Self-Assessment in the Measurement of Public Health Workforce Preparedness for Bioterrorism or Other Public Health Disasters

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SYNOPSIS

Objective. The purpose of this study was to examine effective ways to evaluate public health workers' competence for preparedness.

Methods. The Public Health Ready project, developed by the National Association of County and City Public Health Officials and the Centers for Disease Control and Prevention, is a pilot program designed to prepare local public health agencies to respond to emergency events. Workers at a Public Health Ready site (N=265) rated their need for training and their competence in meeting generic emergency response goals. Cluster analysis of cases was conducted on the self-assessed need for training.

Results. Three groups of workers emerged, differing in their overall ratings of need for training. A given worker tended to report similar needs for training across all training goals.

Conclusions. In this study, workers' ratings of need for training may reflect an overall interest in training rather than need for training in a particular area. Caution should be exercised in interpretation when generic goals and self-assessment are used to measure need for training. Future assessments of training needs may be more effective if they use objective measures of specific local plans.

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The events of September 11, 2001, changed the way the public health community thinks about and plans for an emergency response. In response to these events, the public health community has begun preparing for possible future attacks.[1,2] Public health preparedness is a national goal, and research on preparing the public health workforce can suggest ways to meet that goal. Research on this topic began even before 9/11 with the founding of the Academic Centers for Public Health Preparedness in the year 2000. The Academic Centers were initially funded under a cooperative agreement between the Association of Schools of Public Health (ASPH) and the Centers for Disease Control and Prevention (CDC). Through partnerships with state and local public health agencies, the Academic Centers work to assess training needs, develop courses that meet those needs, and evaluate how well the courses prepare the workforce.[3–5]

Another important effort is the Public Health Ready project, developed by the National Association of County and City Public Health Officials (NACCHO) and CDC.[6] The Public Health Ready project is a pilot program designed to prepare local public health agencies to respond to emergency events. The project has three components: (1) competency-based training, (2) development of local emergency response plans, and (3) demonstrating competence through drills and exercises. Twelve local public health agencies have volunteered to serve as pilot sites, and these sites are working with academic partners to achieve recognition of agency preparedness (i.e., the agency has developed an emergency plan and workers have been trained in the plan with drills and exercises). This effort is important, because lack of trained personnel can be a critical factor in preparedness.[7] This article is the first published study on training workers at a Public Health Ready pilot site.

Published research on preparedness has been limited. One important effort identified basic competencies. Using the Delphi technique with a panel of 59 experts, Gebbie and Merrill identified what workers need to know and do in an emergency.[8] For example, workers need to be able to "describe the chain of command in emergency response." Another study surveyed the training needs of public health workers in Arkansas, Louisiana, Alabama, and Mississippi.[9] The study found that to build on existing skills, workers preferred printed material; to develop new skills, workers preferred coaching or workshops. A third study surveyed 50 public health nurses on preparedness.[10] After a training program, the nurses reported an increase in their perceived level of knowledge. An interesting finding was that 90% reported one or more barriers to coming to work during an emergency.

Though the published research is limited, some practice-based initiatives have begun.[11,12] Workforce surveys have had two limitations to date. First, survey items have been phrased in terms of generic goals. These generic goals can guide the development of appropriate local plans.[5] Indeed, competencies are phrased as generic goals so that local agencies may have the flexibility to adapt them to their local needs. However, when generic goals are used in self-report surveys, it may not be clear how to interpret the answers. For example, one survey developed by an Academic Center participating in the Public Health Ready project was designed to assess workforce preparedness. One item on the survey was, "Describe the appropriate action to take and procedures to follow if there is a suspected or actual emergency situation (outbreak, biological, environmental, etc.)." The survey item does not refer to a specific action in a local plan; instead, the item refers to the more generic "appropriate action." This generic goal may be ideal for guiding the development of local preparedness plans. But different workers are likely to have different ideas about what is an appropriate action, which makes it difficult to interpret the self-report response.

A second limitation is reliance on self-assessment. Researchers have asked public health workers to give their perceptions of what they know and what they can do.[9,10,13] But evidence suggests that when people are unskilled at a task, they tend to be unaware of their lack of skill.[14–16] In one study, for example, physicians self-assessed their knowledge of three diseases; these assessments did not correlate with their actual knowledge.[17] In another study, nurses self-assessed their knowledge of providing life support. The nurses' self-ratings did not correlate with their actual knowledge.[18] In the same way, medical students' self-assessment of their knowledge before an exam did not predict how well the students performed on the exam.[19]

Why are self-assessments weak predictors of knowledge? One answer is that the knowledge people need to act competently is also the knowledge they need to judge how competently they acted.[14] The knowledge that a physician needs to treat a disease is the same knowledge needed to judge if the disease is competently treated. The knowledge that a public health worker needs to guide appropriate action in an emergency is the same knowledge needed to judge if the action is appropriate.

One way to address the two limitations of preparedness surveys—the use of generic goals and reliance on self-assessment—is to group workers according to their self-reported training needs. For example, consider an agency that surveys workers to ask what they see as their most important training needs. With the survey completed, the agency may then plan to provide training to address the highest-ranked needs. But there may be groups of workers who express similar needs. One group of staff members might rank goals A, B, and D as their greatest needs; when a training session covers goal A, it would make good sense to also cover goals B and D, because the workers in the group express a need for all three goals. This type of planning could make training more efficient.

In the present study, we investigated whether public health agency staff members clustered when they rated their self-assessed needs regarding generic goals of public health preparedness. This cluster information could potentially be used to identify related training needs. Knowledge of these related needs could be used to increase the effectiveness of training programs.

METHODS

Staff members were surveyed at the Tarrant County Health Department, a Public Health Ready pilot site that has partnered with the Southwest Center for Public Health Preparedness. First, the survey assessed how confident the

workers perceived themselves to be in responding to an emergency event. Second, the survey determined the perceived need for training in key competency areas.

In all, 265 workers completed the survey. The respondents included managers, professionals, and administrative and support staff; 39 were men and 198 were women, with 28 not indicating their gender. The modal age group was 45–54 years, with 35% of respondents in this age group. Somewhat more than half (55%) were 35 to 54 years of age. The years of experience in public health was highly skewed to the right; a large number of workers had worked for a few years and fewer workers had worked for many years. The mode was 1 year, the median was 5, and the interquartile range was 2–11.

Instrument

The survey instrument consisted of 38 items based on the generic competencies identified by Gebbie and Merrill.[8] Each item described a broad goal for responding to a public health emergency. For example, one item referred to whether the worker could "maintain and use up-to-date knowledge of emerging or infectious diseases." Another item asked if the worker was able to "understand [his or her] role" when working with federal partners. Another item asked if the worker could "take appropriate action" during an emergency response. The workers were asked to indicate their level of confidence that they could achieve the broad goal. Response options were 1=not at all confident, 2=somewhat confident, 3=confident, and 4=very confident. The workers were also asked to indicate their need for training; response options were 1=no need, 2=low need, 3=moderate need, and 4=high need.

Statistical analysis

The data were analyzed using SPSS, Version 10.2.[20] Mean ratings were computed both for confidence that the goal could be achieved and perceived need for training. Correlational analysis was conducted to compare the two sets of means.

Cluster analysis was conducted, using ratings of need for training in meeting the 10 highest-ranked goals. Cluster analysis is a statistical method that finds similar cases and groups them; results would identify workers who had similar self-reported training needs. The analysis was conducted in two stages. In the first stage, we used Ward's method to combine cases.[21] In this method, the variables are changed to z scores, and the distance between cases is the squared Euclidian distance. That is, the distance between two cases is computed by (1) calculating the difference between z scores for each variable, (2) squaring each difference, and (3) summing the squares. The lowest distance score is zero, which means that two people had the same score on all variables. Higher distance scores mean that people have scores that are quite different. Ward's method combines cases so that the sum of squares is a minimum; when the sum of squares is low, people are similar and belong in the same group. The number of clusters to retain is determined by inspection of the dendrogram and by the inverse scree plot.[22]

In the second stage of the cluster analysis, we used the k-means method. Unlike Ward's method, k-means is an it-erative process. After people are placed into groups, the method is used to identify people who do not fit well into their group. These people are placed into other groups, and the process continues until the best fit is obtained.[23] The mean values for a cluster are known as centroids, and the k-means method begins with k centroids, where k stands for a given number. The value of k and the value of the centroids came from the first stage in which Ward's method was used. The use of two stages is common in cluster analysis,[24] and k-means procedures usually outperform hierarchical methods when the results from a first-stage hierarchical method are used as start values.[25,26]

RESULTS

The ratings of confidence and need for training yielded similar results. People with a lower level of confidence for a goal tended to say that they felt a high need for training. The similarity can be seen by comparing the mean rating on confidence with the mean rating on need for training for each of the 38 goals. Using pairwise deletion of missing data, we calculated the correlation between the two means as $r = -0.87$. This high level of similarity suggests that ranking either confidence or need for training would give similar results. The Table lists the 10 top-ranked goals. For each of these 10 goals, the mean rating of perceived need for training was just over 3; the value 3 corresponds to "moderate need."

Values were missing on at least one of the 10 variables for 85 respondents. The people with missing data did not differ from those with complete data on any demographic variable; for example, they did not differ with regard to gender (χ^2 (1, $n=237$)=0.14; $p=0.71$); age (Wilcoxon $z=0.17$; $p=0.87$); or years of experience in public health (Wilcoxon $z=0.43$; $p=0.67$).

Ward's method was applied to the 180 people with complete data, and the results suggested that three clusters offer a good solution. The three centroids were used as the starting point in a k-means analysis, which classified people into one of the three groups. The Figure shows the results of the k-means analysis. The means for the top 10 tasks for the three groups are shown separately, along with 90% confidence intervals for the means. Group 1 ($n=33$) can be described as a *Low Rating* group. Workers in this group rated their need for training as low across all the tasks. Group 2 ($n=81$) can be called a *Moderate Rating* group. Workers in this group rated their need for training at a moderate level on most tasks. Group 3 ($n=66$) can be called a *High Rating* group, as workers in this group tended to report a high need for training for all of the 10 tasks.

The Figure suggests the presence of response sets,[27] i.e., inclinations to respond in a given way. The data suggest that some workers were set to rate their need for training as high, without respect to the given goal. For example, workers in the High Rating group consistently rated their need for training as high, with a mean rating of approximately 3.7 for each of the goals. The mean rating for the Moderate Rating group was approximately 3.0 for each goal, and in the Low Rating group, the mean rating was approximately 2.0 for each goal. The differences between groups are large compared to the differences across goals.
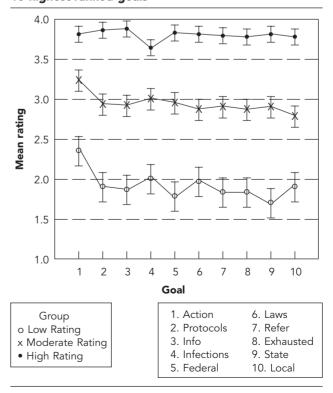
Table. Mean rating for the 10 highest-ranked goals (*N*=265 respondents)

Rank	Goal	n	Mean rating
1	Describe the appropriate action to take and procedures to follow if there is a suspected or actual emergency situation (outbreak, biological, environmental, etc.).	248	3.30
2	Understand the protocols for activating the Health Alert Network (HAN) system as appropriate to your job responsibilities.	225	3.13
3	Describe the protocols and/or public disclosure laws for releasing public information about health hazards to the community.	228	3.12
4	Maintain and use up-to-date knowledge of emerging or infectious diseases.	229	3.11
5	Understand your role in working with the following partners when responding to emergency situations: federal partners.	226	3.06
6	Locate and access current federal, state, and local laws/regulations/ordinances that protect the public's health and understand how they affect your role in response to a specific emergency situation.	242	3.05
7	Refer victims or response personnel to mental health professionals for critical incident stress counseling and management.	224	3.03
8	Understand when and how to refer victims or emergency response personnel to medical and mental health services when own agency's services are exhausted.	226	3.02
9	Understand your role in working with the following partners when responding to emergency situations: state partners.	230	3.02
10	Describe the role of state and local public health agencies in the delivery of community health services during an emergency situation.	244	3.01

DISCUSSION

This article reports the results of a pilot study that explored how to evaluate public health workers' competence for preparedness. To this end, the authors studied how staff members at a local public health department reported their training needs and whether the people rating those self-identified needs converged into identifiable clusters of people with similar needs. The main finding of this study was that the responses to the survey were influenced by response sets. Although the survey's intent was to measure specific training needs, the results suggested that responses were influenced by a general interest in training. That is, if a person was interested in training, he or she might report a high need for training in many areas. These results have important implications for future studies of preparedness in that they raise questions about the use of self-assessment surveys as measures of competence for preparedness.

One issue to address in interpreting the results of the present study is whether the three clusters represent patterns in the data, or whether the cluster analysis has imposed a pattern. Cluster analysis will impose a pattern even when data are random. A cursory look at the results shows that the three clusters are not artifacts. For example, if responses in the High Rating group were random, it would be unlikely that an individual would select 4 (i.e., high need for training) in response to all 10 variables. Because there are 10 variables with four response options, the probability of reporting all 4's by chance alone is $1/4^{10}$, which is a bit less than one in a million. Yet, 23 (13%) of 180 people selected 4 for all 10 goals. Thus, it is not plausible to maintain

Figure. Mean ratings by the three groups identified in the cluster analysis and 90% confidence intervals: perceived need for training to meet 10 highest-ranked goals

Group		
o Low Rating	1. Action	6. Laws
x Moderate Rating	2. Protocols	7. Refer
• High Rating	3. Info	8. Exhausted
	4. Infections	9. State
	5. Federal	10. Local

that the cluster analysis has imposed a pattern. Rather, a more plausible interpretation is that some people express a high need for training across a wide variety of tasks.

A second issue is that people who report a low need for training may be more knowledgeable than other workers. We did not measure knowledge directly, so we cannot describe the knowledge level of the Low Rating group. However, research has yet to show that self-assessment is a good predictor of objective knowledge.[9,10,13–19] Future research could address this question more directly by measuring both self-assessment and knowledge.

The response sets that emerged in this study could be important for future preparedness efforts. Three groups of workers emerged who may have differed in their general interest in training for preparedness. It is likely that the wording of the items and the wording of the response options influenced the emergence of these three groups. Therefore, these same groups may not be identified in other surveys with other response options. However, what is likely to generalize is the existence of individual differences in general interest in training. Program managers may need to keep these differences in mind when planning voluntary training programs.

What do these results suggest for future efforts to assess need for preparedness training? First, it is important to use caution when relying on generic goals as a means of assessment. The public health competencies for emergency response are phrased as generic goals,[8] and they are an excellent guide to developing more specific local plans. After these local plans are developed, then an assessment can focus on the workers' knowledge of and ability to carry out the local plan. This is not to criticize the value of the core competencies. Rather, we note that translating the competencies into useful survey items may require more attention than it has received in the past.

A second consideration is to avoid the use of self-assessment of knowledge. Morse recommends that the way to assess whether workers can carry out the local plan is to use drills and exercises.[5] We agree and add that success can also be measured by assessing the objective knowledge of the local plan. These types of measures—drills, exercises, and tests of knowledge—should be the outcome measures for assessing level of preparedness. The evidence does not support the idea that workers can self-assess their level of knowledge with enough accuracy to be useful in evaluating the training program.

These recommendations are consistent with the Kirkpatrick model,[28] one of the most widely used models to assess training, which can appropriately be applied to public health preparedness efforts.[29] Kirkpatrick suggests that programs can be evaluated at four levels. Level one (*reaction*) responses include opinions on how well the training program was organized, how much was learned, and whether the knowledge learned will be used on the job. At level two (*learning*), objective knowledge items with right and wrong answers can measure learning, as can drills and exercises. An outcome at level three (*behavior*) would be a change in behavior on the job, while an outcome at level four (*results*) would be improved health of the public.

Kirkpatrick notes that self-assessment is appropriate for level one but not for the higher levels. In the context of training for public health preparedness, the way to assess at level two is to measure knowledge and to conduct drills and exercises.

In summary, this study suggests caution in the use of generic goals alone to assess worker competence. A better approach might be to use the generic goals to develop a local plan, then use this more specific plan for assessment. Also, the use of self-assessment to measure knowledge may have serious drawbacks. Previous research has suggested that people tend to be poor judges of what they know and what they need to learn.[14–19] A better approach to evaluation might be to supplement self-assessment with objective measures, such as drills, exercises, and tests of knowledge.

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