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Toward Constructive Change After Making a Medical Error:

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Background: Making a medical error is a uniquely challenging psychosocial experience for clinicians. Feelings of personal responsibility, coupled with distress regarding potential or actual patient harm resulting from a mistake, create a dual burden. Over the past 20 years, experiential accounts of making an error have provided evidence of the associated distress and impacts. However, theory-based psychosocial support interventions to improve both individual outcomes for the involved clinicians and system-level outcomes, such as patient safety and workforce retention, are lacking. There is a need for evidence-based ways to both structure and evaluate interventions to decrease the distress of making a medical error and its impacts. Such interventions play a role within wider programs of health professional support. We sought to address this by developing a testable, psychosocial model of clinician recovery after error based on recent evidence.

Methods: Systematic review methodology was used to identify studies published between January 2010 and June 2021 reporting experiences of direct involvement in medical errors and/or subsequent recovery. A narrative synthesis was produced from the resulting articles and used as the basis for a team-based qualitative approach to model building.

Results: We identified 25 studies eligible for inclusion, reporting evidence primarily from experiences of doctors and nurses. The identified evidence indicates that coping approach, conversations (whether they occur and whether they are perceived to be helpful or unhelpful), and learning or development activities (helpful, unhelpful or absent) may influence the relationship between making an error and both individual clinician outcomes of emotional impact and resultant practice change. Our findings led to the development of the Recovery from Situations of Error Theory model, which provides a preliminary theoretical basis for intervention development and testing.

Conclusions: The Recovery from Situations of Error Theory model is the first testable psychosocial model of clinician recovery after making a medical error. Applying this model provides a basis to both structure and evaluate interventions to decrease the distress of making a medical error

and its impacts and to support the replication of interventions that work across services and health systems toward constructive change. Such interventions may be embedded into the growing body of peer support and employee support programs internationally that address a diverse range of stressful workplace experiences.

Key Words: medical error, adverse events, clinician well-being, recovery, patient safety

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Making a medical error is a uniquely challenging psychosocial experience for clinicians who experience the dual burden of feeling personally responsible coupled with concern regarding the potential or actual patient harm resulting from their mistake.¹ Detrimental impacts of making an error, both personally and professionally, contribute to reduced safety of subsequent patient care, as well as poor health and well-being (including suicidality) among clinicians.² Longer-term resultant impacts on workforce availability and morale as well as financial costs are also notable.³ Over the past 20 years, a plethora of studies have reported experiential accounts of making a medical error across clinician groups and in more than 20 countries.^{1,4} In recent years, these works have extended their focus to the broader concept of experiencing a patient safety incident directly or indirectly.⁴ Patient safety incidents and the associated terms frequently used in this field of research (e.g., adverse events, critical incidents, and complications) may encompass medical errors but refer to a much broader range of events and causation that are often not associated with erroneous thoughts or actions at a clinician level.⁵

Innovative service and system-wide support programs have emerged to support those involved in safety and/or stressful events, some of which have been evaluated for their cost and perceived usefulness.^{6–9} Current programs are often ground in crisis management and trauma recovery models.^{4,10–12} This large group of programs provide support to address a broad spectrum of experiences that cause clinician distress, including stressful clinical incidents and patient trauma, litigation, bullying, workplace violence, and making a medical error. Medical errors are a distinct subgroup within this broader group of safety and/or stressful events and sometimes co-occur with broader workplace stressors. Making a medical error creates a discrete psychological response, with heightened self-conscious emotions such as shame, guilt, and personal failure because an erroneous thought or action can be attributed to an individual's judgement, who may feel a sense of failure and accountability.¹³ Such feelings occur even when the system in which an individual works has not provided the optimal conditions to support safety.^{13,14} There is currently an absence of evidence-based psychosocial interventions that work to resolve the specific distress associated with making a medical error. We address this through the present study.

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Psychosocial interventions to address well-being after involvement in a medical error require depth of understanding about the mechanisms that underlie clinician recovery. A key factor inhibiting progress of testable interventional solutions is a lack of evidence of the factors that moderate or mediate the experience of making an error and its outcomes for individuals and patient care.¹⁵ Although more than 100 studies have reported experiences of clinicians after safety incidents, few have focused explicitly on error.^{16–18} While broader support is valuable for clinicians in distress, greater understanding of the relationship between individual, contextual, and system factors (predictors) and constructive change after errors is required through theory development to devise relevant, tailored interventions that are effective in improving individual well-being outcomes and healthcare improvements in relation to error events.¹⁹

Beyond healthcare contexts, it is well established that psychological factors such as self-esteem and attribution style can buffer the impact of feelings of failure on emotional distress.²⁰ Psychological interventions may therefore have a role within supporting individuals who are directly involved in an error, but evidence of the psychosocial factors that contribute to their error experiences, recovery, and outcomes is needed. Evidence synthesis to understand how clinicians respond to and recover from error, and the extent to which this response is the same as or differs from other safety-related events, is essential for the development of theoretically informed psychosocial interventions that can be rigorously evaluated to promote constructive changes and adaptive recovery after making a mistake.

We sought to use systematic review methodology to update our initial systematic review in this field¹ by identifying evidence produced over the past 10 years to address this long-standing evidence gap by developing an integrative, testable, psychosocial model of clinician recovery after error. The resulting model provides a basis for the development and testing of psychosocial interventions. These interventions may ultimately be incorporated into wider health service models of clinician support to address instances of medical error specifically. We aimed to address the following research objectives: (i) identify all published peer-reviewed evidence of experiences of making and/or recovering from making a medical error among clinicians (all qualified and/or in-training health professionals); (ii) establish the factors that contribute to psychosocial experiences of making a medical error and/or the recovery process; and (iii) construct an integrative, testable, psychosocial model of clinician recovery from making a medical error. We report the review findings and resulting model.

METHODS

Design

Systematic review with narrative synthesis and team-based modeling was used. This review was registered with International prospective register of systematic reviews: CRD42021225009. We used the Preferred Reporting Items for Systematic Reviews to guide the reporting of this review.²¹

Eligibility Criteria

Inclusion Criteria

Studies were eligible if they reported primary data of healthcare professionals' (including trainees) psychological, personal, and/or professional experiences over any period after a medical error and factors that influenced their error response, published in English language between January 1, 2010, and August 2, 2021, as an update to our earlier systematic review up to 2009. A medical error was defined as "the failure of a planned action to be completed as

intended or the use of a wrong plan to achieve an aim without the intervention of an unforeseen event."²² All study designs were eligible, and data could be gathered in any healthcare delivery context.

Exclusion Criteria

Articles were excluded if they were nonprimary sources, such as editorials, opinion pieces, or letters to the editor. Articles published in a language other than English were also excluded. Studies that reported experiences of events in which an error experience could not be delineated were excluded with reference to the research objectives.

Study Identification

Synonyms and relevant concepts were developed for the major concepts being explored in this review, including medical error and individual/psychological/professional/emotional response. A search strategy (Appendix 1) was developed and applied to the following electronic databases in September 2020 and updated in August 2021: MEDLINE, PubMed, Scopus, PsycInfo, and Web of Science. Reference list searches of eligible articles were also searched for additional relevant material. Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) was used for study screening and management.

Study Selection and Data Extraction

Two reviewers (M.P.-I., R.H.) screened the titles and abstracts against the eligibility criteria. Full-text documents were obtained for all potentially relevant articles. The eligibility criteria were then applied to the articles by 3 reviewers (J.J., R.H., R.L.). Three team members then met to finalize the eligible articles for inclusion and conduct a face validity check on the final set of articles (J.J., R.L., R.H.). A further reviewer (U.C.) then extracted the following information from the included studies: author, year of publication, country, study design, setting, sample, and key findings.

Data Synthesis and Model Building

Because of the heterogeneity of the design and outcome measures of the included studies, a narrative empirical synthesis was undertaken in stages by 3 research team members (R.M., J.J., R.H.).²³ Team-based modeling was conducted qualitatively through the process of narrative synthesis in a series of meetings of the research team, which included health, social and clinical psychologists, clinicians, and health services researchers. Our synthesis approach included 4 stages: theory development, development of a preliminary synthesis, exploring relationships in the data, and testing the robustness of the synthesis product.²⁴ Research team meetings enabled us to progress iteratively through these stages. In stage 1, we explored the parameters of the review and refined the eligibility criteria based on detailed exam of the nature of errors and incidents that were explored and described by the studies to focus tightly on the matter of making a medical error. In stage 2, we worked iteratively to identify individually and discuss collectively, emerging facilitators and barriers or influential factors in the recovery process after an error and their interrelationships. This process derived initial themes that were further categorized around coping, learning and development activities, and conversations that formed the basis for the model. With an emerging set of influential factors in error response, we examined differences between studies based on professional groups, location, context, and other factors that may explain different findings between studies. This process led to including likely influential factors around the main model components of institutional processing and individual attributes. In the final stage, we met to discuss the configuration of the prototype model, the weight of evidence to support it, and its application in a range of health systems contexts.²³

Assessment of Study Quality

Because of heterogeneity of the study types selected, appraisal of methodological and reporting quality of the included studies and overall body of evidence was carried out by 2 reviewers (M.P.-I., U.C.) using the 13-item Quality Assessment for Diverse Studies tool (QuADS), which has demonstrated reliability and validity.²⁵

RESULTS

Results of the Search

The systematic database search retrieved 2231 articles. After removal of duplicates, 718 articles remained. A total of 516 articles were excluded after title and abstract screening. The remaining 202 articles underwent full-text review, of which 177 were excluded. A total of 25 articles were included in the review (Fig. 1).

Excluded Studies

Studies were predominantly excluded at full-text review because they did not focus specifically on experiences of making an error (n = 77). Several exclusions were also made for studies that focused on barriers to speaking up and error reporting (n = 25), articles lacking primary data (n = 18), focus on factors contributing to a medical error occurring (n = 8), and the development of measurement instruments (n = 3) in addition to a broader range of reasons for exclusion.

Characteristics of Included Studies

Included articles are summarized in Table 1 and emerged from the following countries: United States (US, n = 13), Iran (n = 3), France (n = 2), Germany (n = 2), Switzerland (n = 1), Singapore (n = 1), Greece (n = 1), and Finland (n = 1). One further study included participants from both the US and United Kingdom (UK). Studies were quantitative (n = 14), qualitative (n = 9), mixed/multimethod (n = 2), using surveys (n = 15), and/or using interviews (n = 10). Samples included doctors/surgeons (n = 13), nurses (n = 13), or multidisciplinary (n = 1) groups in a range of healthcare settings including hospitals (n = 19), primary care (n = 2), school nursing (n = 1), and individuals who volunteered to take part from any health setting (n = 4). Samples sizes ranged from 2 participants in a case study analysis to 5782 participants in a survey sample.

Study Quality

Study quality was variable. Study aims and research settings were reported clearly in all of the studies. Few studies had longitudinal designs or examined the timeline after an error to map temporal differences in responses. The involvement of stakeholders in study design/conduct was infrequently reported although many of the studies seemed to be led by clinical teams. Descriptive detail and justification of sampling and recruitment, data collection instruments, analytical methods, and strengths and limitations were variable, but few studies were considered very weak. We did not exclude studies based on how they performed in the quality appraisal conducted on each study. The quality assessment data were used simply to portray the strength of the available evidence.

Review Findings

Evidence of Emotional Experiences After Making a Medical Error

Fourteen studies examined the emotional responses experienced by healthcare professionals after a medical error.^{13,26–39} Four studies reported the emotions arising in the moment of error realization provided through accounts by clinicians up to 5 years

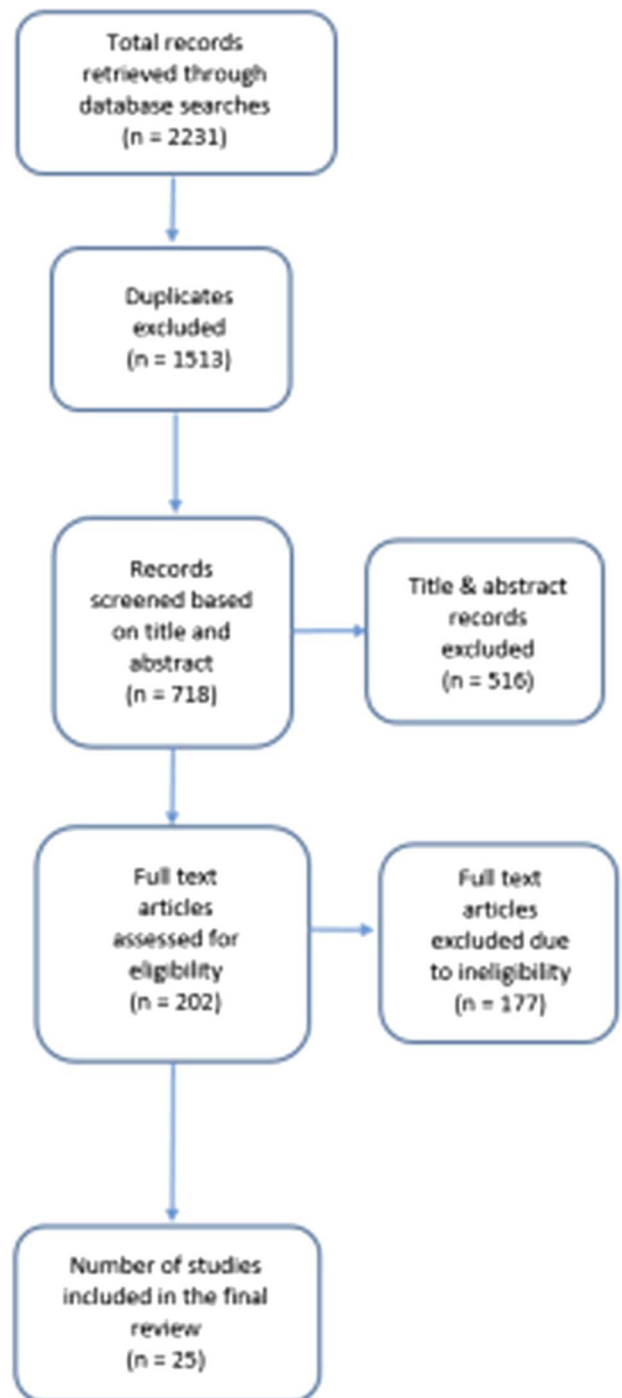


FIGURE 1. Study search and selection process.

after the error event.^{13,30–32} The remainder of the studies provided self-reported experiences of errors more generally. Negative emotions were predominantly reported using a range of scales and outcome measure items. Where closed survey items were used, negative emotions after an error identified in more than one study included: shame and guilt,^{13,26,29,31,39} embarrassment,^{26,28,29,31} depression,^{26,29–31} anger toward the self,^{26,29,31,39} anger toward others,^{26,29,31} inadequacy,^{26,31,39} fear of repercussions,^{26,31} and feeling upset.^{13,29} A wider range of emotions were explored in individual studies, but

TABLE 1. Summary of the Included Studies

First Author	Year	Country	Design	Method/s	Setting	Sample	Study aim	Key Findings
1. Ajri-Khameslou ³⁸	2017	Iran	Qualitative cross-sectional	Semistructured interviews	Hospital	18 Nurses (emergency)	To explore the outcomes of confronting errors among emergency nurses.	<ul style="list-style-type: none"> Impacts of errors included restlessness, fear of outcomes of errors, feeling self-consciousness, and/or remorseful. Learning opportunities identified as a positive. Fear of punitive action and judgement. Opportunities to learn from mistakes nurses were associated with enhanced skills, attention to task, information seeking, and openness with colleagues.
2. Berman ⁴⁹	2021	US	Quantitative	Survey	Hospital	150 Surgeons	To explore frequency of medical errors, describe coping mechanisms, and explore satisfaction with institutional support.	<ul style="list-style-type: none"> Most respondents reported errors resulting in significant patient harm or death. Lack of satisfaction with institutional report was common. Coping was supported by conversations with family and friends in addition to peers. Barriers to providing and receiving support included lack of knowledge about where to access support, fear of blame, and lack of trust in the institution.
3. Chard ³¹	2010	US	Quantitative	Survey	Hospital	272 Nurses (operating room)	To examine the circumstances and perceived causes of intraoperative nursing errors, nurse's emotional responses, coping, and resultant practice change.	<ul style="list-style-type: none"> Errors associated with feelings of anger at self and (less often) anger at others, inadequacy, guilt, and embarrassment. Coping strategies of seeking social support and problem solving in relation to the mistake were associated with constructive changes in practice.

4. Delcroix ³⁴	2017	US	Qualitative cross-sectional	Semistructured interviews	Hospital	10 Nurses (NPs)	To establish NPs' responses and coping mechanisms after making a medical error.	<ul style="list-style-type: none"> Physical and visceral emotional impacts reported widely in response to an error. Feelings of fear and uncertainty regarding patient welfare and professional well-being also commonly reported. Self-blame and seeking forgiveness, support, and understanding. Coping strategies included maladaptive responses such as obsessive compulsive behaviors, hypervigilance, avoidance, and discounting. Constructive coping strategies included addressing the causes of the error and problem solving and seeking to improve individual and organizational skills.
5. Fatima ³⁹	2021	US	Quantitative cross-sectional	Survey	Hospital	109 Physicians (internal medicine, pediatrics and emergency medicine residents)	To assess the impact of medical errors on residents' well-being, the coping strategies used and extent of personal and institutional support.	<ul style="list-style-type: none"> Negative emotions after an error widely reported with guilt, remorse, and inadequacy as the most common, accompanied by fear of judgement and blame. Coping strategies commonly used were those that addressed the problem directly and included the use of institutional support programs. Maladaptive coping strategies were less commonly used but identified by some participants. Strong support was reported from peers but less so at an institutional level.

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TABLE 1. (Continued)

First Author	Year	Country	Design	Method/s	Setting	Sample	Study aim	Key Findings
6.Gupta ⁴³	2019	US	Quantitative cross-sectional	Survey	Hospital	5782 Female physicians (various specialities including residency/fellowship trainees)	To describe the impact of making a medical error on female physicians and to determine the association between experiencing a mistake and burnout.	<ul style="list-style-type: none"> Findings focused on the relationship between medical error and burnout. Errors were associated with higher levels of burnout. Emotions after an error that were commonly identified were feelings of guilt, loss of confidence, shame, and sadness. Coping strategies used were not reported. A small proportion (2%) of respondents described reducing clinical workload, taking leave, formally reducing their clinical roles, or leaving the profession reported. These activities were reported by those who had experienced strong negative emotional outcomes from the error.

7.Harrison ¹³	2015	UK & US	Quantitative cross-sectional	Survey	Hospital	265 Physicians and nurses (120 physicians and 145 nurses)	To investigate professional and personal disruption experienced after making an error, emotional responses, coping strategies used, their relationship, and perceptions of organizational support.	<ul style="list-style-type: none"> • Professional and personal disruption was reported as a result of making an error. • Negative emotions of feeling upset, guilty, worried, distressed, scared, nervous, unhappy, self-doubt, and regret. • Positive feelings of determination, attentiveness, and alertness were also identified. • Emotional response and coping strategy selection did not differ between countries or the level of patient harm, but nurses in both countries reported stronger negative feelings after an error. • Respondents favored problem-focused coping strategies that include facing up to the mistake and addressing the problem directly. Other strategies included activities to manage anxiety/emotional distress. • Strategies to avoid the problem such as taking leave from work or going on holiday were less frequently used. • The use of a given coping strategy was associated with a particular emotional response to error suggesting a relationship between the two.
8.Karga ²⁶	2011	Greece	Quantitative	Survey	Hospital	536 Nurses	To investigate emotional responses of nurses to making an error, coping strategies, and how these are associated with constructive or defensive changes in practice.	<ul style="list-style-type: none"> • Emotional responses to error commonly included depression, anger and guilt. • Coping strategies included: accepting responsibility, problem solving, seeking social support, emotional regulation, and avoidance. • Senior staff responses were associated with the coping approach taken, with positive responses from senior staff associated with more constructive coping strategies.

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TABLE 1. (Continued)

First Author	Year	Country	Design	Method/s	Setting	Sample	Study aim	Key Findings
9.Koehn ³³	2016	US	Qualitative cross-sectional	Semistructured interviews	Hospital	30 Nurses (ICU)	To explore nurses' experiences after making medical errors and factors influencing decisions to report.	<ul style="list-style-type: none"> Emotional impacts of making an error were widely reported and often visceral. Experiences did not differ between nurses based on their age or years of experience. The study focused on the trajectory of feelings rather than factors influencing these or coping responses used. Error experiences associated with feelings of guilt, shame, anxiety, loss of confidence, and anger, in addition to concern for patient welfare. Longer-term impacts of heightened vigilance in professional practice alongside lingering guilt were noted. Coping strategies included verbalizing the challenges in a problem-focused way, but also defensive approaches such as minimizing the significance of the error, rejecting responsibility, and avoidance. Feelings of depression, guilt, self-doubt, and anger were common. Coping through conversations with others including partners or family members, friends, colleagues, and supervisors was commonly described as valued. Defensive and constructive approaches to coping were described and not mutually exclusive. Constructive coping was described as activities focused on trying to learn from the mistake and prevent reoccurrence Defensive coping strategies were described as approaches to mitigate the individual's responsibility for the error. No associations between coping approaches and emotional impacts were discussed.
10.Laurent ⁴⁴	2014	France	Qualitative cross-sectional	Semistructured interviews	Hospital	40 Physicians and nurses (ICU: 20 physicians and 20 nurses)	To identify the psychological repercussions of an error on professionals in intensive care and their coping strategies.	
11.Mankaka ⁴²	2014	Switzerland	Qualitative cross-sectional	Semistructured interviews	Hospital	8 Female physicians in general internal medicine)	To explore experiences of female residents who have made medical errors and the coping mechanisms used.	

12. May ⁴⁵	2012	US	Qualitative cross-sectional	Semistructured interviews	Any healthcare setting	61 Physicians (various specialities)	To examine the role of talking (or remaining silent) in the physician's experience of coping with medical error.	<ul style="list-style-type: none"> • Coping through conversations with others including partners or family members, friends, colleagues, and supervisors was commonly described as valued. • Talking with others was important for processing and finding meaning. Many physicians used their stories to teach and help others. • Some types of conversation were unhelpful, such as those that were cruel, insensitive, self-serving, and dishonest. Talking with well-intentioned colleagues and family members was often unhelpful if they minimized the error. • Conversations that were focused to addressing and understanding the error were identified as most valued.
13. McLenman ²⁷	2015		Quantitative cross-sectional	Survey	Hospital	281 Physicians (anesthesiologists)	To examine how medical errors impact anesthesiologists in key work and life domains and their attitudes regarding support after errors.	<ul style="list-style-type: none"> • Feelings arising because of an error were reduced confidence in their ability as a doctor, ability to sleep, job satisfaction, and concern with regard professional reputation. • Respondents were more likely to experience distress if they were female, older, had previously been involved in a serious error, and were dissatisfied with their last error disclosure. • Support differed between departments, with a common perception that there was not adequate organizational support. • Barriers to psychological support were the inability to take time off work and the potential for organizational support mechanisms to be included in their employee records.

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TABLE 1. (Continued)

First Author	Year	Country	Design	Method/s	Setting	Sample	Study aim	Key Findings
14. Mohsenpur ³⁷	2018	Iran	Qualitative cross-sectional	Semistructured interviews	Hospital	8 Nurses	To explore the meaning of Iranian nurses' experience of "being a wrongdoer" as a result of a medical error.	<ul style="list-style-type: none"> • Strong physical and emotional response reported including anxiety about patient welfare, loneliness and isolation. Heavily interlinked with a sense of judgment and blame. • Colleagues identified as accusatory and contributing to distress. • Self-judgement was associated with negative feelings after an error, conversely the ability to learn from an error created a sense of improved well-being. • Physical, psychological, and professional distress reported after errors. • Nurses who are younger and less experienced were more likely to experience detrimental impacts such as turnover intention and absenteeism. • Peer support was identified as the most desirable to cope with an event, followed by being given space and time. Hospital-provided counseling was least desirable to respondents. • Feelings of regret, emotional distress, self-blame, guilt, and shame common. • Stronger regret was identified in instances of patient harm.
15. Mok ²⁸	2019	Singapore	Quantitative cross-sectional	Survey	Hospital	1,163 Nurses	To investigate nurses' experience of making a medical error and quality of support in Singapore.	<ul style="list-style-type: none"> • Physical, psychological, and professional distress reported after errors. • Nurses who are younger and less experienced were more likely to experience detrimental impacts such as turnover intention and absenteeism. • Peer support was identified as the most desirable to cope with an event, followed by being given space and time. Hospital-provided counseling was least desirable to respondents. • Feelings of regret, emotional distress, self-blame, guilt, and shame common. • Stronger regret was identified in instances of patient harm.
16. Muller ⁴¹	2020	Germany	Qualitative cross-sectional	Survey	Primary care	29 Physicians (GPs)	To explore the experience of regret after diagnostic decisions in primary care.	<ul style="list-style-type: none"> • Physical, psychological, and professional distress reported after errors. • Nurses who are younger and less experienced were more likely to experience detrimental impacts such as turnover intention and absenteeism. • Peer support was identified as the most desirable to cope with an event, followed by being given space and time. Hospital-provided counseling was least desirable to respondents. • Feelings of regret, emotional distress, self-blame, guilt, and shame common. • Stronger regret was identified in instances of patient harm.

17. Nevalainen ⁴⁸	2014	Finland	Quantitative cross-sectional	Survey	Primary care	165 Physicians (GPs)	To study differences in coping between young and experienced GPs in primary care who experience medical errors.	<ul style="list-style-type: none"> Inexperienced GPs expressed more often fear of making a medical error and identified making more mistakes than their more experienced counterparts. Fear of making an error was noted but lack of in-depth study of emotional responses. Different actions were noted to manage errors between experienced and less experienced participants, with more experienced GPs tending to advise their patients of a mistake. Younger GPs sought support from senior colleagues rather than speaking with their patients. Coping approaches were not explored in depth.
18. Plews-Ogan ⁴⁷	2013	US	Qualitative cross-sectional	Semistructured interviews	Any healthcare setting	61 Physicians (various specialties)	To investigate how physicians coped positively with having made a serious mistake.	<ul style="list-style-type: none"> Focus on process of coping with making an error identified phases of error processing that contribute to positive coping. Five elements in the process of coping were identified that positively impacted the individuals coping response: acceptance, stepping in, integration, new narrative, and wisdom. The 5 phases describe the psychological and emotional processing that occurs whilst engaging in coping activities.
19. Plews-Ogan ⁴⁶	2016	US	Mixed-methods cross-sectional	Semistructured interviews and survey	Any healthcare setting	61 Physicians (various specialties)	To understand how clinicians learn and adapt positively after making a harmful mistake.	<ul style="list-style-type: none"> Focus on how coping was supported in the aftermath of an error rather than emotional responses. Eight themes were used to describe factors that led to positive outcomes and ability to cope: talking about it, disclosure and apology, forgiveness, a moral context, dealing with imperfection, learning, improving, and helping others. The factors that support coping center around communication and interpersonal dynamics and personal growth.

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TABLE 1. (Continued)

First Author	Year	Country	Design	Method/s	Setting	Sample	Study aim	Key Findings
20. Stillwater ³⁶	2018	US	Case studies	Semistructured interviews	School	2 Nurses	To report accounts of school nurse medication errors and relate them to second victim experience in other fields of healthcare	<ul style="list-style-type: none"> Brief accounts of experiences of making an error that depict a strong emotional reaction but not present detailed accounts of emotion, coping, or the process of recovery. Fear of repercussions or punitive action was noted as a key concern. Feelings of being upset, feeling guilty, angry at oneself, and embarrassment commonly noted. Coping mechanisms included apologizing and addressing the causes of the error and trying to improve individual practice to prevent mistakes.
21. Taifoori ²⁹	2015	Iran	Quantitative Cross-sectional	Survey	Hospital	153 Nurses	To determine how OR nurses react to nursing errors.	<ul style="list-style-type: none"> Visceral reactions to making a medication administration error regardless of error severity. Emotions included fear, anger, guilt, shame, and disappointment, coupled with concern about the well-being of the patient and fear for their professional role. Coping strategies not explored.
22. Treiber ³²	2018a	US	Quantitative cross-sectional	Survey	Any healthcare setting	168 Nurses (recent graduates)	To understand recent nursing graduates' experiences of making a medication error surrounding.	<ul style="list-style-type: none"> Strong negative emotional responses included feeling scared about patient welfare and professional implications, in addition to disappointed with their performance. Coping was supported by coworkers and senior colleagues through conversations that promoted learning.
23. Treiber ³⁵	2018b	US	Quantitative cross-sectional	Survey	Hospital	168 Nurses (recent graduates)	To assess the impacts of making a medication error on nurses.	<ul style="list-style-type: none"> Strong and long-lasting emotional impact of errors noted, with feelings such as guilt that could remain for more than 2 y after the event. Coping through changing practice was commonly described including activities such as additional checks, asking for help, and spending longer on patient education.
24. Venus ⁴⁰	2012	France	Multimethods cross-sectional	Semistructured interviews and survey	Hospital	10 Trainee physicians (general practice)	To measure the professional and personal impact of medical errors on French GP trainees.	

25. Wimming ³⁰	2018	US	Quantitative cross-sectional	Survey	Hospital	463 Health professionals (multidisciplinary NICU)	To examine the impact of errors or adverse events on emotional distress and professional quality of life in healthcare providers in the neonatal intensive care unit, and the moderating role of coworker support.	<ul style="list-style-type: none"> Higher levels of anxiety, depression, burnout, and secondary traumatic stress among those who had experienced a medical error. High levels of perceived coworker support buffered the association between errors and negative healthcare provider outcomes, with good coworker support associated with better psychological health among health professionals.
NICU, Neonatal Intensive Care Unit.								

not reported in more than one study. Eight studies examined emotional experiences among only doctors,^{27,40,41} only female doctors,^{42,43} or both doctors and nurses.^{13,30,44} These studies associated making an error with personal distress of guilt or regret^{13,39,41,44} and workplace impacts of burnout.^{30,43} One of these studies demonstrated that doctors and nurses in a neonatal intensive care unit who were involved in an error reported higher levels of depression and burnout compared with those who had not or who had only observed an error.³⁰ One of the studies found that positive feelings of increased determination, attentiveness, and alertness were reported by hospital doctors and nurses in the UK and US after error in addition to negative emotions.¹³ Seven studies (4 qualitative) from 3 countries included only nurses.^{28,32–38} The largest of these studies with 1163 nurses from an acute public hospital in Singapore found that younger nurses and those with less work experience were likely to experience greater psychological and physical distress from making a mistake than their more experienced counterparts.²⁸ In the 7 studies that included only nurses, feelings of emotional distress reflective of the wider body of work were often described as closely linked with experiences of organizational processes including lack of feedback.^{28,32–38}

Evidence of Psychosocial Factors That Contribute to Emotional Experiences and Resultant Changes in Practice

Ten studies provided direct evidence of factors influencing clinicians' path of recovery from making an error, indicating possible moderators and/or mediators between making an error and its outcomes.^{13,26,27,30,31,40,44–47} In one of these studies, the relationship between experiences of an error and anxiety and depression was moderated by perceptions of coworker support.³⁰ In this study, making an error was associated with higher levels of anxiety and depression was present when perceptions of coworker support were low, but this association was not present when coworker support was high.³⁰ One study of 536 nurses across 5 hospitals in Greece found that accepting responsibility, seeking social support, positive responses from senior staff after a mistake, and emotional self-control were all positively associated with constructive changes in practice.²⁶ Managerial support was negatively correlated with defensive changes in practice in this study, meaning that clinicians reporting practising less defensively if they had management support after an error.²⁶ Conversely, perceived judgmental responses from a manager toward nurses who had made an error were associated with defensive changes in practice, which include one or more of the following: "getting more worried, feeling less confident at work, being more likely not to report errors, trusting others less and considering leaving profession."²⁶ Responses that were perceived to be negative from managers or more senior clinicians were also found to be associated with defensive changes in practice.²⁶ Similarly, seeking social support, as well as problem solving focused on addressing the factors contributing to the error, was a significant predictor of constructive changes in practice among perioperative nurses in the US.³¹

There was limited and mixed evidence from the included studies regarding the impact of patient harm resulting from an error on clinician's distress and/or recovery. In one study, anesthesiologists believed that their lives would be more likely to be effected by the mistake as its severity in terms of patient impact increased,²⁷ but emotional responses among physicians and nurses in the study of U.K. and U.S. clinicians did not identify any significant difference in the nature of emotional response by the level of patient harm resulting from an error.¹³

Coping approach was indicated as a factor that may moderate the relationship between making an error, emotional responses,

and constructive change. In particular, adaptive coping strategies were linked to constructive changes that improve clinical practice.⁴⁷ Eight qualitative studies and a survey study provided evidence of activities or experiences that influenced clinicians' coping approaches, with variations in the extent to which these activities were used by professional group and years of experience.^{13,26,29,31,45-49} One data set of 61 U.S. doctors' experiences was used in 3 qualitative studies that specifically explored posttraumatic growth after making a serious medical error.⁴⁵⁻⁴⁷ In these studies, doctors who coped effectively after making a serious error identified common techniques. These were talking about their error, disclosing it to patients and families, learning to accept their imperfections, and several techniques around learning and improvement as a direct result of the mistake.⁴⁶ These contributors to adaptive coping were presented in one of the articles as the following 5 elements of adaptive coping: acceptance, stepping in, integration, new narrative, and wisdom.⁴⁷ However, recent analysis of experiences of 413 pediatric surgeons demonstrated that more than 40% did not hear from anyone after their error.⁴⁹ While discussion of errors with peers and loved ones was commonly identified as an avenue for support that was valued after an error, the third study using this dataset highlighted that talking can be helpful or unhelpful depending on the nature of the conversation.^{45,49} Talking was critical to processing an error emotionally and for finding meaning, but conversations that minimize an error by simply providing reassurance or that are cruel, insensitive, or self-serving can be detrimental to recovery.⁴⁵

Five further qualitative studies described coping responses, often using problem- and emotion-focused descriptors to describe coping that sought to address the error and its healthcare impacts or the emotional ramifications for the involved clinician/s, respectively.^{13,26,29,31,48} Among perioperative nurses, planning to do things differently in the future, making a plan of action, preventing feelings from affecting other actions, and paying more attention when caring for patients were frequently identified.^{29,31} A further survey of 265 doctors and nurses found that facing up to the mistake and addressing the problem directly were associated with fewer detrimental impacts of making an error on the clinician. The authors indicate that these approaches may serve a reappraisal function to facilitate learning from the mistakes.¹³ Two further studies reported that nurses and less experienced general practitioners (GPs) were more likely to take emotion-focused approaches, such as seeking social support and talking to a supervisor or colleague about a medical error^{26,48} as compared with experienced GP counterparts. More experienced GPs were reported to cope better with errors by being more likely to tell, explain the incident, and apologize to the patient, to seek an explanation for, and to understand the error.⁴⁸ A cross-sectional survey analysis of medical trainees also identified their tendency to use less adaptive coping approaches, such as substance use and disengagement.³⁹

Evidence of coping strategies that were associated with poorer outcomes for doctors and nurses involved in errors were reported in 4 studies.^{13,26,29,31} These coping strategies included avoidance of the issue by taking leave from work, avoiding challenging situations, behaving as if nothing happened, and trying to keep others from realizing the magnitude of the error.^{13,29} While these behaviors were reported by some, they were uncommon in the included studies.^{13,29} A study of 272 perioperative nurses in the US demonstrated that escape/avoidance strategies were strongly associated with emotional distress among nurses in the sample.³¹ The nature of this relationship could not be determined from the study; those experiencing intense levels of distress may have needed to use escape as a coping mechanism or the coping mechanism may have led to greater emotional distress. Examination of the relationship between emotional responses, coping, and change in a study of

nurses in Greece indicated that while internally directed emotional responses (e.g., feeling guilty) were positively associated with constructive changes, when coupled with externally directed emotional responses (e.g., feeling angry at others), they were associated with defensive changes in practice.²⁶ This study further supported the finding that escape/avoidance and distancing strategies were positively correlated with defensive changes in practice.²⁶ A study of 265 U.K. and U.S. physicians and nurses identified a positive correlation between using emotion-focused coping strategies and feeling scared, and a negative correlation between problem-focused coping strategies and feeling upset. Avoidance-based approaches were negatively correlated with feeling interested.¹³ In this study, coping strategy was not a function of perceived harm resulting from the error or of the professional group.

To Construct a Testable, Psychosocial Model of Clinician Response and Recovery From Making a Medical Error

The team-based process for modeling undertaken through the narrative synthesis led to the preliminary Recovery from Situations of Error Theory (ReSET) model presented in Figure 2. Through this review, we have identified 2 parallel processes in error response and recovery: (a) institutional processing of an error event and (b) an individual clinician's emotional processing of an error event, which includes emotions and psychological experiences that arise and their resolution. Institutional processing may only occur where an error is known beyond the clinician directly involved and/or is reported. Where an error is known, and particularly if it is harmful to a patient, institutional processing can include immediate patient management, notification to the institution and those involved, investigative process, and support to all parties.⁵⁰ Where an error remains unknown to those other than the clinician involved and/or their intimate circle, emotional processing still occurs. The ReSET model therefore focuses on an individual clinician's emotional processing of an error event, within which experiences of institutional processing may be a contributing factor. Institutional processing may be influenced by societal, legal, and cultural contexts that may be considered when applying this model. Table 2 provides examples of the model components.

Using the evidence derived in this synthesis, individual attributes, such as personality traits, are likely to influence experiences and recovery. These may include personal coping style (the way an individual generally copes across situations rather than a coping approach or strategy used in a particular situation), psychological resilience (which is comprised of three elements: attribution style, mental flexibility or perfectionism, and self-esteem), and previous experiences.^{13,45-47} These individual attributes are in themselves malleable and subject to change over time, but at the given point of error realization, these are important foundational factors that seem to have some influence in how an individual responds to making an error. Individual attributes and past experiences may influence the coping approach taken and the extent to which conversations and learning or development activities are perceived to be helpful along the path of recovery. The role of individual attributes and their relationship with error recovery are not strongly represented in the review evidence but apparent from wider psychological literature regarding individual differences in responses to perceived failure and in emotional regulation that underpin the ReSET model.^{20,51} With these individual attributes and past experience, individuals embark on emotional processing of an error and recovery, with the optimal outcomes being their psychological recovery and constructive change to improve care.

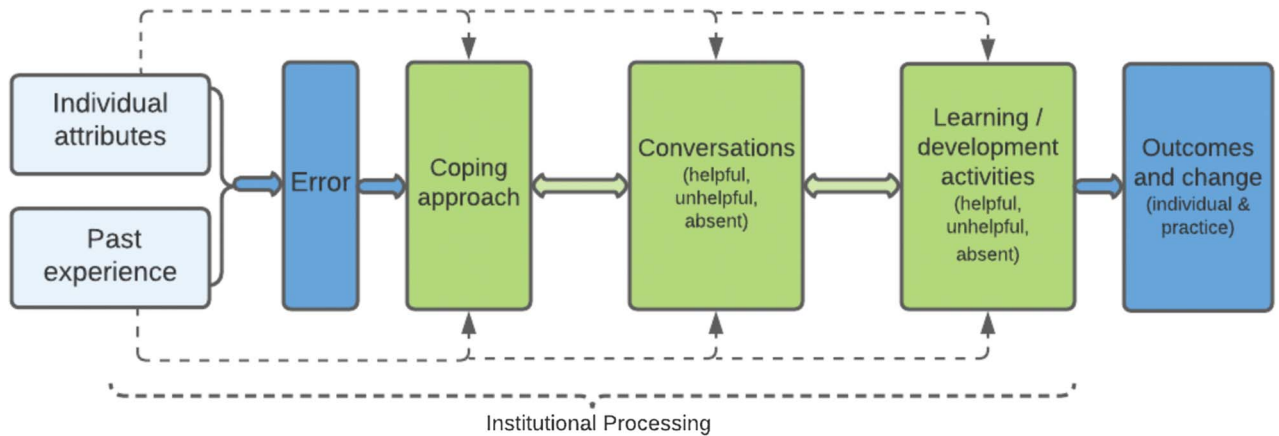


FIGURE 2. ReSET Model of Clinician Recovery

Emotional processing describes the feelings and psychological experiences that arise in response to realizing an error has occurred, which can influence a clinician’s ability to recover and to make constructive changes in response to an event. The 25 included studies provide substantial evidence of the types of emotional and psychological responses that arise after an error, including self-conscious emotions of shame and guilt alongside anxiety and depression.^{13,26,28,30} However, there is limited evidence of temporal differences in when emotions arise along the trajectory after an error beyond immediate feelings of anxiety and worry upon learning of the error.^{13,30–32} The ReSET model proposes that 3 major factors individually and collectively influence responses to error. The 3 factors are coping approach, conversations (absence of, helpful, and unhelpful); and learning or development activities (absence of, helpful, and unhelpful). These factors seem to influence outcomes of an error for individuals (psychological recovery) and for the system or service through clinicians’ ability to drive practice change that improves care. As such, these factors may be mediators and/or moderators of the relationship between making an error and its outcomes for individuals and their practice. There was also indicative evidence of possible relationships between these 3 factors, i.e., coping approach, learning or development activities, and coping approach with conversations. For example, people who use a problem-focused coping approach seem to recover more readily, but a problem-focused coping approach means that an individual is also more likely to seek out learning and development activities. In this way, there is a possible relationship between coping approach and learning and development activities. Causal links between coping approach, conversations, and learning or development activities could not be conclusively distinguished from the available cross-sectional, retrospective study evidence. The model therefore depicts the relationship between error experiences and outcomes as influenced by these 3 nonlinear factors.

TABLE 2. Examples of Potential Model Components

Coping Approaches	Learning/Development Activities	Conversation Types
Problem-focused	Training courses	Analytical
Emotion-focused	Supervision	Solution generating
Avoidance	Coaching	Silence
Denial	Mentoring	Reassurance
Defensive	Collaborative incident analysis	

Coping Approach

Evidence from the included studies indicates that problem-focused coping approaches, in which clinicians try to make sense of and address the circumstances and actions leading to their error, as being those that promote constructive change.^{47,48} Coping approaches that focus on avoidance or self-blame/self-critique were often associated with defensive changes in practice and less likely therefore to contribute to constructive change outcomes for the clinician, their patients, or organization.³¹ We propose that coping approach may be influenced by individual attributes and past experiences³⁴ but may also be associated with the degree to which particular types of conversations and development activities are perceived to be helpful. For example, those who take a problem-focused coping approach may find development activities that are focused to making sense of the error and its causes valuable.

Conversations (and Silence)

Three studies using one data set explicitly focused on the impact of talking and of silence in error experiences, with wider reference to the detrimental emotional impacts of silence on clinicians.^{45–47} Silence after an error as a result of not holding conversations with peers, with senior staff and/or with patients and families, was discussed as impeding emotional processing of an error experience. However, conversations did not always contribute to positive outcomes for health professionals or their practice.⁴⁵ The distinction between helpful and unhelpful conversations was notable and more subtly reflected in the findings of studies that made reference to positive or negative responses from peers or managers after a mistake.^{26,42} Conversations were often reported as a mechanism by which reactions and the judgement of peers and senior staff regarding an error were conveyed.^{29,40} Some studies indicated that helpful conversations were those that promote problem-focused coping in contrast to conversations of lesser value that focus on reassurance or were detrimental because they attribute blame or convey disapproval.^{26,45} It is possible that the degree to which conversations are perceived to be helpful is linked to an individual’s coping approach and individual attributes.

Learning or Development Activities

Learning or development activities are promoted after an error as part of continuous quality improvement. The use of such techniques could be considered characteristic of a problem-focused coping approach in that such activities seek to achieve constructive change. The perceived value of such activities may therefore be associated with an individual’s coping approach. Included studies

discussed experiences of learning or development activities after an error, identifying instances in which supportive and nonjudgmental development activities were helpful.^{31,42,46} While learning and development activities may promote constructive change, included studies indicated that such activities may contribute to detrimental emotional impacts for clinicians if administered poorly, with perceived negative inferences. Studies also described instances in which there was an absence of an approach to learning after errors, which was considered a gap.⁴⁰

DISCUSSION

Our resulting evidence-based theoretical ReSET model delineates the experiences directly contributing to a medical error and the recovery process that follows. The model, derived from an evidence synthesis, proposes the factors that contribute to the recovery process from the moment of error realization to the subsequent response to the event. Its application provides a basis to both structure and evaluate health service and systems interventions to mitigate the distress of making a medical error and to foster growth and adaptive recovery. The ability to provide evidence-based support is critical in light of the exposure to circumstances to error that clinicians face worldwide in the increasingly complex context of healthcare provision, illuminated by the COVID-19 pandemic.¹⁴ Our findings highlight an absence of studies that have explored the relationship between patient outcomes and the emotional or psychological distress of health professionals. Earlier evidence from a large-scale analysis of clinician experiences suggests that while responses to making an error may differ depending on the degree of patient harm, significant negative emotional fallout can occur even when there is little or no patient harm.⁵²

Using our ReSET model, health systems, services, and researchers can develop multimodal interventions to promote adaptive recovery from instances of error, supported by rigorous evaluation of their effectiveness in reducing the detrimental psychological and professional outcomes of contributing to an error. One application for ReSET is to provide a basis for the development of interventions that are embedded within clinician support and wellness programs internationally. Such programs exist to provide support and advice to clinicians regarding stressful workplace events, litigation, physical, and psychological health.^{10,12} Medical errors are known contributors to the distress that occurs across these areas; therefore, embedded tailored and theory-based interventions can support a diverse range of program content.

Our findings and resultant model highlight the central importance of coping approach coupled with the right kind of support based on individual preferences, characteristics, and contexts in promoting clinician well-being and in moving toward constructive changes when a mistake occurs. The available evidence indicates that a one-size-fits-all approach to the provision of support is unlikely to be suitable and that tailored, dynamic, and highly personalized support may produce optimal outcomes. A conversation or learning activity that is highly valuable for one clinician may not align with the coping approach and preferences of another. Coping approaches seem highly influential in determining the nature of support and learning/development activities that will be most helpful in influencing an individual's recovery from an error. The extent to which an individual or those around them can influence the coping approach that they adopt is less clear. Knowledge of the nature of the relationship between coping approaches and the support and learning activities that are helpful after an error is crucial toward the development of tailored programs.

In identifying and synthesizing the available evidence toward the ReSET model, several questions emerged that remain unanswered in the current evidence base. In the wider literature, many

studies have examined and reported individual and often work-related factors that contribute to the occurrence of error and/or error reduction. Levels of clinician burnout, depression, work-related stress, mentorship, and their ability to feel hopeful have been consistently identified as associated with the number of errors made.^{53–57} The presence of mentorship and hopefulness are identified as possible protective factors that minimize the number of errors made and/or their severity.^{53,54} These factors may have some relevance to responses after an error but have not been explored in this context. For example, systematic review evidence beyond healthcare suggests that factors such as burnout, self-esteem, and attribution style may buffer emotional distress in the context of errors of failure,²⁰ yet the influence of these individual level factors on clinician responses to being involved in an error and their ability to cope was not examined in identified articles over the past 10 years.

Our findings and resultant model are subject to the limitations of both the review process and included studies. A comprehensive and systematic approach to evidence identification, review, and data extraction ensured that those studies relevant to the review aims and in the academic domain were retrieved where possible. As no gray literature were explored, it is possible that relevant works produced by health systems and services were omitted. The search terms were developed by a multicountry team who has extensive expertise and experience on the research topic, supported by an experienced medical librarian. It is possible that studies were not captured, which either used alternative terminology to describe and capture experiences of errors or evidence in studies that produced knowledge regarding experiences of error as an incidental finding. The included studies had variable study quality, and while some high-quality evidence was identified, studies predominantly relied on cross-sectional data of retrospective accounts of errors. These designs preclude advancement of knowledge regarding the temporal impacts of error involvement and are subject to recall bias.

CONCLUSIONS

Using theory-based interventions is important to ensure that interventions are developed with an understanding of how and why they work. Using our ReSET model as the basis for intervention development, health systems, services, and researchers can develop multimodal interventions to promote adaptive recovery from instances of error. These interventions may be embedded in wider support programs and supported by rigorous evaluation of their effectiveness in reducing the detrimental psychological and professional outcomes of contributing to an error. Our systematic review findings and resultant model highlight the central importance of coping approach coupled with the right kind of support based on individual preferences, characteristics, and contexts in promoting clinician well-being and in moving toward constructive changes when a mistake occurs.

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