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RESEARCH ARTICLE

Patient Safety and Public Heath

Development of a Measure of Patient Safety Event Learning Responses

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Objective. To define patient safety event (PSE) learning response and to provide preliminary validation of a measure of PSE learning response.
Data Sources. Ten focus groups with front-line staff and managers, an expert panel, and cross-sectional survey data from patient safety officers in 54 general acute hospitals.
Study Design. A mixed methods study to define a measure of learning responses to patient safety failures that is rooted in theory, expert knowledge, and organizational practice realities.
Extraction Methods. Learning response items developed from the literature were modified and validated in front-line staff and manager focus groups and by an expert panel and second group of external experts. Actual learning responses gleaned from survey data were examined using exploratory factor analyses and reliability analysis.
Principal Findings. Unique learning response items were identified for minor, moderate, major events, and major near misses by an expert panel. A two-factor model of major event learning response was identified (factor 1 = event analysis, factor 2 = dissemination/communication of learnings). Organizations engage in greater learning responses following major events than less severe events and, for major events, organizations engage in more factor 1 responses than factor 2 learning responses.
Conclusions. Eleven to 13 items can measure learning responses to PSEs of differing severity. The items are feasible, grounded in theory, and reflect expert opinion as well as practice setting realities. The items have the potential for use to assess current practice in organizations and set future improvement goals.

Key Words. Patient safety events, incidents, learning from errors, adverse events, near misses

Patient safety events (PSEs) will persist in health care (Gaba 1994). We need, therefore, to understand these events and to learn from them (Kohn, Corrigan, and Donaldson 1999; Vincent et al. 2000; Etchells and Bernstein 2001). Recent organizational literature suggests that individuals and organizations can draw from their own and others' failure experiences to learn about what

aspects of their processes or operations to adopt, modify, or avoid (Haunschild and Sullivan 2002; Chuang and Baum 2003; Kim and Miner 2007). Although learning from patient safety (PS) failures is easier said than done in health care (Edmondson 1996) due to the complexity of health care organizations (Plsek and Greenhalgh 2001) and to cultural traditions where secrecy, legal protection, and strong authority gradients prevail (Walshe and Shortell 2004), analysis of failures has been shown to improve performance at the individual level (Ellis, Mendel, and Nir 2006).

Outside of health care, most studies of organization-level learning from failure look at whether organizations change their behavior in response to failure and the dependent variables are always failure/accident rates or costs (e.g., annual number of automotive recalls [Haunschild and Rhee 2004], bank closure rates [Kim and Miner 2007], airline accident/incident rates [Haunschild and Sullivan 2002], and rail accident costs per operating mile [Baum and Dahlin 2007]). In health care, failure *events* are not as easily defined and measured (Sutcliffe 2004; Ginsburg et al. 2005; Pronovost, Miller, and Wachter 2006) because they are underreported (Lawton and Parker 2002; Greenberg 2009), have relatively low base rates (Rivard, Rosen, and Carroll 2006), and are easily confounded. This makes it useful to focus on more upstream learning processes as we try to measure learning from PS failure events. Moreover, as March and Sutton (1999) and others (Greenberg 2009) contend, using performance as the sole measure of learning runs the risk of missing out on important opportunities to identify and understand the micro-processes that contribute to learning outcomes. The health care literature is, however, relatively silent on the detailed *processes* of such learning (Carmeli 2007), although some case examples of how learning is taking place in the context of PS do exist (e.g., Sirio et al. 2003). Only one recent paper was found in the literature briefly describing a survey the authors developed for the purpose of assessing perceptions of incident learning ability within their own organization (Cooke, Dunscombe, and Lee 2007).

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Achieving an understanding of the critical processes involved in learning from PS failures, and being able to measure the processes of learning from failure, are important steps in enhancing our ability to learn from PSEs. The objective of this mixed methods study is to define and provide preliminary validation of a measure of PSE learning response. PSEs include adverse events[1] and near misses.[2] We focus on these two particular forms of failure in PS, as they provide substantial learning opportunities (Handler et al. 2000).

While PSE learning responses can take place at the level of the individual provider, the team or patient care unit, as well as the organization, in this paper we draw on the broader organizational literature and focus on organization-level PSE learning responses. Sasou and Reason (1999) proposed that learning responses include (1) identification of PSEs, (2) analysis of their causes, and (3) taking of appropriate corrective action. This conceptualization of learning from failure is consistent with Argote's (1999) definition of learning in the broader organizational literature and with double-loop learning (Argyris and Schon 1978). Most of the theoretical (e.g., Cannon and Edmondson 2005; Cooke and Rohleder 2006) and empirical literature (e.g., Tucker and Edmondson 2003; Carmeli 2007; Cooke, Dunscombe, and Lee 2007; Carmeli and Schaubroeck 2008) on failure-induced learning processes inside and outside of health care adheres to a similar definition.

Methods

A measure of PSE learning response at the organizational level was developed using a mixed methods approach. First, a literature review was conducted to identify a list of responses that experts suggest should follow PSEs in order to promote learning. Second, focus groups were used to ensure the resulting list of learning responses was grounded in practice. Third, an expert panel was convened followed by use of a second group of experts, with each group further validating the list of learning responses. Fourth, the final list was used to develop a questionnaire that was administered by mail to a sample of PS officers in order to do a preliminary examination of the factor structure and reliability of the proposed measure.

Development of Initial List of Learning Responses

In 2004, the peer-reviewed and gray PS literature were searched to identify a preliminary list of actions in which organizations could engage in response to PSEs in order to promote learning.

In Fall 2005, 10 focus groups (five with front-line nursing and pharmacy staff and five with patient care managers and PS officers) regarding the types of PSEs that were meaningful to front-line providers and managers in acute care settings were being conducted as part of another phase of the study reported here. To further the current paper's objective, these focus group participants spent the last half-hour describing things that happen following PSEs in their organization. These data were analyzed to identify common learning responses that were absent from the initial list developed from the literature. See Ginsburg et al. (2009a) for details of the focus group methodology.

Expert Panel Procedures

A modified nominal group technique (expert panel) was used to harness the insights of a diverse group of experts (Jones and Hunter 1995) regarding the most appropriate PSE learning responses. A panel of eight individuals with academic, quality improvement, or clinical training and who have special expertise in PS and/or failure-induced learning was convened in March 2006.[3] Panelists were identified by the study authors and the senior patient safety expert (P. G. N.) in particular. All have numerous years of experience in PS or failure-induced learning. Before the face-to-face panel meeting, panelists were sent the list of learning responses developed from the literature and focus groups. They were asked to focus on things a single organization might reasonably do to learn from PSEs and to rate the importance of each item (*not at all important*, *somewhat important*, and *very important*), taking both feasibility and effectiveness into account. They were also invited to add additional learning responses they felt were important but missing from the list. Finally, recognizing that some learning responses will be more or less appropriate for different kinds of PSEs, panelists were asked to rate the importance of each learning response separately for four types of PSEs (*major events*, *major near misses*, *moderate events*, and *minor events*). We have defined these events elsewhere (Ginsburg et al. 2009a).

The face-to-face meeting focused on the four types of PSEs individually. For each type of PSE reasons for disagreements on the prepanel exercise were explored, items were clarified and modified and new items were considered. Following discussion of each PSE, panelists engaged in a voting exercise where they were given six dots to allocate to those items they saw as most important for achieving learning following that type of PSE. An individual could not allocate more than two dots to any one item. Following the expert panel, a list of learning response items that received two dots or more (by type

of PSE) was mailed out to six other external experts[3] in the field of PS for further feedback.

Mail Questionnaire Procedures and Sample

For each type of PSE, learning response items that received two dots or more by the expert panel were turned into questionnaire format (e.g., item (g) in Table 1 became item 11: "A multidisciplinary review team in our hospital helps units with the analysis of these kinds of events"). Four-point frequency-based Likert-type responses were used. The questionnaire was pilot tested for face validity and clarity with a convenience sample of six patient safety officers (PSOs) not included in the subsequent study sample. Following minor revisions, mail surveys were sent to PSOs in 69/118 (58 percent) general acute care hospitals in the Canadian province of Ontario (beforehand the CEOs in all 118 general acute hospitals in the province were invited to have their organization participate in the study and 69 of them agreed).

Questionnaire data for each of the four types of PSEs were separately subjected to exploratory factor analysis (EFA) and internal consistency reliability analysis. While factor solutions with high communalities (item communalities reflect the proportion of the variance of a variable that is accounted for by the common factors) and strong loadings have been shown to produce high pattern accuracy with small samples such as ours in a recent Monte Carlo study (Hogarty et al. 2005), we treat these analyses as preliminary given that only factor loadings >0.70 are significant with this sample size using critical values outlined by Stevens (1992). Differences in learning responses across PSE types were compared using paired analyses (paired *t*-test and repeated measures ANOVA).[4]

Results

Literature and Focus Groups

Table 1 lists 16 different learning responses that were found in our literature search. Overall, the focus group data on response-related activities were consistent with these items. However, three additional learning responses, included at the bottom of Table 1, were gleaned from focus group data. These reflect the importance of (1) follow-up regarding incidents so that possible solutions or corrective actions can be taken; (2) putting interim or temporary "fixes" in place while formal event investigation and change processes take place; and (3) using multiple formal and informal communication strategies to

Table 1: Learning Responses Identified from the Literature

Learning Response	*Source*
(a) PSEs can be investigated at mortality and morbidity conferences	Hobgood, Ma, and Swart (2000)
(b) PSEs should be submitted to an anonymous incident reporting system in an organization (e.g., a reporting system where no identifying information is included within an incident report)	Department of Health (2000), Leape et al. (1998), Runciman, Merry, and Smith (2001)
(c) PSEs should be submitted to a *confidential* incident reporting system in an organization (e.g., a reporting system which, though confidential requires some identifying information with each incident report)	Runciman and Moller (2001)
(d) Incident investigations are carried out which ask specifically about factors contributing to the incident, factors minimizing the incident, and suggested corrective strategies	Department of Health (2000), Runciman and Moller (2001)
(e) When PS events are investigated, the focus is on root causes and system/latent factors rather than immediate causes such as individuals' mistakes	Department of Health (2000), Leape (1994), Reason (1990)
(f) There is a requirement (policy) to conduct root cause analysis (RCA) of PS incidents to uncover latent errors underlying the incident	Eagle, Davies, and Reason (1992), Leape et al. (1998), Wald and Shojania (2001)
(g) An interdisciplinary expert review team helps with the analysis of PS incidents	Leape et al. (1998), Wald and Shojania (2001)
(h) System changes to prevent future PSEs are made as a result of RCA	Wald and Shojania (2001)
(i) Data about PS incidents are collated and analyzed by people in the organization with appropriate statistical skills	Runciman and Moller (2001)
(j) Reporting system data are reviewed and aggregated by unit, department, or other meaningful group	Runciman and Moller (2001)
(k) Rapid, useful, intelligible feedback on the frequency of incidents is provided to reporting units	Department of Health (2000), Runciman and Moller (2001)
(l) Organizations share and have access to incident data from other organizations	Runciman and Moller (2001)
(m) Use of reward and/or recognition programs for front-line providers and teams who identify PSEs and improve processes accordingly	Leape et al. (1998), Runciman and Moller (2001)
(n) Organizations are investing in bar coding and other medication systems (physician	Bates (1999), Berwick (2002), Evans et al. (1998)

continued

Table 1. *Continued*

Learning Response	*Source*
computer order entry) shown to reduce adverse drug events	
(o) Organizations routinely use failure mode and effects analysis	Berwick (2002)
(p) The most appropriate provider discloses information about an incident to the patient and/or family	Gallagher et al. (2003)
(q) Importance of organizations following up with staff regarding incidents they report so staff can discuss the event and possible solutions or corrective actions that can be taken	Focus group data
(r) Putting interim or temporary "fixes" in place while formal event investigation and change processes take place	Focus group data
(s) Using multiple formal and informal communication strategies to ensure things that are learned from PSEs are properly communicated to other relevant staff members	Focus group data

PS, patient safety; PSE, patient safety events.

ensure things that are learned from PSEs are properly disseminated to relevant staff.

Expert Panel

For each of the four types of PSEs (minor, moderate, major events, and major near misses), the voting process led to the identification of 11–13 learning responses that panelists deemed to be feasible and important (see Table 2). The item numbering format is indicative of an item's origin—plain numeric items are from either (a) the original list developed from the literature (e.g. item 11), (b) the focus groups (e.g. item 17, item 22), or (c) are items panelists suggested should be added in the prepanel mail exercise (e.g., item 21). Items preceded by an "N" are new items that emerged during the expert panel process and items followed by an "R" are items that were *substantially* revised by the panel. Table 2 shows that while certain items were identified as being important for all four types of PSEs (e.g., item 26: "Procedural changes resulting from event investigation are followed up on regular bases," item N1: "Individuals involved in the event contribute to the understanding and

Table 2: Important Learning Response Items That Emerged from the Expert Panel Process

Learning Response Item	*Items That Met the Importance Threshold (e.g., Received ≥ 2 Votes) (√)*			
	Minor Event	*Moderate Event*	*Major Near Miss*	*Major Event*
1. We report these events to a reporting system that is external to the hospital			√	
2R We report these events to a reporting system that is internal to the hospital			√	
5. We have dedicated "patient safety rounds" where these events are discussed	√		√	
7R. There is a systematic approach to identify strategies to reduce re-occurrence of these events	√	√	√	
9R. Discussion around these events focuses mainly on system-related factors, rather than focusing on the individual(s) most responsible for the event		√	√	√
10R. There is a systematic approach in our organization used to help identify *what* occurred, *how* and *why* it happened	√	√	√	√
11. A multidisciplinary review team in our hospital helps units with the analysis of these kinds of events			√	√
12. Information about these events is collated and analyzed by people with appropriate knowledge and skills to look for solutions to reduce re-occurrence of these events	√	√		
15. Information about these events is shared with staff informally within the unit (e.g., through personal communications, emails, communication books, bulletin boards)	√			√
17. Timely responses are provided to those who report these events (e.g., to discuss these events, possible solutions, etc.)	√			
19. If there appear to be trends in these events (e.g., other events with similarities), information about the causes and resolutions are disseminated in all relevant areas of the hospital	√	√		
21. These events, and a description of changes/ improvements made following them, are included in regular reports to our Board				√
22. Things that are learned from these events are communicated to staff using more than one method (e.g., communication book, in-services, unit rounds, emails) and/or at *several* times so all staff hear about it	√		√	√

continued

Table 2. *Continued*

Learning Response Item	*Items That Met the Importance Threshold (e.g., Received ≥ 2 Votes) (√)*			
	Minor Event	*Moderate Event*	*Major Near Miss*	*Major Event*
23. A formal process for disclosure of events to patients/families is followed and this process includes support mechanisms for patients, family, and care/service providers				√
24R. Changes are made to reduce re-occurrence of the these events		√	√	√
26. Procedural changes resulting from event investigation are followed up on regular basis	√	√	√	√
N1. Individuals involved in the event contribute to the understanding and analysis of the event	√	√	√	√
N2. Individuals involved in the event contribute to the generation of possible solutions	√	√	√	√
N3. The processes that follow these events are handled in a timely way				√
N4. The patient and family are invited to be directly involved in the processes that follow major events (analyzing what occurred and making any necessary changes)				√
N6. Units/staff identify those minor events that require in-depth review	√	√		
N7. These events are discussed openly across the organization		√	√	

Gray indicates that item did not meet the importance threshold for the type of PSE (i.e., received fewer than two dots).

analysis of the event"), other items were deemed to be important only in response to certain types of PSEs. For example, two items that have to do with trend identification (item 12 and item 19) were deemed to be important for minor and moderate events due to their higher frequency but not for major events and major near misses. Similarly, item N5, "Individuals involved in the event have a quick and easy way to capture/report what happened," was deemed to be very important by the panel for all types of events except major events because these severe events will almost automatically be subject to reporting and analysis. The importance of multidisciplinary review (item 11) was identified for more severe events (major events and major near misses)—while it may be advantageous to have multidisciplinary review of moderate events, panel discussion revealed that the need for panelists to also consider

feasibility prevented them from rating this item as important for less severe events.

Results from the six external experts who provided feedback on the learning response items shown in Table 2 supported the results from the expert panel with one caveat. Several external experts questioned why board reporting (item 21) and disclosure (item 23) were only listed as important learning responses for major events and not for less severe types of PSEs.

Survey Results

Fifty-four out of 68[5] PSOs (79 percent) returned the questionnaire. The respondent group was comprised of 28 (52 percent) from small hospitals, 20 (37 percent) from large community hospitals ($\geq$ 100 beds), and 6 (11 percent) from teaching hospitals. The distribution is similar to that of all general hospitals in Ontario.[6] Precursors to EFA showed the data fit the necessary requirements for this technique. For major event learning responses—Bartlett's test of sphericity was significant ($\chi^2(\mathrm{df} = 78) = 400.287$, $p < .0001$), indicating sufficient overlap among learning response items to consider this analysis. The overall KMO measure of sampling adequacy = 0.877, demonstrating sample size was sufficient to support EFA with this many variables. KMOs for all but item N4 (KMO = 0.757) were ≥ 0.8 and considered meritorious by Kaiser (1974). Mean item communalities are high (0.64 for major event learning responses) according to characterizations used by Hogarty et al. (2005) in their Monte Carlo study.

Preliminary EFA of minor, moderate, major event, and major near miss learning responses suggests two factors for major events and only one factor for minor and moderate events and major near misses.[7] Table 3 shows the items and factor loadings for a two-factor model of major event learning response. Factor one includes six items with significant loadings ≥ 0.70. These items have to do with the process of analyzing major events, including how this is done (10R, 9R), who is involved (N1, 11), who is informed (item 23), and what changes are made (24R). Factor two includes three items with significant loadings ≥ 0.70 and has more to do with dissemination through the organization (items 15 and 22) and inviting patients and family to be involved in the processes that follow major events (N4). Item 21's loading (board reporting of major events) on factor 1 (0.64) is likely significant. Three items have lower, likely nonsignificant, cross loadings on both factors (N3, N2, 26). For major events, the total variance explained is 64 percent for all 13 items. α's are strong (six-item factor 1 $\alpha = 0.90$, three-item factor 2 $\alpha = 0.78$). Alphas for minor

Table 3: Major Event Learning Responses—Items and Factor Loadings ($n = 48$)

	Factor	
	1	*2*
11. A multidisciplinary review team in our organization helps with the analysis of major events	0.92	0.05
9R. In discussions around major events, the focus is mainly on system-related factors, rather than on the individual(s) most responsible for the event	0.91	0.19
24R. Changes are made to reduce re-occurrence of major events	0.79	0.20
23. A formal process for disclosure of major events to patients/families is followed and this process includes support mechanisms for patients, family, and care/service providers	0.79	0.08
10R. Following major events, a systematic approach is used in this organization (e.g., root cause analysis) to understand what occurred, how and why it happened	0.74	0.04
N1. Individuals involved in major events contribute to the understanding and analysis of the event	0.72	0.14
21. Major events, and a description of changes/improvements made following them, are included in regular reports to our Board	0.64	0.00
N3. The processes that follow major events (analyzing what occurred and making any necessary changes) are handled in a timely way	0.56	0.43
22. Things that are learned from major events are communicated to staff using more than one method (e.g., communication book, in-services, unit rounds, emails) and at several times so all staff hear about it	0.01	0.90
15. Information about major events is shared with staff informally (e.g., through personal communications, emails, communication books, bulletin boards)	0.01	0.88
N4. The patient and family are invited to be directly involved in the processes that follow major events (analyzing what occurred and making any necessary changes)	0.07	0.70
26. Procedural changes resulting from analysis of major events are followed up on a regular basis	0.38	0.48
N2. Individuals involved in major events contribute to the generation of possible solutions	0.45	0.47

Notes. Extraction using principal component analysis oblique (Oblimin) rotation, listwise deletion of cases. Gray area highlights which factor the item loads onto.

event learning (12 items) = 0.93, moderate event learning (11 items) = 0.96, and for major near miss learning (13 items) $\alpha = 0.94$—levels high enough to meet recommendations for applied research (Nunnally 1978; Peterson 1994).

Table 4 shows the frequency with which PSOs report their organization engages in learning responses for all four types of PSEs. Mean learning response scores for each PSE type were compared using a paired *t*-test (to

compare major event factor 1 learning responses and major event factor 2 learning responses) and repeated measures ANOVA (to compare minor, moderate, majorNM, and major event learning responses). For major events, PSOs report engaging in factor 1 learning responses significantly more often than factor 2 learning responses (factor 1 mean = 3.63, where 4 = *always/almost always* and 1 = *never/almost never*) (SD = 0.54), factor 2 mean = 2.88 (SD = 0.79) (paired $t(52) = 8.28$, $p < .001$). Table 4 shows us that over 85 percent of PSOs report that their organization engages in each of the factor 1 learning responses (related to analysis of major events) "always/almost always" or "usually" while fewer than two-thirds of PSOs report their organization engages "always/almost always" or "usually" in factor 2 learning responses (related to communication and dissemination of information following major events) and only one-third report that patients and families are "always/almost always" or "usually" invited to be involved in the processes that follow major events.

Differences in learning responses across all four types of PSEs, analyzed using repeated measures ANOVA with type of PSE learning response (minor, moderate, major near miss, and major events) as the within-subjects factor, showed the main effect of type of PSE was significant ($F(3,159) = 40.09$, $p < .001$). Mean minor event learning response = 2.58 (SD = 0.67), mean moderate event learning response = 3.07 (SD = 0.74), mean major near miss learning response = 3.03 (SD = 0.72), mean major event learning response = 3.38 (SD = 0.55)). Post hoc comparisons, using the Bonferroni adjustment for multiple comparisons, showed that mean learning response scores are significantly different across all types of PSEs ($p < .001$) with one exception: the difference between moderate event learning response and near-miss event learning response is not significant.

DISCUSSION

Three aspects of failure-induced learning emerged from the literature suggesting that learning from PSEs requires responses that (a) identify and bring PSEs to the attention of others (*identification*), (b) include processes to properly analyze the system-level causes of PSEs (*analysis*), and (c) put corrective strategies in place to reduce reoccurrence (*change*). Learning responses that are consistent with these areas emerged from the focus groups and expert panel.

However, the focus groups and expert panel further highlighted the importance of timely feedback to those involved in PSEs—feedback that has

Table 4: Percentage of Organizations That Engage in Learning Responses "*Always/Almost Always*" or "*Usually*" for Each Type of PSE

	% Engaging in Learning Response "Always/Almost Always" OR "Usually"			
Learning Response Item	*Minor Event*	*Moderate Event*	*Major Near Miss*	*Major Event*
1. We report these events to a reporting system that is external to the hospital			18.8	
2R. We report these events to a reporting system that is internal to the hospital			88.9	
5. We have dedicated "patient safety rounds" where these events are discussed	13.5		28.0	
7R. There is a systematic approach to identify strategies to reduce re-occurrence of these events	57.4	74.1	90.7	
9R. Discussion around these events focuses mainly on system-related factors, rather than focusing on the individual(s) most responsible for the event		87.0	94.4	96.3*
10R. There is a systematic approach in our organization used to help identify *what* occurred, *how* and *why* it happened)	56.6	70.4	70.4	87.0*
11. A multidisciplinary review team in our hospital helps units with the analysis of these kinds of events			83.0	94.4*
12. Information about these events is collated and analyzed by people with appropriate knowledge and skills to look for solutions to reduce re-occurrence of these events	67.9	75.9		
15. Information about these events is shared with staff informally within the unit (e.g., through personal communications, emails, communication books, bulletin boards)	46.3			64.2†
17. Timely responses are provided to those who report these events (e.g., to discuss these events, possible solutions, etc.)	54.7			
19. If there appear to be trends in these events (e.g., other events with similarities), information about the causes and resolutions are disseminated in all relevant areas of the hospital	63.0	72.2		
21. These events, and a description of changes/ improvements made following them, are included in regular reports to our Board				92.2
22. Things that are learned from these events are communicated to staff using more than one method (e.g., communication book, in-services, unit rounds, emails) and/or at *several* times so all staff hear about it	47.2		65.4	62.3†

continued

Table 4. *Continued*

Learning Response Item	*% Engaging in Learning Response "Always/Almost Always" OR "Usually"*			
	Minor Event	*Moderate Event*	*Major Near Miss*	*Major Event*
23. A formal process for disclosure of events to patients/families is followed and this process includes support mechanisms for patients, family, and care/service providers				88.5*
24R. Changes are made to reduce re-occurrence of the these events		81.1	88.9	96.2*
26. Procedural changes resulting from event investigation are followed up on regular basis	51.9	62.3	75.9	88.5
N1. Individuals involved in the event contribute to the understanding and analysis of the event	66.7	79.6	85.2	88.9*
N2. Individuals involved in the event contribute to the generation of possible solutions	63.0	75.9	79.6	84.9
N3. The process that follow these events are handled in a timely way				92.5
N4. The patient and family are invited to be directly involved in the processes that follow major events (analyzing what occurred and making any necessary changes)				33.3†
N6. Units/staff identify those minor events that require in-depth review	67.9	75.5		
N7. These events are discussed openly across the organization		66.7	57.4	

Note. Gray indicates that item did not meet the importance threshold for the type of PSE.
*Item loads on major event factor 1 learning response.
†Item loads on major event factor 2 learning response.

been noted by others to close the loop and let staff know it is worthwhile to take the time to report events (Tucker and Edmondson 2003). Our focus groups also stressed the importance of dissemination throughout the organization concerning PSEs and related changes as noted by others (Argote 1999; Cannon and Edmondson 2005; Cooke and Rohleder 2006). This reflects the theoretical importance of transferring learning through the organization (Szulanski 1996; Szulanski 2000; Berta et al. 2005) (e.g., replicating and retaining what is learned) as well as the practical challenges of transferring learning to staff working on different shifts and on multiple patient care units. In addition, the expert panel identified the importance of involving staff and patients/families involved in PSEs in the processes of event analysis and change. All of

these areas are consistent with Argote's (1999) slightly broader definition of learning, which focuses on the processes of identifying, analyzing, creating, retaining, and also disseminating effective knowledge and practices to reduce the likelihood of similar events reoccurring in the future. These areas are also consistent with the kind of "sensemaking" around PS hazards described by Battles et al. (2006).

Results from our expert panel suggest learning responses (PSE *identification*, *analysis*, and *change*) should be different for different types of PSEs. For instance, for major events, responses that have to do with *analysis* and *change* were seen as more important than learning responses related to PSE *identification*, because, as noted *identification* is more likely to be automatic with major events. However, for minor and moderate events more of the *identification* and (trend) *analysis* types of learning responses were seen as important by the panel.

Expert panel and survey results suggest two additional contributions. First, as seen in Tables 2 and 4, the expert panel process specified four learning responses that are important following *all four* types of PSEs we studied. All these reflect the importance of including staff who are involved in a PSE in the processes of event analysis and change. Second, despite suggestions in the literature that organizations should be learning from small failures (Sitkin 1992; Edmondson 2004) our survey results empirically demonstrate that organizations tend to respond to catastrophes more so than to less severe events and near misses. Learning from small failures is argued to be essential for preventing related consequential failures (Cannon and Edmondson 2001); yet it appears that health care organizations could do more to take advantage of the kinds of "free passes" that more minor events and near misses afford them. Part of the challenge lies in the fact that minor PSEs, even if frequent, may not always be recognized at the "sharp end" as having compromised safety (Greenberg 2009). In addition, health care providers are overburdened in their daily operations and could not possibly report and respond to all PSEs. Indeed, being overburdened in their daily operations (and being told to manage small problems on their own) has been used to explain nurses' propensity to engage in workarounds and first-order problem solving[8] rather than the kind of second-order problem solving that characterizes learning and promotes long-term change (Tucker and Edmondson 2003). To enhance learning from PS failures there is clearly a need for strategies to inform and to educate senior administrators, managers, and providers about the benefits of clearly defining PSEs (Tamuz, Thomas, and Franchois 2004) in order to help ensure that potentially significant smaller PSEs are identified.

Table 4 suggests that there is room for improvement in all learning responses in the organizations that responded to the survey. This appears to be particularly relevant for the last stage of the learning from failure process—for example, disseminating and communicating the results of PSE analysis and change. This finding is consistent with others who found that organizations engage more often in the early stages of incident learning (Cooke, Dunscombe, and Lee 2007).

Our factor analysis defined two factors related to major event *analysis* (factor 1) and *dissemination* of learnings (factor 2). This is consistent with Argote's (1999) definition of learning in the organizational literature, which, in addition to the processes of identifying and analyzing information, also emphasizes retention and dissemination of what is learned. However, for less severe events, we were unable to detect the three learning response factors suggested by theoretical models of learning from failure. We did generate Cronbach's α's for groups of items that reflect the *analysis* and *change* aspects of failure-induced learning theory. These α's were >0.80 for all four types of PSEs (results not shown).[9] Accordingly, it is unclear whether, with a larger sample size and/or a larger pool of items, discrete learning response factors that reflect event *identification*, *analysis*, *change*, and perhaps *dissemination*, might be identified for the less severe types of events we studied. The contrast between our EFA results and the theoretical model of learning response (and the α's just noted) serves to highlight the fact that empirical assessment of the factor structure of PSE learning response is an important, hitherto unexplored area that requires additional research. Such research might examine questions including (a) whether PSE *identification*, *analysis*, *change*, and *dissemination* are elements of what is a fundamentally unidimensional construct or whether learning response is truly a multidimensional construct; and, if the latter is true; (b) whether the dimensionality of learning from failure is indeed different for different types PSEs. In this respect, one must consider work by Gibson and Vermeulen (2003), which used a composite learning behavior score. They combine items from three factors they confirmed using confirmatory factor analysis (CFA)—arguing that *all* aspects of the learning behavior process must be present in order to score high on learning behaviors.

Finally, consideration of the expert panel results together with the EFA results highlight the need to (a) obtain data from different stakeholders and (b) to do so using different methodologies as we attempt to define a measure of PSE learning response. For instance, EFA results showed lower communalities for the board reporting and patient/family disclosure items (results not shown) and a noticeably higher α for the second major event learning response

factor when the patient/family involvement item (N4) is excluded from the scale (0.90 versus 0.78). Alone, results of these psychometric analyses might lead these items to be dropped. However, our expert panel suggested that board reporting (item 21) and patient/family disclosure and involvement in the PSE follow-up processes (N4) are highly important learning responses. Our *external* experts suggested even greater importance should be given to these areas and argued that, *for less severe events*, board reporting and patient/family disclosure may be the *truest* hallmarks of learning from failure. Other research has also demonstrated the importance of engaging patients in what we have described as the *identification* stage of the learning process (Weingart et al. 2005). Consideration of the place and importance of patient/family involvement and board reporting in the failure-induced learning process also raises the question of whether theoretical models of the learning from failure process which include event *identification*, *analysis*, and *change* should perhaps be extended to more explicitly include an *accountability* dimension. Indeed, recent attention has been called to the fact that hospital boards have significant opportunity—and responsibility—when it comes to responding to PS issues (Conway 2008).

The present study developed a measure of learning from PS failure that is firmly rooted in theory, expert knowledge, and the realities of organizational practice settings. While our ability to bring together empirical data that reflect expert knowledge and the perspective of front-line organizational safety leaders is an important strength of this study, future research is required to more firmly demonstrate the proposed measure's construct validity. For instance, development of a properly validated measurement instrument typically requires cross-validation using CFA and/or includes predictive and discriminant validity analysis and our study data are not appropriate for these analyses. Further cognitive testing of the survey items would also strengthen the instrument.

Future studies could also build on work that considers the role of group learning in organization-level learning from failure (Edmondson 1999, 2002; Ginsburg et al. 2009b) to examine the applicability at the patient care unit level of the organization-level measure of learning response proposed in this paper. Potential interactions between organization and unit-level learning response also require further research. Future studies should also examine how learning takes place at the individual level among groups like physicians, which we do not report on here. Indeed, individual-level learning responses may be the most salient type of response that occurs among physicians given the largely autonomous manner in which they practice. Unfortunately, however, individual learning responses tend to occur in silence and may prevent system-level learning[10] (Department of Health 2000; Chuang, Ginsburg, and Berta 2007).

Understanding the factors that influence learning from PS failures also remains an important avenue for research. Finally, the PS literature has prescribed various ways health care organizations can improve PS. But there is a lack of empirical evidence about the effectiveness of many of these policies and actions for reducing re-occurrence of PS failure events and, ultimately, improving PS. While PSE learning response is an important dependent variable in its own right (Chuang, Ginsburg, and Berta 2007), future research, however difficult, is required to *empirically* examine the relationship between learning responses and improvements in other important PS outcomes. Such research may be particularly important given that (a) health care organizations face numerous, often competing, priorities and it is unclear where learning sits as a priority, and (b) health care organizations constitute complex adaptive systems that are highly interdependent and tend to produce unpredictable outcomes (Plsek and Greenhalgh 2001; Burton 2002; Rowe and Hogarth 2005), thereby making the learning—performance link particularly challenging.

This study has some limitations worth noting. First, the composition and dynamics of an expert panel can affect the product, and consensus-type processes do not guarantee the correctness of the outcome (Jones and Hunter 1995). To mitigate the potential pitfalls of using this nominal group technique, experts were carefully selected to ensure individuals possessed both unique and common expertise relevant to learning from PS failures. Face-to-face interactions were also monitored to ensure no individual dominated the discussion. In addition, we were not forcing consensus, which is a common criticism of some consensus-type methods such as the Delphi (Sackman 1975). Moreover, the expert panel process was only one part of a multimethod approach that also included a second group of renowned PS experts (our external expert group) who provided independent assessment of the panel outcomes.

Second, there are limitations with our survey data. The data come from a relatively small sample and although we had fairly high participation and response rates using a population of hospitals that represents Canada's largest province, for analysis purposes we had only 54 cases. This limitation reflects a significant challenge of and barrier to conducting organization-level research. We do know that "lack of resources for studies" and "survey fatigue" were the primary reasons that organizations declined to participate in the study at the time of the initial invitation. There could therefore be a systematic bias in our sample. Similarly, it may be that the 54/118 hospitals we received surveys from have taken a greater interest in safety than those who declined to participate or did not return a survey. We also rely on a response from one individual per organization. While we have tried to ensure the items are more

behavioral than perceptual, a single individual's response may deflate or, more likely in our case, inflate the actual extent of an organization's learning responses. This limitation should be of less concern for the development of the measure, and it should not be seen to threaten results on the *relative* differences in learning responses to the four types of PSEs. However, given that the science of measurement needs to be far more advanced when used for external comparison than when used to guide improvement (Solberg, Mosser, and McDonald 1997), any future use of the instrument where there is only one respondent per organization should avoid using the data (a) to suggest absolute levels of learning response or (b) to make external comparisons among organizations.

Results reported here should be generalizable beyond the Canadian context. First, we drew on an international body of literature in the first stage of the study and the expert process included individuals from across North America. Second, while the focus groups and mail survey were conducted in Canadian settings, the Canadian environment is similar to other countries in many areas relevant to this study: (1) Canada has a national sentinel event reporting system and many organizations are trying to implement other local reporting systems; (2) Canada does not use any notable financial or other incentives that reward safety practices; (3) Canada is increasingly introducing formal disclosure policies and creating senior positions devoted to PS such as the PSO position; and (4) while the malpractice environment is different from the United States, issues relevant to this study such as physician's error disclosure attitudes and experiences, have been found to be the same in Canada and the United States (Gallagher et al. 2006).

Conclusion

This study reports on the development of a measure of PS learning response that is firmly grounded in theory, expert knowledge, and practice. Moreover, the measure provides a strong starting point for assessing failure-induced learning response by using different, reliable item sets to measure how organizations respond to PSEs. The measure also represents the first step in development of a PS process or outcome measure. This work has useful practice implications. Because the learning response items for each type of PSE represent highly actionable process measures and have clear accountability (Rivard, Rosen, and Carroll 2006), the measure could in the future be used by organizations as a guide or checklist against which they can assess current practice and set goals for improvement.

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NOTES

1. An adverse event is defined as an injury caused by medical management rather than by an underlying disease or condition (Brennan et al. 1991). We focus on preventable adverse events as they offer more substantial learning opportunities than nonpreventable adverse events which reflect the risk associated with treatment, such as a life-threatening allergic reaction to a drug when the patient had no known allergies (Kohn, Corrigan, and Donaldson 1999).
2. Near misses have been defined by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) as any process variation which did not affect the outcome, but for which a recurrence carries a significant chance of a serious adverse outcome.
3. *Expert Panel Group*: *David L. Cooke*, Adjunct Associate Professor, Haskayne School of Business, University of Calgary; *Lisa Droppo*, Director, Patient Safety at Trillium Health Centre; *Ed Etchells*, Director, Patient Safety Service, Sunnybrook Health Sciences Centre & Associate Professor of Internal Medicine, University of Toronto; *Michele Lahey*, Executive Vice President & Chief Operating Officer, Capital Health, Edmonton; *Emily Musing*, Executive Director of Pharmacy, University Health Network; *Rob Robson*, Chief Patient Safety Officer, Winnipeg Regional Health Authority; *Anita Tucker*, Lumry Family Assistant Professor of Business Administration, Harvard Business School; *Marlies van Dijk*, Western Canada Leader, Safer Healthcare Now. *External Expert Feedback Group*: *Ward Flemons*, VP Patient Safety, Calgary Health Region & Clinical Professor of Medicine University of Calgary; *Julie Morath*, COO, Children's Hospitals and Clinics of Minnesota and member of the Lucian Leape Institute of the National Patient Safety Foundation; *Peter Pronovost*, Associate Professor in Anesthesiology and Critical Care Medicine, Surgery, Nursing and Health Policy and Management at Johns Hopkins University and the 2004 recipient of the John M. Eisenberg Patient Safety and Quality Research Award; *Kathleen Sutcliffe*, Professor of Management and Organizations University of Michigan Ross School of Business; *Saul N. Weingart*, VP for Patient Safety, Dana-Farber Cancer Institute, and Associate Professor of Medicine, Harvard Medical School, Boston, MA.

4. Comparisons reflect reports of how an organization learns from different kinds of PSEs. Mean learning response scores for each PSE type were calculated and compared using repeated measures ANOVA (to compare minor, moderate, majorNM, and major event learning) and a paired *t*-test (to compare major event factor 1 learning and major event factor 2 learning). Because of differences in the items used to measure learning from each type of PSE, the item sets for the PSE learning responses we compared are not the same.
5. One of the 69 hospitals that agreed to participate in the survey was excluded in error at the time of data collection.
6. Hospital size groups are based on the Ontario Public Hospitals Act Classification of hospitals which classifies general hospitals as teaching, general hospitals with $\geq$ 100 beds, and general hospitals with $<$100 beds. The size distribution of study hospitals is similar to all Ontario general hospitals. More detailed PSO study data on the number of beds suggests our sample is also similar to the size distribution of U.S. hospitals (using AHA data for sporadic years between 2000 and 2006).
7. Decisions regarding the number of factors to extract were made by considering the eigenvalue >1 criteria (Kaiser, 1960), the Scree test (Cattell, 1966), as well as the method of parallel analysis (Cota et al., 1993).
8. First- and second-order problem solving are analogous to the concepts of single- and double-loop learning (Argyris and Schon 1978). First-order problem solving reflects band-aid style problem fixing, while second-order solutions focus on identifying and changing the root causes of a problem to prevent recurrence.
9. The α for major near miss event identification was 0.788 (there was only one identification learning response item for minor and moderate events and, as noted, no identification learning response items for major events).
10. We conducted one focus group with a group of hospitalist physicians from one community hospital. However, we do not report the results here because they were quite different and suggest another important avenue for research which we instead outline here.

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