

PROOF COPY ONLY**DO NOT DISTRIBUTE**

JEM

Using root cause analysis (RCA) to facilitate corrective actions, after action reports (AARs), and improvement plans

AQ:1

Ralph Renger, PhD, MEP
 Mary Davis, DrPH
 Brenda Granillo, MS

ABSTRACT

Root cause analysis (RCA) is methodology recommended by the Homeland Security Exercise and Evaluation Program (HSEEP) for examining why exercise objectives were not met and providing specific recommendations for corrective action. The consequence of not completing the RCA as required by HSEEP is significant. In the absence of a RCA arriving at the best corrective action is less likely. Despite its importance, there is research evidence from a Centers for Disease Control and Prevention study that the RCA is seldom completed. Several reasons are presented as to why the RCA is not completed including a lack of guidance as to how to conduct a RCA. An example of how to complete a RCA is provided followed by a discussion of the benefits of using the approach over traditional exercise debriefing methods. Reasons why there may be continued resistance to using RCA despite having the necessary facilitation skills and dedicated time are also discussed.

Key words: RCA, HSEEP, RCA and exercise evaluation

A key guiding principle of Homeland Security Exercise and Evaluation Program (HSEEP) is the exercise program management cycle (Figure 1). The exercise program management cycle consists of the following five steps: foundation, design and development, conduct, evaluation, and improvement planning. The concept is relatively straightforward: we need to learn from the exercises we conduct and make improvements to subsequent exercises. Evaluation is the step in which strengths and weaknesses of exercise are uncovered. Based on evaluation findings,

future exercises attempt to build on strengths and correct weaknesses. The cycle of planning, conducting, evaluating, and using lessons learned to plan future exercises results in continual improvement.^{1,2}

The focus of this article is on the evaluation and improvement planning phases of the program management cycle. Specific guidance on evaluation and improvement planning can be found in HSEEP volume III.³ One of the first steps in the exercise design and evaluation process is to define objectives.⁴ Objectives can be derived based on need arising from previous exercises or real life events as identified in after action reports (AARs) or mandated by sponsors. Once objectives are defined the exercise narrative, injects, and expected actions can be developed. Objectives should be specific, measurable, attainable, realistic, and time bound (SMART). It is the expected actions associated with the objectives that are then used to develop the exercise evaluation guidelines (EEGs).

The responsibility for completing EEGs lies with the lead evaluator and evaluation team. When completing the evaluation HSEEP states “. . . evaluators should record specific observations regarding what occurred; a root cause analysis (RCA) examining why events occurred; and, if necessary, specific recommendations for corrective action.”^{3(p4)} The purpose of the RCA is to pinpoint the reason why an expected action was not met. According to ref. 5, RCA is a structured approach to identify the real cause of a problem and to identify actions that will result in a permanent solution to that problem.

To be used effectively, RCA should be one component of a systematic quality improvement process that

DOI:10.5055/jem.2012.0000

*Journal of Emergency Management***PROOF COPY ONLY****DO NOT DISTRIBUTE**

PROOF COPY ONLY**DO NOT DISTRIBUTE**

Figure 1. The exercise program management cycle.

includes identifying a problem and potential solutions as well as implementing these solutions and determining if these solutions have the intended effect on improved practice.⁵ Quality improvement has been used effectively in police departments, healthcare, public health, and manufacturing to improve an organization's abilities to deliver services and meet customer needs.⁶⁻⁹ Public health agencies have used quality improvement to improve preparedness for pandemic influenza.⁹

The importance of identifying root causes of unmet objectives cannot be understated. Knowing the root cause is fundamental for understanding the necessary corrective actions, making recommendations for improvement, and reducing the likelihood that the problem will reoccur. The root causes and associated corrective actions should appear in the AAR. Despite the importance of RCA, it is rarely completed as part of HSEEP events. In a recent study, the Centers for Disease Control and Prevention requested AARs from several hundred of their grantees. Almost all AARs were incomplete and virtually none referenced root causes.¹⁰ The study also found that many of the corrective actions listed in the AARs were nonspecific and nonmeasurable.

The consequence of not completing the RCA as required by HSEEP is significant. In the absence of a RCA, arriving at the best and most targeted corrective action is less likely. For example, a common problem cited in AARs is communication failure. However, there are many reasons "why" communication may have failed. For example, communications may have failed due to equipment problems, and even more specifically dead batteries. Another reason may have been because there was a lack of understanding of the ICS communication protocol due to lack of training. Both root causes are plausible and both lead to very specific corrective actions and recommendations. However, when a RCA is not conducted and the problem is stated in general, higher order terms (ie, a communication problem), it is difficult to derive targeted corrective actions. This can lead to activity traps; corrective actions that feel right are implemented with fidelity, but on closer inspection do not target the root cause.¹¹

AQ:2

Based on the authors' experience and discussion at the 2012 Public Health Preparedness Summit, there are many possible reasons why a RCA is not completed.¹⁰ First, the RCA process takes time, making it impossible to conduct within the time frame of an exercise as is the case with EEGs. The HSEEP guidance recognizes this and recommends conducting the RCA after the exercise. However, the hotwash is seldom scheduled with enough time to complete a RCA.

A second challenge is the responsibility for completing the RCA falls on the lead evaluator. Using field notes and insights gathered during the hotwash, the lead evaluators may attempt to construct the RCA on their own. However, the lead evaluator is not necessarily a subject matter expert (SME), may not have the expertise to identify the root causes for failed objectives, or lack the training and therefore lack the self-efficacy to conduct the RCA.

Only two paragraphs in HSEEP Volume III are devoted to discussing RCA, but there is no description of the methodology or reference sources.³ RCA is discussed in the FEMA IS-130 course: Exercise Evaluation and Improvement Planning where the learner is provided a reference to the "staircase model" and an example as to how it is applied.¹² However, the example is best

PROOF COPY ONLY

Journal of Emergency Management
 Vol. 10, No. 3, September/October 2012
DO NOT DISTRIBUTE

described as deficient, not providing detail necessary to replicate the methodology.

Given these considerations, there are two purposes of this article. First, to illustrate how a RCA can be completed to evaluate unmet exercise objectives. Second, to illustrate the additional benefits of the RCA over traditional approaches to exercise debriefing. By so doing, the article hopes to increase the awareness, knowledge, and self-efficacy of lead evaluators to conduct RCA. This in turn will hopefully lead to more comprehensive AARs complete with meaningful corrective actions that can improve future exercise and real world response, saving lives and property.

METHOD

RCA is part of a collection of tools and approaches to improve quality and performance.⁵ It is based on a series of the following assumptions:

- RCA must be performed systematically and be backed up by data and evidence;
- data gathering and analysis must establish all potential known causal relationships between the problem, symptom of the problem, and true causes of the problem.

- there are potentially many root causes to a problem.
- potential solutions should be analyzed to determine if they will result in a permanent fix

RCA begins by identifying a problem of interest,^{13,11} In the context of exercise evaluation, the problem is an unmet objective. Thus, it is important for the lead evaluator to debrief with the evaluation team “before” the player hotwash, compare notes and observations, and identify unmet objectives: objectives for which the expected actions were not completed.³

The unmet objective is then presented to the players and controllers (hereinafter collectively referred to as SMEs). The lead evaluator must then spend time ensuring the SMEs have an understanding of the objective. If not, then the potential for significantly different root causes to be identified is high.^{14,15} This is problematic because different root causes will yield different corrective actions.

Once SMEs have a common understanding of the unmet objective, it is written on the right-hand side of a flipchart or white board (Figure 2, panel 1). A whiteboard is preferred because it offers more flexibility in

AQ:3

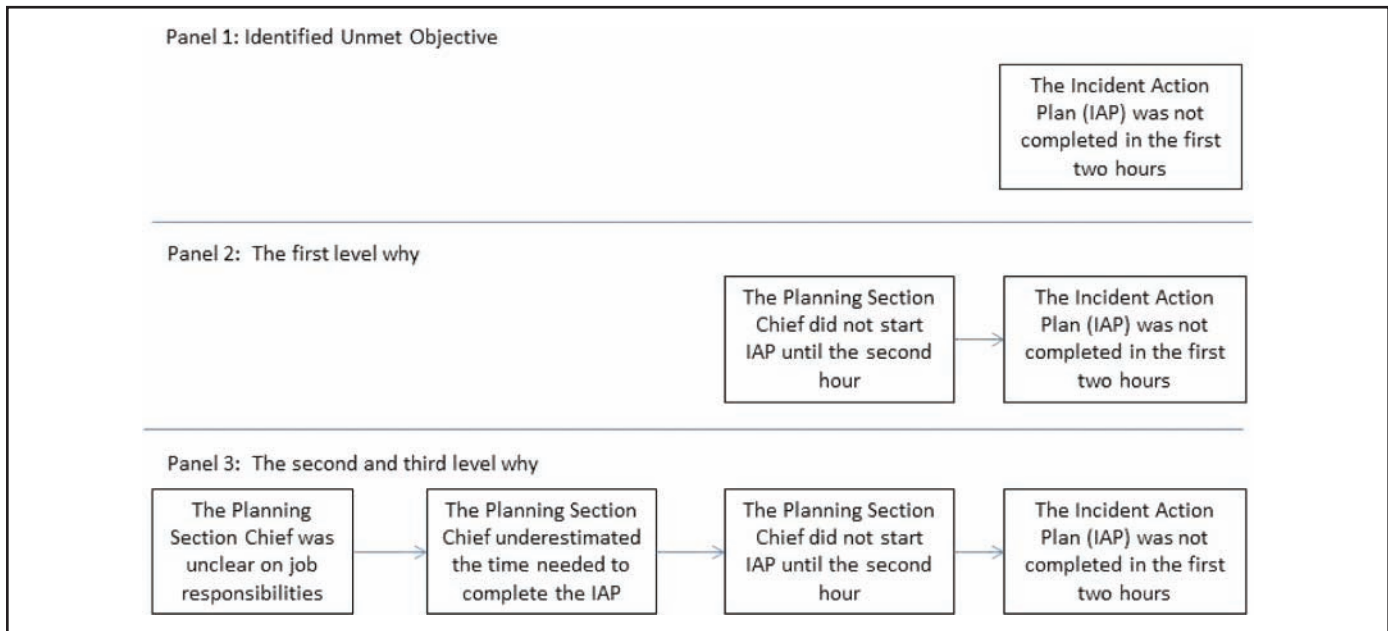


Figure 2. Developing a thread of logic using RCA.

PROOF COPY ONLY**DO NOT DISTRIBUTE**

making ongoing corrections based on SME feedback. PowerPoint displayed on a LED projector also works well. Placing the problem on the right-hand side is important because identified root causes will always precede the problem or will be to the left of the unmet objective.

The evaluator then begins by asking the SMEs for a reason why the objective was unmet. The SMEs response is placed to the left of the problem statement, as shown in Figure 2, panel 2. This response is referred to as an antecedent condition (AC). The evaluator must then check the logic of the evolving thread. This is done by using if-then statements^{14,11} For example, if the planning section chief did not start the Incident Action Plan (IAP) until the second hour, then the IAP was not completed in the first 2 hours. It is important to engage in the logic checking process for two reasons. First, problems in logic will be detected rather quickly and can be corrected so the rest of the process can proceed as intended. Second, it facilitates the SMEs' understanding of the RCA process. SMEs quickly grasp the process and purpose when it is made visual and the logic is tested.¹⁶ This helps them become more engaged and constructive. If problems in logic are detected, then the SMEs are consulted to resolve the issue. Checking the logic can result in the AC being changed or moved. This is why a whiteboard or using PowerPoint is

preferred. The need for a whiteboard or projector means the lead evaluator should identify a suitable debriefing location during the exercise planning phase.

Once the logic is validated the evaluator then asks the SMEs the second why question. This is shown in Figure 2, panel 3. Again the evolving thread of logic is tested using if-then statements. This process continues until the SMEs have identified the root cause. A common question by facilitators learning the RCA process is where to stop. There are a few rough guidelines. Ohno¹⁷ suggests a maximum of five whys are needed to identify a root cause. Another tip is to stop asking "why?" when the AC likely cannot be changed. For example, a small community may have an EOC which has too little operational space to be functional but because there are no other available buildings there is no solution to the problem.

Once a thread of logic has been exhausted, SMEs are then asked for another first level why. If-then statements are used to check logic, the second why is asked. The process continues until all the root causes are uncovered. A more complete RCA is shown in Figure 3. The process can take anywhere from 5 to 30 minutes depending on the complexity of the ACs of the unmet objective. For this reason, it is important for the evaluator schedule ample time for the hotwash: at least an hour but preferably a 2 hour window.

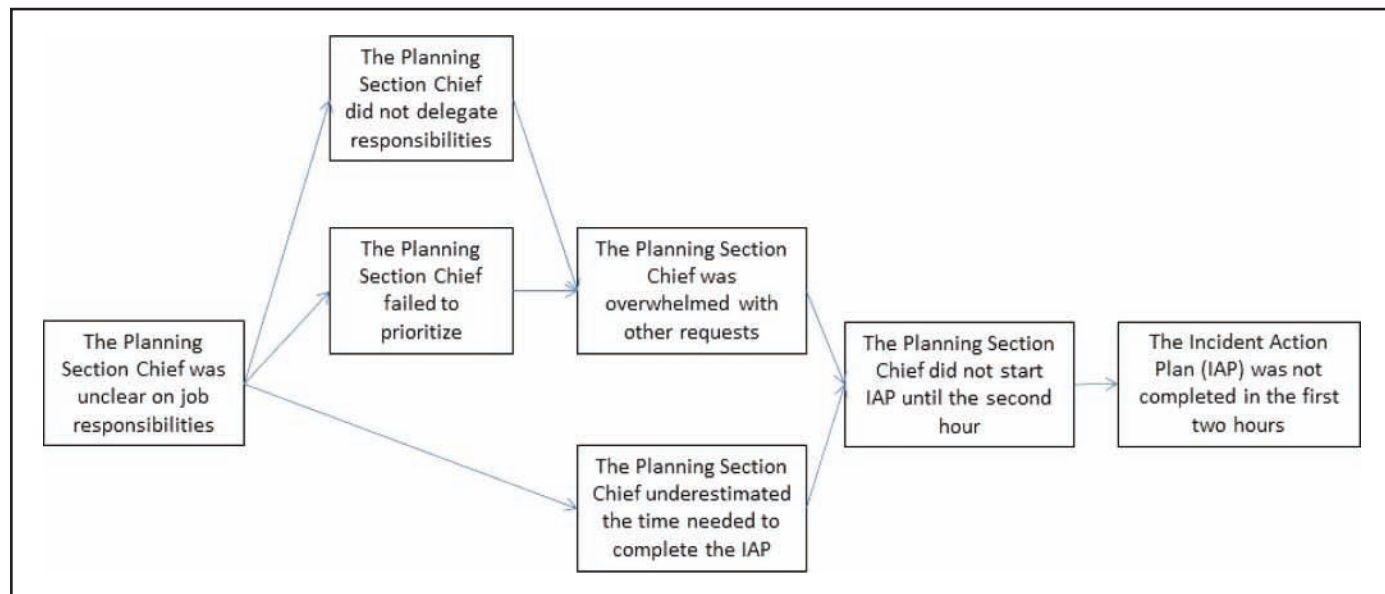


Figure 3. A sample RCA completed.

PROOF COPY ONLY

Journal of Emergency Management
 Vol. 10, No. 3, September/October 2012
DO NOT DISTRIBUTE

PROOF COPY ONLY**DO NOT DISTRIBUTE**

Corrective actions should be directed at the root cause(s) identified by the RCA. In Figure 3, there is only one root cause, so in this case where the corrective action should be directed is clear. This was deliberate to be able to illustrate the RCA process. However, it is common for many root causes to be identified: too many to correct within available resources or in time for the next exercise(s). HSEEP provides no guidance how to prioritize root causes and how to transition from root causes to corrective actions.

The evaluation literature proved extremely useful in filling the HSEEP guidance gap. Renger and Titcomb¹¹ use a three-step process called the ATM (Antecedent conditions, Targeting, and Measurement) approach. In step 1, the RCA map, like that shown in Figure 3 is developed. Step 2, Targeting provides a methodology for prioritizing root causes and ensuring corrective actions are appropriately aligned.

With respect to prioritization, criteria to cull root causes are first defined and framed as questions. For example, questions like “Are there the necessary resources to correct this Antecedent condition (AC) or root cause?” “Can this root cause be corrected before the next exercise?” and “Is correcting this root cause necessary for success to an upcoming exercise?” are asked using a stepwise hurdle approach. That is, the first question is applied to all root causes. Those for which the answer is “no” are eliminated from future consideration. The second question is only applied to the root causes surviving (ie, to which the answer was “yes”) the first question. The third question is only applied to root causes surviving both questions 1 and 2.

By only applying subsequent prioritization criteria to root causes surviving the previous question, fewer and fewer root causes are considered in each step, expediting the process. The prioritization process typically takes less than 45 minutes to complete.¹⁶ It is important to note that this step is completed neither after the exercise nor during the hotwash. It is completed with the design team after the exercise.

AQ:4

Renger and Titcomb’s¹¹ targeting step consists of two phases. The next phase is to ensure the corrective action(s) aligns with the prioritized AC or root cause. For example, referring back to Figure 3, there are

many possible corrective actions including replacing the planning section chief, providing training for the planning section chief, and/or making job action sheets readily available. The corrective actions chosen will depend on the demographics and contextual circumstances in which affected stakeholders operate. It is important to note explicitly identified root causes will better facilitate the identification of targeted (ie, properly aligned) corrective actions. This will help avoid potential activity traps.¹¹

The final step is Measurement. Here, indicators are sought to monitor whether the corrective actions have been implemented and lead to expected downstream changes that eventually correct the problem.

The AAR is especially useful in evaluating corrective actions because it requires a timeline for implementing them. The more challenging issue is identifying a measure to indicate whether the corrective action led to improvements in the root cause and subsequent ACs. In our example, the improved clarity of the planning section head’s job roles and ability to better delegate responsibilities might be evidenced by the presence of an ICS chart in the planning section with assigned names. Another possible indicator would be to monitor the number of requests coming from above and below the chain of command regarding clarification. These are only examples and other indicators may be more appropriate. The important consideration in selecting an indicator is that it has meaning for the intended audience and provides information on which to make decisions, which is the purpose of evaluation.¹⁸ RCA results in an explicit visual understanding of the issues, which leads to a more focused discussion and increased likelihood of defining indicators that have meaning for the intended audience.¹⁶

The evaluation purpose of RCA is quality improvement, not knowledge development or establishing merit and worth.¹⁹ This is why the TCL metrics for the preparedness measures are concrete, observable indicators.²⁰ Measures that possess established psychometric properties (ie, reliability and validity), necessary in the field of research evaluation where the purpose is knowledge development and to establish cause and effect are not required when the evaluation purpose is quality improvement.

PROOF COPY ONLY**DO NOT DISTRIBUTE**

PROOF COPY ONLY**DO NOT DISTRIBUTE****DISCUSSION**

RCA can be a powerful tool for developing corrective actions if conducted properly. Key points in successful implementation of RCA are that a) SMEs (players and controllers) have a common understanding of the unmet objective before beginning RCA, which is facilitated by ensuring objectives are SMART, b) unmet exercise objectives are first identified by comparing evaluator and controller notes and observations; of course to determine whether an objective was met requires establishing a standard of acceptability a priori,²¹ c) sufficient time is allowed to complete the RCA during the hotwash with SMEs, d) the lead evaluator is trained in how to conduct an RCA, e) the design team is engaged in targeting root causes and, f) the design team is challenged to justify the relationship between the root cause and the corrective action.

A traditional hotwash is an open ended discussion designed to gather players' observations about what did and did not go well and suggestions for improvement. Often the resulting feedback is a list of issues. What the list fails to do is recognize that many of the issues may be "related." That is, a single issue may precipitate a sequence of events because it is the root cause. The advantage of RCA is that it is a more structured approach with end results showing the relationship among issues, culminating in the identification of root causes. It is a root cause toward which the corrective action is aligned. This leads to a more efficient use of resources as one corrective action could lead to a sequence of issues being resolved.

A second advantage of RCA is a more meaningfully targeted discussion of corrective actions. Instead of an open-ended discussion around communication issues and what to do about it, RCA can help pinpoint the reason why the communication issue exists. Knowing why, or the root cause, allows for a targeted discussion and an increases likelihood of identifying an impactful corrective action.

The failure to implement RCA and report findings in the AAR has been documented,¹⁰ but the reasons why are not well understood. It was hypothesized one reason may be a lack of understanding on behalf of lead evaluators how to a) conduct a RCA, b) target priority root causes, and c) develop corrective

actions that align with these priorities. This article provides an example of how to conduct a RCA. It is important for the lead evaluators to remember they do not have to be a SME and complete the RCA in isolation, but rather to work with the other evaluators, players, and controllers immediately after the exercise to complete the RCA. To do this requires scheduling ample time to complete the RCA. Assuming there is enough time scheduled to complete the RCA, an additional challenge is maintaining SME motivation to remain after the exercise when motivation and energy may be low. One advantage of RCA is it is an engaging process, which increases the likelihood of maintaining SME interest.

HSEEP guidance is lacking regarding how to develop corrective actions from the RCA. The evaluation and quality improvement literature can be used to fill this gap. By developing meaningful questions based on prioritization criteria, it is possible for the design team to quickly cull root causes that can be corrected. As each possible corrective action is considered, it is important to justify how it addresses the root cause so the corrective action is appropriate and will produce expected improvements.

Even with better training and a sound methodology for conducting RCA and arriving at corrective actions, there may still be a reluctance to engage in RCA and report corrective actions in an AAR. For many agencies, identifying a root cause is synonymous with assigning blame.¹⁰ In this regard, the result of RCA is far more threatening than a typical hotwash, which results in a general discussion of strength and weaknesses. Even though FEMA recommends focusing the exercise evaluation on capabilities relevant to exercise objectives rather than producing a report card on individual performance,¹² the fact remains that it is difficult to disentangle the person from the capability. However, use of an RCA within a quality improvement approach focuses on processes rather than people.

A possible solution to this problem is to conduct individual RCA interviews and then combine the results into a single RCA summary map thus allowing each player a voice while simultaneously protecting his or her identity.^{11,16} The challenge with this option is the RCA must be completed after the exercise. AQ:5

PROOF COPY ONLY

Journal of Emergency Management
 Vol. 10, No. 3, September/October 2012
DO NOT DISTRIBUTE

PROOF COPY ONLY**DO NOT DISTRIBUTE**

This poses problems in terms of resources (ie, time) and player recall.

In summary, it is hoped that the illustrations provided herein will raise awareness among lead evaluators for the need to build their RCA facilitation skills and encourage them to use this process during the hot-wash in lieu of the current, unstructured, client satisfaction approach. If done properly, then the RCA can lay the foundation for better targeted corrective actions which can add significant value to the evaluation and improvement planning phases of exercise program management cycle. To ensure root causes are corrected, identified improvements must be systematically implemented and tested as part of a larger quality improvement process.⁵

Ralph Renger, PhD, MEP, Mountain West Preparedness and Emergency Response Learning Center, University of Arizona, Tuscon, Arizona.

Mary Davis, DrPH, North Carolina Institute for Public Health, University of North Carolina, Chapel Hill, North Carolina.

Brenda Granillo, MS, Mountain West Preparedness and Emergency Response Learning Center, University of Arizona, Tuscon, Arizona.

REFERENCES

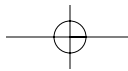
1. EPA: How to develop a multi-year training and exercise (T&E) plan: A tool for the water sector. 2011. Available at <http://water.epa.gov/infrastructure/watersecurity/emerplan/upload/epa816k11003.pdf>. Accessed January 15, 2012.
2. HSEEP: Homeland Security exercise and evaluation plan volume I: HSEEP overview and exercise program management. United States Department of Homeland Security, 2007. Available at <https://hseep.dhs.gov/support/VolumeI.pdf>. Accessed February 23, 2012.
3. HSEEP: Homeland Security exercise and evaluation plan volume III: Exercise Evaluation and Improvement Planning. United States Department of Homeland Security, 2007. Available at <https://hseep.dhs.gov/support/VolumeI.pdf>. Accessed February 23, 2012.
4. FEMA: Unit 4: Exercise Design Steps. 2012. Available at <http://training.fema.gov/emiweb/downloads/IS139Unit4>. Accessed July 4, 2012.
5. Duffy G, Moran J, Riley W: Solve the Real Problem Using Root Cause Analysis. Public Health Foundation White Paper. 2012.

Available at <http://www.phf.org/search/Results2.aspx/Results.aspx?k=root%20cause%20analysis>. Accessed April 27, 2012.

6. Beitsch L, Moran J, Duffy G: Why Don Berwick was almost right: How public health quality improvement operates in complex systems. *J Public Health Manag Pract.* 2012; 18(1): 70-73.
7. Lotstein D, Seid M, Ricci K, et al.: Using quality improvement methods to improve public health emergency preparedness: PRE-PARE for Pandemic Influenza. *Health Affairs.* 2008; 27(5): 328-339.
8. Riley W, Brewer R: Review and analysis of quality improvement techniques in police departments: Application for public health. *J Public Health Manag Pract.* 2009; 15(2): 139-149.
9. Seid M, Lotstein D, Williams V, et al. Quality improvement in public health emergency preparedness. *Ann Rev Public Health.* 2007; 28: 19-31.
10. Singleton CM, Rose D: Addressing root causes in after-action improvement plans (AAR/IP): Making the most of the AAR/IP to improve preparedness and quality improvement. Paper presented at the Public Health Preparedness Summit, Anaheim, CA, February 22, 2012.
11. Renger R, Titcomb A: A three-step approach to teaching logic models. *Am J Eval.* 2002; 23(4): 493-503.
12. FEMA: IS-130: Exercise Evaluation and Improvement Planning. 2012. Available at <http://emilms.fema.gov/IS130/EXEV0202000.htm>. Accessed April 28, 2012.
13. Cole G: Advancing the development and application of theory based evaluation in the practice of public health. *Am J Eval.* 1999; 20: 453-470.
14. Doggett AM: Root cause analysis: A framework for tool selection. *Am Soc Qual.* 2005; 12(4): 34-45.
15. De Grave WS, Boshuizen HPA, Schmidt HG: Problem-based learning: Cognitive and meta-cognitive processes during problem analysis. *Instr Sci.* 1996; 24(5): 321-341.
16. Renger R, Hurley C: From theory to practice: Lessons learned in the application of the ATM approach to developing logic models. *Eval Program Plann.* 2006; 29(2): 106-119.
17. Ohno T: *Toyota Production System*. Portland, OR: Productivity Press, 1988.
18. Preskill H, Boyle S: A multidisciplinary model of evaluation capacity building. *Am J Eval.* 2008; 29(4): 443-459.
19. Mark MM, Henry GT, Julnes G: *Evaluation: An Integrated Framework for Understanding, Guiding, and Improving Policies and Programs*. San Francisco, CA: Jossey Bass, 2000.
20. TCL: Target capability list: A companion to the national preparedness guidelines. United States Department of Homeland Security, 2007. Available at <http://www.fema.gov/pdf/government/training/tcl.pdf>. Accessed February 23, 2012.
21. Green LW, Kreuter MW: *Health Promotion Planning: An Educational and Ecological Approach*. 3rd ed. Mountain View: Mayfield, 1999.
22. Patton MQ: *Utilization-Focused Evaluation: The New Century Text*. 3rd ed. Thousand Oaks, CA: Sage, 1997.

AQ:6

AQ:7



PROOF COPY ONLY

DO NOT DISTRIBUTE

Author Queries

AQ1: Please confirm whether the change made to the title is OK.

AQ2: Please spell out ICS and LED in the text.

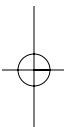
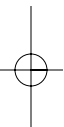
AQ3: Please check whether the edited sentence “The lead evaluator must then ...” conveys the intended meaning.

AQ4: Please check whether the edited sentence “It is important to note that ...” conveys the intended meaning.

AQ5: Please check whether the edited sentence “A possible solution to this problem ...” conveys the intended meaning.

AQ6: Please check whether all the URLs are active and current.

AQ7: Ref. 22 is not cited anywhere in the text. Please insert its citation at an appropriate place or delete it from the reference list.



PROOF COPY ONLY

DO NOT DISTRIBUTE

