
No. of pts being treated	Crowding; Throughput	Input	1.3 - Real-time capacity information
No. of pts waiting for specialty consult or disposition by consultant > 4 hours	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of ED diagnostic orders	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of pts waiting test results	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of nurses working	Crowding; Throughput	Staffing	1.3 - Real-time capacity information
Pts treated by acuity per bed hours	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of pts per nurse or physician	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
No. of pts admitted or discharged per physician	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
Sum of pt care time per shift	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
ED ancillary service turnaround time	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
Time to consultation	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
Time to room placement	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
ED treatment time	Crowding; Throughput	Throughput	1.3 - Real-time capacity information
ED LOS	Crowding; Throughput	Throughput	1.3 - Real-time capacity information

MEASURE CONCEPT DESCRIPTION	DOMAIN	INPUT, THROUGHPUT, OUTPUT, OR STAFFING	MAPPING TO NQF REMCS FRAMEWORK, PART 1
Ambulance diversion episodes	Diversion	Input	1.3 - Real-time capacity information
Nearby EDs diverting ambulances	Diversion	Input	1.3 - Real-time capacity information
Hours on ambulance diversion	Diversion	Input	1.3 - Real-time capacity information

Appendix B: Project Expert Panel and NQF Staff

EXPERT PANEL

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