Process Flow Mapping for Systems Improvement: Lessons Learned

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Abstract: *This article fills a gap in the evaluation literature by detailing how to conduct process flow mapping: a continuous quality improvement (CQI) method. The importance of process flow mapping and the steps required to complete the method are illustrated in the context of evaluating a cardiac care system. The article discusses several challenges and solutions in conducting process flow mapping, including (a) selecting appropriate subject matter experts, (b) mapping simultaneous processes, (c) terminating mapping, (d) integrating multiple process flow maps, and (e) validating process flow maps. The article concludes by reinforcing the importance for systematically documenting new evaluation methods for dissemination and utility purposes.*

Keywords: *continuous quality improvement, feedback mechanisms, process flow mapping, system evaluation*

Résumé : *L'article comble une lacune dans la littérature d'évaluation en décrivant la schématisation des processus opérationnels : une méthode d'amélioration continue de la qualité (ACQ). L'importance de la schématisation des processus opérationnels et les étapes de mise en application de la méthode sont illustrées dans le contexte d'un système de soins cardiaques. L'article discute de plusieurs défis et solutions en matière de schématisation des processus opérationnels, y compris a) le choix des bons experts, b) la schématisation de processus simultanés, c) la conclusion de la schématisation, d) l'intégration des schémas de processus opérationnels et e) la validation des schémas de processus opérationnels. L'article se termine en soulignant l'importance de documenter systématiquement les nouvelles méthodes d'évaluation à des fins de diffusion et d'utilisation.*

Mots clés : *amélioration continue de la qualité, mécanismes de rétroaction, schématisation des processus opérationnels, évaluation de systèmes*

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 Canadian Journal of Program Evaluation / La Revue canadienne d'évaluation de programme
31.1 (Spring / printemps), 109–121 doi: 10.3138/cjpe.267

DESCRIPTION OF CASE AND EVALUATION CONTEXT

Seven rural Midwestern states requested assistance in evaluating their respective cardiac care systems. A cardiac care system is complex, consisting of many subsystems including dispatch services, emergency medical services (EMS), critical access hospitals (CAHs), and tertiary care facilities (Eisenberg & Mengert, 2001; Renger, 2015). These subsystems together form the cardiac arrest chain of survival that is widely accepted as the national standard for system response (American Heart Association, 2015; Dumas et al., 2013; Eisenberg, 2013)

Why Was the Evaluation Conducted?

The challenge in evaluating this complex system is to provide the methods and data necessary to stakeholders to improve system efficiency and effectiveness (Blumenthal & Kilo, 1998; Renger, 2015). System efficiency and effectiveness are especially important in cardiac care because a patient's outcome is directly related to response timeliness. For a cardiac arrest, the likelihood of survival falls 7–10% for every minute of delay in CPR and defibrillation (Eisenberg, 2013). Within 10 minutes, clinical death will progress to irreversible biological death (Brouwer, Walker, Chapman, & Koster, 2012; Eisenberg, 2013).

We began by examining the methodologies for evaluating modern systems. There was only one published system evaluation theory (SET; Renger, 2015). SET is grounded in systems thinking and systems theory (Renger, 2015; Von Bertalanffy, 1969; Williams & Hummelbrunner, 2010). The first step in SET is to define the system, including the feedback mechanisms, attributes, and inputs (Kitano, 2002; Renger, 2015). The focus of this article is on the lessons learned as they pertain to one essential component of the evaluation approach: system feedback mechanisms.

Feedback mechanisms are a process by which information concerning the adequacy of the system, its operations, and its output are introduced into the system (Banathy, 1992). Functional system feedback mechanisms continually monitor the environment and provide timely and credible information for making decisions to improve efficiency (Flynn, Schroeder, & Sakakibara, 1994; Kitano, 2002; Renger, 2015). Specifically, decisions based on system feedback mechanisms often centre on whether to make changes to standard operating procedures (SOPs), or the processes, by which the system functions to meet its goal (Blumenthal & Kilo, 1998; Cook, 1998). Explicit system processes are necessary for system actors to understand what they are supposed to do to operate efficiently and effectively. SOPs provide system actors this necessary guidance. SET suggests using process models to define the SOP steps (Checkland & Poulter, 2010; Renger, 2015). Once the process is defined, ways to streamline it can then be determined, for example by identifying or removing redundant steps, replacing a step with another more efficient step, or perhaps by combining steps.

A review of the cardiac care literature yielded no all-encompassing process model. This was somewhat surprising given the commonalities of the response model and the sound research on effective cardiac care response (Eisenberg, 2013). The available cardiac care SOPs describe small, important parts of the overall process, for example the advanced cardiac life support (ACLS) protocol (Hazinski, 2010), but there was no protocol describing the steps from the start to the end of the response.

What Is the Value of Using Process Flow Mapping?

The continuous quality improvement (CQI) literature was helpful in understanding how to evaluate system processes (Øvretveit & Gustafson, 2002). CQI is defined as "the process-based, data-driven approach to improving the quality of a product or service" (Mittman & Salem-Schatz, 2012, p. 1). The premise of CQI is that there is always room for improving operations, processes, and activities to increase quality (Blumenthal & Kilo, 1998; Shortell, Bennett, & Byck, 1998). For processes to be improved upon, they must first be made explicit. One recommended method for defining system processes is process flow mapping. Process flow mapping is a way to systematically document an organizational process for improvement purposes (Snyder, Paulson, & McGrath, 2005). Process flow mapping uses qualitative interviews with subject matter experts (SMEs) and detailed observation reports to capture the system process so questions regarding its efficiencies can be identified. Through evaluation of the resulting process flow map (PFM), areas of waste, lag, and/or redundancy can be identified and systematic interventions, innovations, or other changes for process improvement can occur (Snyder et al., 2005). With respect to the cardiac care system, the results of eliminating such waste from the system's organizational processes are improved quality of care and patient health status.

Many software applications are available to assist in developing a PFM (Kibbe & Scoville, 1993). Understandably, for proprietary reasons, there are no accompanying guidelines explaining how to conduct process flow mapping. Available PFM guidelines generally describe the relationship between shapes and key elements of a PFM (e.g., a diamond is a decision point), and the "how-to manuals" focus on the mechanics of drawing the PFM. However, there is no guidance in the literature describing how to develop a PFM.

What Resources Are Needed to Conduct a PFM Interview?

The Leona M. and Harry B. Helmsley Charitable Trust provided necessary funding to conduct in-person process flow mapping with all cardiac care SMEs in this study. However, other evaluators choosing to conduct process flow mapping may not be as fortunate. The average PFM interview, based on 74 interviews completed with cardiac care system SMEs, lasts between 45 and 60 minutes. All interviews were face-to-face and usually completed at the SME's place of employment. Two evaluators conducted each process flow mapping interview: one to facilitate and map the process with the SME and another to make a written record of the conversation. A whiteboard was used to capture the evolving process. The use of the whiteboard and in-person interviews was deliberately chosen because of their documented utility in facilitating similar qualitative interviews (Renger & Hurley,

doi: 10.3138/cjpe.267 *CJPE* 31.1, 109–121

2006). Finally, a tripod-mounted video camera was used to record all PFM interviews to cross-validate the written record of the interview.

DESCRIPTION OF THE GENERAL CHALLENGE AND HOW IT IMPEDES THE EVALUATION PROCESS

A major challenge was the lack of available guidance regarding how to conduct process flow mapping. Without such guidance, it was difficult to establish a reliable and valid representation of the system processes. Without an explicit understanding of the system processes, the evaluation of system feedback mechanism was extremely challenging, if not meaningless (Blumenthal & Kilo, 1998; Renger, 2015). To address this challenge and introduce consistency in documenting system processes, we drafted a training manual. The training manual was then continually revised after each of the 74 interviews. Ongoing revision of the training manual is considered part of the evaluation team's internal quality improvement process; as new situations are encountered or better methods are identified, the manual is adjusted.

We describe below the challenges and solutions associated with six essential elements of completing a PFM interview. These are detailed in the training manual. Readers interested in receiving a complete manual free of charge may do so by contacting the first author with her/his request.

SPECIFIC CHALLENGES AND HOW THEY WERE ADDRESSED

Selecting SMEs for the Process Flow Mapping Interview

The process begins by first identifying subject matter experts with whom to conduct process flow mapping. The cardiac care system consists of many professionals working at different levels within many subsystems. As evaluators without substantive cardiac care content expertise, we found it difficult to select appropriate SMEs. To address this obstacle and improve SME participation, the literature suggests relying on leadership to identify key SMEs (Patton, 2008; Ryals & Davies, 2010). Therefore, leadership in the states participating in the study helped identify and introduce our evaluation team to SMEs. We provided leadership with talking points to explain the aims of the evaluation project in nontechnical and meaningful terms. As a result of using state leadership, 44 of 45 of the identified SMEs agreed to participate in the PFM interviews. This nearly perfect response rate is a testament to the importance of leadership in ensuring the success of any system initiative (Patton, 2008; Renger, 2015).

One important consideration in selecting SMEs is the utility of the resulting PFM (Patton 2008; Sanders, 1994). Our experience and findings in conducting process flow mapping across the cardiac care response systems for the seven states concluded that the processes are quite similar. However, leadership and SMEs in individual states possessed a strong belief that there were substantive regional differences. Therefore, it was necessary to engage each state in process flow mapping to ensure the utility of the resulting processes.

Training Evaluation Team Members to Use the PFM Manual

All trainees were first required to read the PFM manual as well as view videoed PFM interviews. Trainees then accompanied a trained evaluator to a PFM interview. The initial role assigned to trainees was to assist in writing the narrative associated with the member check (Renger & Bourdeau, 2004). After completing a PFM, the video recording was reviewed with the experienced facilitator, who pointed out key aspects to conducting a successful interview. Once the trainee felt comfortable, usually after observing 3–4 interviews, he/she assumed the lead facilitator role and was supported by the trained evaluator. Following each interview, the trainee and trainer reviewed the video recording together to identify areas of improvement.

Conducting the PFM Interview

Following the system theory principles upon which SET is derived, each PFM interview began by establishing the system boundaries (Renger, 2015; Williams and Hummelbrunner, 2010). Boundaries are defined as the parameters that limit the extent of the system. They may be physical or conceptual (Ericson, 2011). With this starting point, SMEs are first asked, “What happens next?” The response is written below the first boundary and connected with an arrow (see Figure 1). This exchange repeats until reaching the end system boundary. Documenting the visual map on the whiteboard helps the SME understand the evolving PFM methodology (Renger & Hurley, 2006). It also assists the facilitator and SME in tracking the process flow. Taking a picture of the finalized PFM is a cost-effective and efficient way to electronically save this valuable information.

One challenge was the SME’s ability to recall all the process steps. To address this challenge we (a) sent a pre-interview briefing letter to SMEs specifically asking them to prepare to walk through their process and to have any related policies and protocols with them, and (b) asked whether anything happens between the documented steps before moving onto the next step. This additional question afforded the SME the opportunity to reflect on their process and identify potential process gaps (see Figure 2).

One problem with asking “What’s next?” is that it lends itself to a linear process. However, many system processes are not linear; decision points and simultaneous processes often need documenting. To address this challenge and maintain the fluidity of the PFM interview it is best to first complete “no” branches of decision points, as they tend to have less steps with which they are associated or often loop back to a previous point in the PFM (see Figure 3). After “no” branches are completed, it is best to then complete the “yes” branches. Completing the process flow for one branch at a time, rather than working on simultaneous processes (e.g., page second crew), also streamlines the interview process by focusing the SME’s thought processes. In addition, it is helpful to read the map back to the SME. Often, having their own process read back helps the SME identify process steps, decision points, and subsequent branches that may have been initially overlooked.

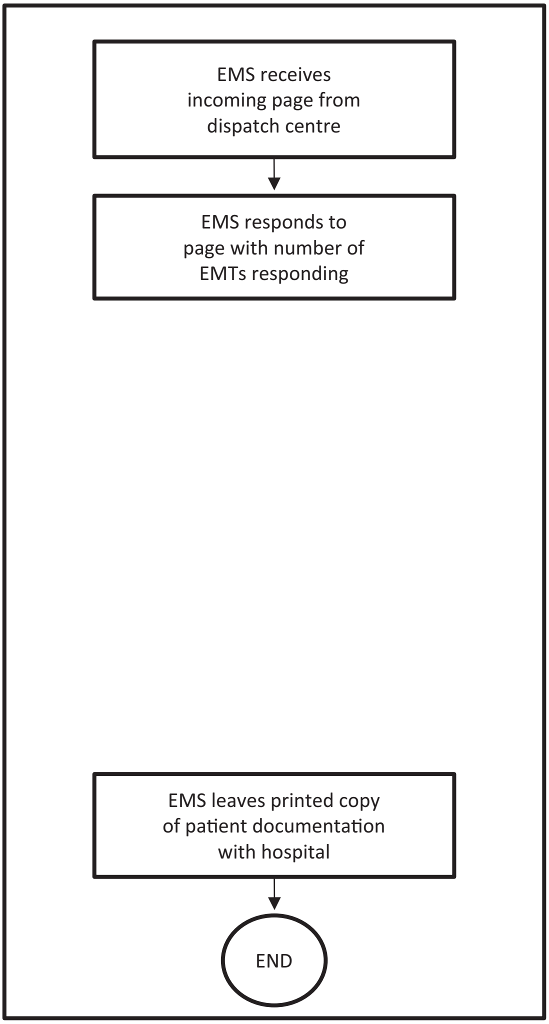

Figure 1. Map with beginning and ending boundaries, and first step of process linked.

Determining How Many PFM Interviews to Conduct

Conducting in-person PFM interviews is costly. Therefore, knowing when to stop conducting interviews is important. Leaning on the qualitative methods literature and the concept of saturation helped in knowing when to stop. One rule of thumb is to stop interviewing when less than 5% of information in an interview is new compared to the last PFM interview (Coskun, Akande, & Renger, 2012; Renger & Hurley, 2006). When the saturation point is not met and more SMEs are needed,

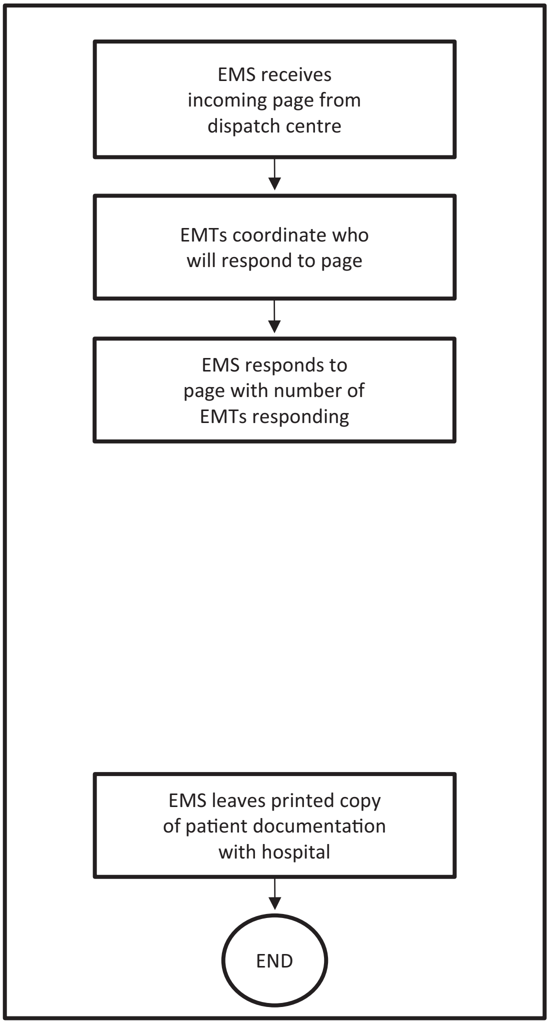

Figure 2. Filling in potential process gaps by asking "Did anything happen between these steps?"

a snowball sampling technique—that is, asking subject matter experts post-interview to identify additional subject matter experts—is effective (Goodman, 1961).

The average cost (based on the 74 PFM interviews completed) per PFM interview was approximately US $300. This estimate includes the preparation, interview, travel, and follow-up time. Depending on the scope of the project, conducting PFMs until reaching the 5% saturation point may be cost-prohibitive. This financial barrier was mitigated through strategic logistical planning and

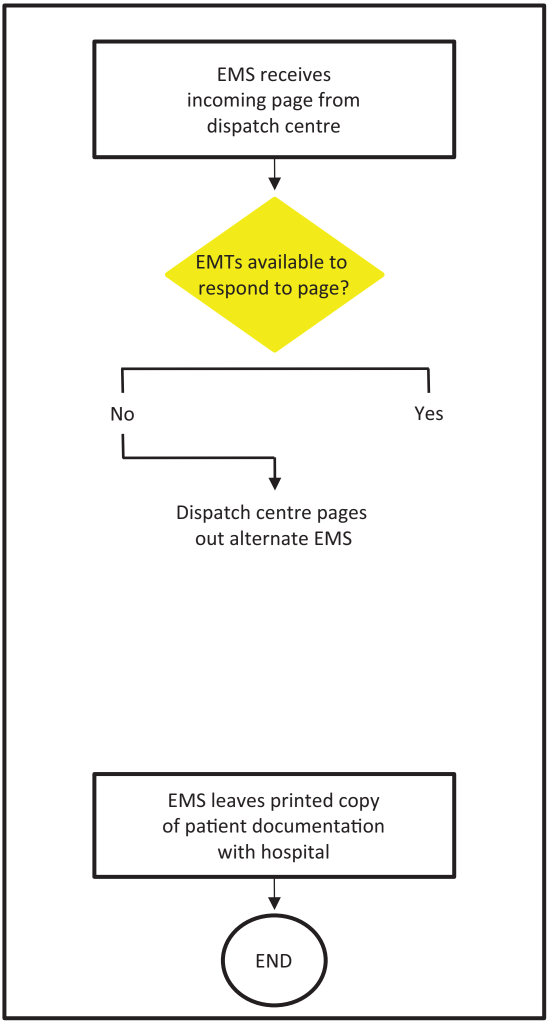

Figure 3. Dealing with decision points in process flow mapping.

considering cost of travel and staff salaries. Costs were offset by sending one staff member rather than two to complete some of the mapping. If using only one staff member, then it was critical to video the interview.

Integrating PFM Interviews

Process flow maps are useful at an individual or agency level by helping SMEs make tacitly understood processes explicit. However, developing a representative model (e.g., at the state level) was more challenging because of the need to integrate individual PFM interviews. One useful method for integrating individual interviews was to work from a foundation, or template, and then systematically compare each interview to that template for new information (Renger & Hurley, 2006). To do this, each evaluation team member rated the PFM interview on a scale from 1 (a poor-quality interview) to 5 (a high-quality interview). The PFMs with greater detail and breakdown of steps received a higher rating. The highest rated PFM interview became the foundation to which to compare subsequent PFM interviews.

Using the template, individual PFMs were integrated one at a time, checking each process step to see whether the process deviated, was similar, or remained the same. Areas where the process deviated were highlighted for comparison with subsequent maps. Although the template map was chosen based on highest level of detail, this did not mean it necessarily best represented the overall process. Therefore, if the majority of maps being integrated disagreed with the template map, then the process step was changed for the integrated map. Integrating maps is only recommended for comparing standardized and clearly defined processes (e.g., medical processes).

Validating the PFMs

Validating PFM interviews occurred at two levels. At an individual level each SME was sent a member check (Renger & Bourdeau, 2004). The member check consisted of a short narrative highlighting the major process steps accompanied by the process flow map. SMEs were asked to provide feedback. Of the 74 member checks, 72 provided feedback. Only validated PFMs were integrated.

The challenge is that the integrated PFM must represent the values and be meaningful to all system stakeholders, not just the SMEs participating in the process flow mapping (Patton, 2008). The fact is that often fewer than 10 SME interviews were needed to reach saturation. However, while economical and valid, this small sample posed problems for general acceptance by a wider audience.

To address this issue we developed a web portal to solicit broader input and validation of the integrated PFM. The web portal promotes interaction among stakeholders and facilitates dialogue in a convenient, cost-effective way. The web portal also served several other important purposes. First, because the work flow process is subject to change (e.g., to new recommendations based on research from the American Heart Association), the web portal maintains a pulse on these changing environmental factors to ensure the system model remains current and accurate. Features of the portal include the ability of visitors to comment on a static PFM or to interactively manipulate the PFM to better reflect his/her vision of the process flow. Visitors can view each other's comments in an effort to stimulate ideas and discussion, but they cannot overwrite previous feedback. Second, the portal allows interested stakeholders to provide input, a philosophy consistent with systems perspectives (Williams & Hummelbrunner, 2010). Third, the portal promotes transparency and builds trust among stakeholders. Finally, the portal closes the feedback loop with respect to the PFM process, demonstrating to stakeholders their input was being used for system improvements (Renger, 2015).

Information technology expertise was needed to build and maintain the web portal. This added cost to the evaluation. Synthesizing multiple texts and diagrams into an interactive map was not easy, and the web portal required multiple drafts before launch. Further, continuous information technology expertise and assistance was needed to ensure ongoing functionality.

Feedback from the web portal is overwhelmingly positive. Stakeholders engaging with the site expressed appreciation for a transparent and collaborative process. Further, presenting the synthesized information in real time assured leadership and system stakeholders that the comprehensive integrated PFM accurately reflected subsystem processes.

What Systemic Issues Should the Evaluation Community Address?

Attention to evaluating systems evaluation is growing (Renger, 2015). This is not the same as using systems thinking and systems theory to augment program evaluation (Renger, 2015). We used SET to guide our evaluation. A first key step in SET is defining the system (Renger, 2015). This includes more than just defining the boundaries and subsystems (Renger, 2015; Williams & Hummelbrunner, 2010); it also includes detailing the feedback mechanisms and system processes underlying them. Process flow mapping is a valuable tool to assist evaluators in meeting this goal. However, there is very little published material on how to facilitate a PFM interview. As a result of our work, we now have available a detailed PFM training manual available at no cost.

As evaluators proceed in advancing systems evaluation, they will undoubtedly uncover the need to develop new methods (Renger, 2015). Many of these methods, such as process flow mapping for CQI purposes, must be "simplified techniques—that are accessible to employees without an advanced education—for applying scientific approaches to the improvement of daily work processes" (Blumenthal & Kilo, 1998, p. 626). The need for mainstreaming measures is especially true when evaluating systems in which the sheer scope of the evaluation dictates the need for system actors to contribute to the evaluation (Renger, 2015). Therefore, it is important to encourage evaluators to document new methods in simple, clear terms. In addition, engaging in the process of documenting methods as they are being developed allows evaluators to reflect on their process and keep an eye toward improvement. As Jewiss and Clark-Keefe (2007) acknowledge, disciplined reflective process can help guide an exploration of subjectivity, monitor against bias, and prevent a variety of ethical and practical dilemmas. While the documentation may be a living document and subject to revision, the practice of recording processes supports reflexivity, promotes knowledge transfer, and fosters a culture of documentation.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. Jirina Foltysova, Mr. Tom Nehring, and Ms. Jessica Renger for their support and contributions to this manuscript.

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doi: 10.3138/cjpe.267