TITLE:

A structured framework improves clinical patient assessment and non-technical skills of early career emergency nurses: a pre-post study using full immersion simulation

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/jocn.13284](https://doi.org/10.1111/jocn.13284)

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SOURCES OF SUPPORT

This study was funded by the New South Wales (NSW) Emergency Care Institute, NSW Agency for Clinical Innovation and NSW Ministry of Health, Australia. Funding was allocated to the collection and analysis of data.

Received Date : 10-Dec-2015

Revised Date : 30-Jan-2016

Accepted Date : 25-Feb-2016

Article type : Original Article

ABSTRACT

Aims and objectives: To evaluate the effect of the new evidence-informed nursing assessment framework HIRAID (**H**istory, **I**dentify **R**ed flags, **A**ssessment, **I**nterventions, **D**iagnostics, reassessment and communication) on the quality of patient assessment and fundamental non-technical skills including communication, decision-making, task management and situational awareness.

Background: Assessment is a core component of nursing practice and underpins clinical decisions and the safe delivery of patient care. Yet there is no universal or validated system used to teach emergency nurses how to comprehensively assess and care for patients.

Design: A pre-post design was used.

Methods: The performance of thirty eight emergency nurses from five Australian hospitals was evaluated before and after undertaking education in the application of the HIRAID assessment framework. Video-recordings of participant performance in immersive simulations of common presentations to the emergency department were evaluated, as well as participant documentation during the simulations. Paired parametric and non-parametric tests were used to compare changes from pre to post intervention.

Results: From pre to post intervention, participant performance increases were observed in the percentage of patient history elements collected, critical indicators of urgency collected and reported to medical officers, and patient reassessments performed. Participants also demonstrated improvement in each of the four non-technical skills categories: communication, decision-making, task management and situational awareness.

Conclusion: The HIRAID assessment framework improves clinical patient assessments performed by emergency nurses and has the potential to enhance patient care.

Relevance to clinical practice: HIRAID should be considered for integration into clinical practice to provide nurses with a systematic approach to patient assessment and potentially improve the delivery of safe patient care.

Keywords: Emergency nursing; Nursing assessment; Nursing model; Emergency service, Hospital; Clinical skills; Non-technical skills; Communication; and Patient Safety

What does this paper contribute to the wider global community?

- Evidence that application of the structured nursing assessment framework HIRAID improves the quality of nursing patient assessment and enhances non-technical skills including communication, decision-making, self-awareness and task management
- HIRAID has the potential to improve patient safety if implemented in the clinical setting

INTRODUCTION

Assessment is a core component of nursing practice and underpins clinical decisions in the delivery of safe patient care. Patient assessment in the emergency department (ED) is unique compared to other areas of clinical nursing as patients may present with a variety of complaints, non-specific signs and symptoms, and often without a prior medical diagnosis or available baseline data (Wears et al. 2010). The urgency of the patient's condition and treatment needs are therefore not immediately explicit

during the initial stages of ED care. When a patient first presents to the ED the triage nurse performs a brief assessment and allocates a triage category indicating how long the patient can wait for emergency care (Department of Health and Ageing 2009). After triage, patients are normally located to a treatment area where an emergency nurse performs a more comprehensive assessment and commences further investigations, interventions and emergency care to meet the patient's clinical needs. Emergency nurses must perform accurate and comprehensive patient assessment to determine the urgency and treatment needs of patients who present to the ED.

The high risk ED clinical environment makes patients vulnerable to adverse events, threatening their safety. The prevalence of preventable adverse events occurring in the ED range from 36% to 71%, most commonly related to poor clinical management, incorrect diagnosis and medication errors (Stang et al. 2013). Strategies are needed to improve clinical performance of emergency care clinicians, to reduce the incidence of preventable errors and optimise patient outcomes.

To perform accurate and timely comprehensive patient assessments, emergency nurses must possess a high standard of knowledge as well as competence in technical and non-technical assessment skills. Technical skills are the procedural or clinical skills which clinicians must be competent in to diagnose, monitor and treat patients (Kodate et al. 2012). Non-technical skills are described as how individuals interact, encompassing social and cognitive skills that underpin technical skills (Kodate et al. 2012). A review of the literature reported nine core non-technical skills specifically linked to patient safety and error in the ED: communicating, managing workload, anticipating, situational awareness, supervising and providing feedback, leadership, maintaining standards, using assertiveness, and decision-making (Flowerdew et al. 2012). Emergency nurses must be skilled at accurately reporting assessment findings and nursing care in written form, but also verbally when escalation of care is required (Munroe et al. 2015b).

BACKGROUND

A review of the literature reported that the application of structured patient assessment frameworks improves the assessment performance of nurses and medical staff working on wards and in the ED in select patient groups (e.g. chest pain) (Munroe et al. 2013). Limited evidence was also found indicating a structured approach to patient assessment enhances clinical documentation, care delivery and subsequent patient outcomes (Munroe et al. 2013). Whilst the primary survey provides an evidence-informed, systemic approach to patient assessment that may be used by nurses regardless of the patient's presentation to readily identify patient deterioration (Considine & Currey 2015), there is currently no known universal system used to teach nurses new to the ED how to comprehensively assess and care for patients after triage.

To address this gap in clinical practice, HIRAID (**H**istory, **I**dentify **R**ed flags, **A**ssessment, **I**nterventions, **D**iagnostics, reassessment and communication) (Figure 1), an evidence-informed patient assessment framework was designed to provide emergency nurses with a systematic guide to patient assessment and clinical documentation after ED triage (Munroe et al. 2015b). The seven HIRAID assessment components and their importance in the emergency nursing assessment process are presented in Table 1.

Education in the HIRAID framework as an approach to the initial comprehensive assessment of simulated emergency patients decreases emergency nurses' anxiety and increases self-efficacy in assessment performance (Munroe et al. 2015a). This study hypothesises that application of the HIRAID assessment framework will improve the quality of patient assessment performed by emergency nurses and fundamental non-technical skills including communication (verbal and written), decision-making, self-awareness and task management.

METHODS

Study design

A pre-post design was used to evaluate the impact of education in the application of the HIRAID assessment framework (intervention) on emergency nurses assessment performance in December 2013. HIRAID was evaluated in the simulated setting guided by the Knowledge to Action Cycle which recommends that newly devised tools must be tested prior to implementation, to determine the validity of the tool and its usefulness in the clinical setting (Graham et al. 2006).

Sample and recruitment

Registered nurses with less than three years post graduate experience were invited to participate in this study through an expression of interest placed in six regional and metropolitan Australian emergency departments. Both regional and metropolitan hospital sites were selected to test the feasibility of the intervention across different emergency settings where education programs and resources vary. Participants with less than three years post graduate experience were selected due to a recent increase in early career nurses working in the ED (Baumberger-Henry 2012, Glynn & Silva 2013). Appropriate education is necessary to assist novice nurses to cope with the stress associated with beginning their nursing career (Parker et al. 2003) and to develop confidence working in the ED clinical environment (Baumberger-Henry 2012). Sample size calculations were performed using G*Power 3.1.3 (Faul et al. 2007). A sample of 34 was estimated to provide 80% power to detect statistically significant differences in assessment performance pre to post HIRAID education, with 2-tailed alpha <0.05 and a medium (0.5) effect size.

Eighty six eligible nurses were identified and invited to participate in the study. Forty (46.6%) nurses from five hospital sites agreed to participate. Two were unable to attend (sickness and work commitments) leaving a final sample of 38 participants. A number of nurses indicated they did not want to participate in the study as they did not like the idea of being video-recorded. Reluctance of emergency nurses to being filmed has been previously reported in the simulation literature (Rosenzweig et al. 1999).

Ethical considerations

Ethics approval was granted from the relevant Human Research and Ethics Committee (HREC approval: LNR/13/WMEAD/44). ED nurse managers and hospital executives were approached and permission granted to conduct the study and accommodate nursing rosters to enable nurses to participate. Agreement was also sort and granted from managers from two Simulation Laboratories for the use of their facilities. Participation in the study was voluntary and written consent was obtained from participants prior to undertaking study activities.

Intervention

All participants completed a four hour interactive education workshop, designed to teach the critical components and application of the HIRAID assessment framework. The workshop was delivered by a team of experienced emergency nurses and comprised of three sessions: 1) introduction to the seven critical HIRAID components (Table 1) (90 minutes); 2) how to document and communicate effectively (60 minutes); and 3) application of HIRAID in the clinical setting (90 minutes). A 15 minute break was provided between sessions.

The first session comprised of a demonstration video of a nurse performing an initial patient assessment with and without following the HIRAID assessment framework. Power-point presentations, group discussions and activities were used to teach the HIRAID assessment components. Case studies and role plays were used to provide participants with opportunity to practice applying HIRAID on a variety of common patient presentations to the ED.

In the second session, participants were instructed on communication strategies and then divided into small groups during which case studies and role plays were used to provide participants opportunity to practice verbal and written communication skills. Participants were educated in the use of the structured communication tool ISBAR (Introduction, Situation, Background, Assessment, Recommendations/ Requests) reported to improve the quality of the handover process (Australian Commission on Quality and Safety in Health 2009). Graded assertiveness, a four step escalation tool, was also discussed as a strategy in communicating concerns about patients to medical officers (MOs)

(Curtis et al. 2011). Participants were informed how to document their emergency nursing notes using the HIRAID structure.

The last session of the workshop revised the seven HIRAID assessment components followed by a demonstration of how HIRAID should be applied in clinical practice. Participants were divided into small groups and practiced applying the complete HIRAID assessment framework in role plays. To conclude, a group discussion was conducted on how participants would apply HIRAID when they return to the clinical setting.

PowerPoint presentations, videos, group discussions and in-class role play were integrated into the workshop to meet the different learning styles of participants and promote principles of experiential and transformative learning, by acknowledging the importance of experience, reflection and attitudes to generate learning (Fowler 2007, Matthew-Maich et al. 2010). Immersive patient simulation was not used as part of the education intervention.

Simulated scenarios

Using immersive simulation techniques, participants were individually videorecorded performing an initial patient assessment and commencing nursing care for a simulated patient presenting to the ED, both before and after participating in the HIRAID workshop (intervention). Two different simulated clinical scenarios were developed and validated using a systematic evidence-informed process reported to achieve a high degree of realism (Munroe et al. 2016). The scenarios were based on real emergency patients and representative of two from the top ten most common presentations to EDs in New South Wales (Health Information Exchange 2013): abdominal pain (Scenario A) and shortness of breath (Scenario B). Scenarios were randomly assigned so that half of the participants performed Scenario A and the other half Scenario B pre-intervention and each were assessed using the alternative scenario post-intervention.

The scenarios were standardised through the use of a scenario template with the intention of combining them for pre-post analysis. A similar level of complexity was integrated into the two scenario scripts and a similar number of critical indicators and treatment needs were factored into each scenario. Both scenarios were validated by three emergency physicians and a simulation expert / anaesthetist. Additionally, both scenarios were pilot tested by six experienced emergency nurses to ensure consistency in delivery.

Each scenario consisted of a patient allocated to a bed after presenting to the ED and already triaged. After receiving handover the participant was responsible for performing an initial comprehensive patient assessment and commencing nursing care. The scenarios lasted for 17 minutes during which

the participant was required to carry out clinical documentation and handover care of the patient to a receiving nurse at the end of the scenario, as they would in the real world clinical setting.

Professionally trained actors were paid to play the role of the patient in both scenarios. Supportive roles which included a medical officer (if requested by the participant) and a registered nurse, who delivers and receives clinical handover on the patient, were carried out by registered nurses experienced in emergency nursing. Physiological parameters were pre-programmed and made accessible to participants via the patient's cardiac monitor, which was controlled remotely through SimMan®.

Instruments

Participants' demographic data were collected at the beginning of study days. Participants' performance was evaluated using a data collection instrument developed specifically for this study, as no relevant validated tools were identified. The data collection instrument comprised of an observation and documentation checklist for each scenario and a non-technical skills scale. The observation checklists measured the percentage of relevant items performed in each of the seven HIRAID assessment components presented in Table 1. Efficiency of the nursing assessment was assessed through measuring the time from the beginning of the scenario to the first time the nurse consulted with a MO. Patient history items, red flags and assessment items were categorised to indicate if they were performed before or after the first consultation with a MO. Skills were only included in the checklists if they could be objectively measured through observation, either performed or verbalised by the participant. The documentation checklists assessed the completeness and accuracy of the patient's medical record through measuring the completeness of the seven HIRAID assessment components recorded during each simulated clinical scenario.

As no validated scales were identified to evaluate the non-technical skills of emergency nurses (Jepsen et al. 2015), the Anaesthetics Non-technical skills (ANTS) scale (Fletcher et al. 2003) was adapted for this study and referred to as the Emergency Nurses' Non-technical Skills (ENNTS) Scale. This scale consisted of 12 items divided into four skill categories reported as critical to patient safety in the ED (Flowerdew et al. 2012) including: communication (coordinates activities, exchanging information, using authority and assertiveness), task management (planning and preparing, prioritising, identifying and utilising resources), situation awareness (gathering information, recognising and understanding, anticipating); and decision-making (identifying options, balancing risks and selecting options, re-evaluating). The quality of each non-technical skill was rated on a three-point Likert scale: 1) poor (performance indicated cause for concern, endangered or potentially endangered patient safety, considerable improvement is needed); 2) acceptable (Performance was of satisfactory standard but could be improved); and 3) good (performance was of consistently high standard, enhancing patient safety; it could be used as a positive example for others).

The ANTS system was originally designed to evaluate behaviour of anaesthetists and comprised of four skill categories: teamwork and communication, task management, situation awareness and decision making (Fletcher et al. 2003). The internal consistency of the original ANTS scale has been reported with Cronbach's alpha ranging from 0.79 to 0.86 in the four skill categories (Fletcher et al. 2003). In this study the total ENNTS scale had a high internal consistency with Cronbach's Alpha coefficient of 0.94 pre and 0.97 post intervention. The Cronbach's Alpha of the skills categories ranged from 0.74 (decision-making pre-intervention) to 0.94 (task management post-intervention).

Data management and analysis

A blinded review of participants' individual performance in the simulated clinical scenarios was conducted by three doctoral trained registered nurses, two with specific expertise in emergency nursing and one critical care nurse experienced in simulation education. An audit of 20% of the 76 scenarios performed, demonstrated 99% consensus between the three reviewers.

Data were entered into Microsoft® Excel prior to being imported to SPSS version 22.0 for statistical analysis. Descriptive statistics were used to summarise sample characteristics. Participant scores were calculated as a percentage of the total possible score for each assessment component. Summative scores were calculated for overall non-technical skills and skill categories. Means and standard deviations, or medians and the associated interquartile range (IQR) are reported as appropriate. Logit transformation was conducted on proportional data prior to analysis. Parametric and non-parametric tests were used as appropriate and effect sizes or 95% Confidence Intervals (CI) of the differences were computed to compare for differences in outcomes from pre to post HIRAID education.

RESULTS

Participant demographics

Sample characteristics are presented in Table 2. When compared to the international nursing workforce demographic, the sample was younger and had a higher proportion of male nurses (Canadian Institute for Health Information 2011, Health Resources and Services Administration et al. 2013, Health Workforce Australia 2014).

Pre and post HIRAID intervention comparison

From pre to post assessment, there was a significant improvement in the completeness of the patient assessment performed, with an increase in the percentage of patient history elements identified before the first MO consult and throughout the total duration of the scenario (Table 3). Participants identified a higher proportion of critical indicators of urgency and communicated a higher proportion of critical

indicators to the MO (Table 3). After participation in the HIRAID education there was an increase in the percentage of reassessments performed by participants (Table 3). Communication skills of participants improved from pre to post intervention and a higher number of nurses specifically requested that the MO review the patient in the post-intervention scenario compared to pre-intervention (Table 3). There was an increase in the number of nurses who were observed to use both graded assertiveness and the ISBAR structure (Table 3).

The total non-technical performance score was higher in the post-intervention assessment compared to pre-intervention (Table 4). Significant improvements were also seen in all four non-technical skill categories (Table 4).

DISCUSSION

Application of the HIRAID assessment framework improved the completeness and efficiency of emergency nurses when conducting patient assessments in the simulated setting. Non-technical skills including communication, decision-making, situational awareness and task-management were all enhanced when applying the HIRAID approach to patient assessment. These outcomes extend previous reports that the application of the HIRAID assessment framework increased self-efficacy and reduced anxiety, when conducting patient assessments in an immersive simulated setting (Munroe et al. 2015a).

Patient assessment

Ability to perform comprehensive patient assessments is likely to assist emergency nurses to develop a comprehensive understanding of the patient's condition and identify the urgency and treatment needs of patients. Application of the HIRAID assessment framework improved the efficiency and completeness of patient history collected by emergency nurses. Collecting an effective patient history in the ED can be challenging due to the many interruptions and communication barriers experienced by emergency clinicians (Burley 2011). Failure to follow a systematic approach has also been identified as a contributor to poor history taking (McKenna et al. 2011). HIRAID provides emergency nurses with a systematic approach to collecting a patient history, resulting in a more complete patient history being conducted.

Application of the HIRAID approach to patient assessment improves recognition and reporting of critical indicators of urgency. Various escalation tools have been designed in Australia and worldwide to assist nurses to detect and respond to physiological signs of clinical deterioration, such as the

Medical Emergency Team (MET) call criteria (MERIT study investigators 2005) and the Emergency Clinical Instability Criteria which is the only published ED specific tool (Considine et al. 2012).

Whilst these tools are effective in identifying physiological changes indicative of clinical deterioration, they do not collect patient history data which indicate potential for clinical instability. Many clinical guidelines have been developed to elicit clinical and historical factors to identify patients at risk and guide treatment for specific conditions such as sepsis (Clinical Excellence Commission 2013). HIRAID is the first known conceptual assessment framework designed to inform the comprehensive nursing assessment of patients who present to the ED (including a complete patient history and physical assessment), which may be applied to any clinical presentation and has been reported to improve emergency nurses' recognition and reporting of both historical and physiological critical indicators.

Improvements in the reassessment of patients presenting to ED as a result of the HIRAID assessment framework has potential to lead to better patient outcomes. The reassessment and ongoing monitoring of patients is considered necessary to prevent gaps in care and optimise patient safety (Jones et al. 2014). This includes the evaluation of treatment which is essential to determine if the treatment provided was effective, to identify any changes in the patient's health status and if further intervention is required.

It is not apparent why the percentage of relevant initial assessments, diagnostics and number of interventions performed by participants did not change from pre to post intervention. The HIRAID education focused on the critical components and structure of emergency nursing assessment, but did not teach the technical knowledge and skill necessary to carry out these skills. As such, participants may have learnt that a particular task was indicated but did not have the capability to carry out the task. Further education and training related to enhancing clinical knowledge and skills may be required to optimise the impact of the HIRAID assessment framework in emergency nurses' overall clinical performance.

Communication

The positive improvement seen in nurses' communication skills when applying the HIRAID assessment framework will likely also enhance the exchange of information between health clinicians in the clinical setting. In the ED, communication can be difficult as clinicians are often required to multi-task and experience frequent interruptions, which can contribute to failures in safe care delivery (Wears et al. 2010). Failure to communicate effectively may result in information being misinterpreted or changed, resulting in adverse events and poor patient outcomes (Garling 2008).

The increased use of graded assertiveness and a structured approach to clinical handover, resulting from the application of HIRAID, will likely assist nurses to accurately and effectively communicate important patient information and lead to safer patient care. Doctor-nurse communication is a critical component of patient safety in the ED. When an emergency nurse recognises their patient exhibiting signs of clinical deterioration or a potential risk for serious illness or injury, it is imperative that the nurse communicates this to a senior MO. Information about the patient communicated to the MO can trigger pattern recognition and assist MOs to form decisions about diagnosis and treatment (Croskerry 2009). Poor communication between emergency nurses and MOs can lead to missed or delayed diagnosis (Kachalia et al. 2006) and medication errors (Creswick et al. 2009).

Overall, the completeness of clinical documentation in this study was poor. Frequent interruptions, lack of motivation to enter information, poor competence and poor supervision of clinicians have all been reported to contribute to poor nursing documentation (Paans et al. 2010). It is unclear why the accuracy and completeness of the documentation did not improve when applying the HIRAID assessment framework. It may be due to the limited duration of the HIRAID intervention and time focused on teaching how to effectively document. Further investigation is needed to understand these outcomes and refine the HIRAID intervention to improve clinical documentation.

Decision-making

The decision-making skills of emergency nurses significantly improved when applying the HIRAID assessment framework. Emergency nurses are required to make regular clinical-decisions which inform their actions, often based on limited information and in situations that require rapid intervention. Clinical decision-making is considered knowledge-based work which involves high levels of cognition where human errors commonly occur (Crosskerry 2003). In the ED this is attributed high levels of occupational stress and emotional burnout which can interfere with cognitive load (Adriaenssens et al. 2011).

The ability to make sound clinical judgements requires the ability to recognise cues, balance risks and select options and perform ongoing re-evaluation to ensure the correct decision has been made (Fletcher et al. 2003). Novice nurses do not have the clinical experience to draw from and tend to be more task orientated, which can result in responding to unfamiliar clinical situations without addressing the complexity of the situation (Gillespie & Peterson 2009). HIRAID has the potential to promote an analytical approach to decision-making through assisting nurses to collect relevant patient data and critically thinking about the available evidence to inform their clinical judgements. An analytical approach to decision-making has been reported to hold greater scientific rigor than intuitive thinking and leads to less clinical errors (Croskerry 2009). Enhanced critical thinking was however

not reflected in the clinical documentation in this study, as the completeness of the clinical record did not improve after undertaking education in the HIRAID assessment framework.

Situational awareness

Emergency nurses' demonstrated better situational awareness when applying the HIRAID assessment framework. Demanding workloads, time pressures, distractors and fatigue common to the ED can impair situational awareness (Wise et al. 2010). High levels of situational awareness have been linked with a reduction in human error and adverse events, and better patient outcomes (Fore & Sculli 2013).

Task Management

The HIRAID assessment framework provides emergency nurses with a structured approach to prioritising tasks improving their ability to manage their work within the resource limited ED environment. There are a number of workforce issues that affect the efficiency of care delivery in the ED including nursing shortages (Garling 2008) and stretched hospital budgets (Australian Medical Association 2014) through limiting available resources. Failure to deliver care in a timely and coordinated manner may be detrimental for the patient, resulting in increased morbidity and mortality (Lees et al. 2010).

Limitations

This study was tested on a purposeful sample of registered nurses with less than three years post graduate experience and did not evaluate the effects of the HIRAID assessment framework when applied by more experienced nurses. Less than fifty percent of the target population participated in the study, however according to sample power calculations, the sample size was considered large enough to detect statistical and clinical differences when comparing participant performance before and after exposure to the HIRAID intervention. The study used a pre-post design which did not enable comparison of performance in participants who were not exposed to the intervention. The use of a control group in future research studies would provide further insight into the effects of HIRAID. Whilst the observation and documentation checklists had not been tested prior to this study, they were reported to have a high level of face validity and internal reliability. The impact of HIRAID on communication with the patient was not evaluated and warrants consideration, as effective nurse-patient communication is needed to collect an accurate patient history (McKenna et al. 2011). The impact of HIRAID on the quality of the clinical documentation was also not investigated and should be considered for future studies, including the level of detail provided and linkage between assessment findings and nursing actions necessary to support clinical judgements (Paans et al. 2010).

CONCLUSION

Application of the HIRAID assessment framework improves the quality of patient assessment performed by emergency nurses. High quality patient assessments are essential to determine priorities in patient care and ensure safe patient care delivery. Future research on the experiences and perceptions of nurses in applying HIRAID will direct how to refine and successfully implement HIRAID into the clinical setting.

RELEVANCE TO CLINICAL PRACTICE

HIRAID should be considered for integration into clinical education programs to provide nurses with a systematic approach to patient assessment and potentially improve the delivery of safe patient care. The development of a structured implementation plan is essential to ensure the successful implementation and sustainability of HIRAID once introduced into clinical practice. Additional evaluations of HIRAID in the clinical setting will provide further insight into the effects of HIRAID on clinicians' performance and patient care delivery.

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Table 1: Description of the seven HIRAID assessment components, their importance in emergency nursing patient assessment and measurement items for each assessment component

HIRAID assessment component	Description	Rationale	Measurement Items
History	Collection of information about the patient's presenting problem and individual health history	Directs physical assessment and informs investigations and priorities in patient care (Kessenich 2008)	<ul style="list-style-type: none"> • Patient history questions asked / documented • Review of relevant patient history sources
Identify red flags (critical indicators of urgency)	Recognition of historical and physiological critical indicators of urgency, which indicate the patient is critically unwell or has the potential to deteriorate	Timely recognition of critical indicators is necessary to escalate care, provide appropriate clinical response and management and reduce morbidity and mortality (Jacques et al. 2006)	<ul style="list-style-type: none"> • Critical indicators of urgency collected, documented and reported to medical officer and nurse e.g. tachycardia, history of ectopic pregnancy
Assessment	Clinical examination of the patient, including the primary survey, vital signs and relevant focused assessments	Identifies signs and symptoms needed to determine the urgency of the patient's condition, formulate diagnosis and inform treatment (Considine & Currey 2015)	<ul style="list-style-type: none"> • Vital signs performed and documented • Focused assessments performed and documented • Documentation of primary survey
Interventions	The delivery of prioritised and evidence-based nursing care informed by assessment findings	Ensures patients receive the most urgent treatments first and that treatments will optimise patient	<ul style="list-style-type: none"> • Interventions performed or requested MO to perform and documented e.g. inserts or requests MO to insert

		outcomes (Schuster et al. 2005)	peripheral intravenous cannula
Diagnostics	The ordering, performing and reviewing of diagnostic tests	Important for diagnosing or excluding disease and informs treatment decisions (Considine et al. 2013)	<ul style="list-style-type: none"> Investigations performed or requested MO to perform and documented e.g. nurse collects or requests MO to collect blood pathology
Reassessment	Ongoing monitoring of the patient's condition and evaluation of treatment	Essential to ascertain patient progress and response to interventions (Jones et al. 2014)	<ul style="list-style-type: none"> Vital signs and focused assessments performed post interventions Documentation of evaluations post interventions
Communication	<p>Interaction with the patient and other health care professions</p> <p>Documentation of assessment findings and patient care delivered in patient's medical record</p>	<p>Vital for the collection (McKenna et al. 2011) and dissipation of important patient information (Porteous et al. 2009)</p> <p>Important for the exchange of critical patient information between health clinicians and is a legal requirement providing evidence of care delivered (Urquhart et al. 2009)</p>	<ul style="list-style-type: none"> Requests MO to assess patient Use of the structured clinical handover tool ISBAR Use of graded assertiveness Documentation of communication with other health professionals

Table 2 Sample Characteristics

Characteristic	Number (%)	Characteristic	Number (%)
Age in years mean (range)	29.45 (21-49)	ED clinical areas worked in:	
Female	29 (76.3)	Acute or subacute area	38 (100.0)
Male	9 (23.7)	Short stay area/unit	33 (86.8)
Country of birth:		Minors/fast track/urgent care	30 (78.9)
Australia	30 (78.9)	Paediatrics	15 (39.5)
Other	8 (21.1)	Resuscitation room	14 (36.8)
English first language	35 (92.1)	Triage	3 (7.9)
Previous simulation experience	35 (92.1)	Clinical Initiatives Nurse	1 (2.6)
Work Status:			
Full-time	34 (89.5)		
Part-time	4 (10.5)		

Table 3 Changes in patient assessment items performed and documented during the simulated clinical scenarios pre to post intervention

Variable	Pre-intervention	Post- intervention	P value	Effect size
History				
Percentage of patient history elements identified				
Total Mean (SD)	39.7 (11.0)	45.0 (10.0)	0.02	-0.40 ^a
Before MO consult Mean (SD)	31.9 (12.8)	39.9 (10.3)	<0.01	-0.54 ^a
After MO consult Median (IQR)	4.0 (0.5 - 11.7)	0.5 (0.5 – 8.3) ^d	0.19	-0.21 ^b
Percentage of patient history elements documented				
Mean(SD)	24.0 (11.3)	27.7 (9.6)	0.11	-0.27 ^a
Red Flags				
Percentage of red flags identified				
Total Mean (SD)	63.4 (17.7)	70.8 (15.3)	0.02	-0.41 ^a
Before MO consult Mean (SD)	45.0 (27.1)	56.6 (19.5)	0.03	-0.36 ^a
After MO consult Median (IQR)	15.5 (0.5 - 30.5)	10.5 (10.5 – 20.5)	0.41	-0.13 ^b
Percentage of red flags handed over				
Total handed over Mean (SD) ^g	48.8 (16.6)	55.4 (14.1)	0.02	-0.37 ^a
Handed over to MO Mean (SD)	35.0 (16.6)	47.9 (15.0)	<0.01	-0.57 ^a
Handed over nurse Mean (SD) ^g	40.5 (15.9)	43.2 (15.2)	0.37	-0.15 ^a
Percentage of red Flags documented				
Mean(SD)	47.1 (17.0)	51.8 (16.6)	0.24	-0.20 ^a
Assessment				
Percentage of assessments performed				

Total Mean (SD)	61.0 (13.8)	61.0 (15.5)	1.00	0.00 ^a
Before MO consult Mean (SD)	50.2 (20.9)	48.9 (18.2)	0.75	0.05 ^a
After MO consult Median (IQR)	0.5 (0.5-13.0) ^d	13.0 (0.5 – 25.5)	0.39	-0.14 ^b
Percentage of assessments documented				
Total Median (IQR)	71.9 (64.8 – 80.9)	79.1 (64.8 – 86.2)	0.64	-0.08 ^b
Primary survey Median (IQR)	80.5 (80.5 – 100.5)	100.5 (80.5 – 100.5)	0.30	-0.17 ^b
Vitals signs (progress note) Mean (SD)	61.0 (28.1)	65.9 (23.4)	0.36	-0.15 ^a
Vital signs (observation chart) Median (IQR)	83.8 (63.0 – 100.5)	58.8 (0.5 – 88.0)	0.02	-0.38 ^b
Focused assessment Mean (SD)	24.2 (26.7)	30.3 (29.8)	0.37	-0.15 ^a
Interventions				
Percentage of interventions performed				
Median (IQR)	63.0 (56.1 – 75.5)	67.2 (61.3 – 75.5)	0.17	-0.23 ^b
Percentage of interventions documented				
Mean (SD)	27.3 (27.3)	35.5 (24.9)	0.20	-0.21 ^a
Diagnostics				
Percentage of diagnostics performed				
Median (IQR)	33.8 (17.2 – 43.4)	38.6 (17.2 – 57.6)	0.09	-0.28 ^b
Percentage of diagnostics documented				
Median (IQR)	0.5 (0.5 – 17.2)	14.8 (0.5 – 33.8)	0.05	-0.32 ^b
Reassessments				
Percentage of reassessments performed				
Mean (SD)	51.2 (28.8)	63.0 (28.9)	0.01	-0.42 ^a
Reassessments documented				

Evidence of any reassessment N (%)	15 (39.5)	21 (55.3)	0.18	-15.8 (-33.5, 3.55) ^c
Percentage of reassessments post interventions				
Median (IQR)	0.5 (0.5 – 25.5) ^e	0.5 (0.5 – 25.5) ^f	0.19	-0.21 ^b
Plan for ongoing care N (%)	8 (21.1)	11 (29.0)	0.58	-7.9 (-26.37, 11.26) ^c
Communication				
Frequency of communication performed				
Time to first MO consult (secs) Mean (SD)	258.92 (136.54)	222.13 (93.00)	0.22	0.23 ^a
MO consulted: N (%)	38 (100)	38 (100)		
MO review requested: N (%)	8 (21.0)	27 (71)	<0.01	-50.0 (-65.6,-28.0) ^c
Graded assertiveness used: N (%)	18 (47.3)	33 (86.8)	<0.01	-39.5 (-56.7,-17.6) ^c
MO handover structured using ISBAR N (%)	10 (26.3)	26 (68.4)	<0.01	-42.1 (-59.0,-19.8) ^c
Nurse handover structured using ISBAR N (%) ^g	11 (31.4)	21 (60.0)	0.03	-28.6 (-47.9,-5.25) ^c
Percentage of communication documented				
With MO (informing them of patient) N (%)	12 (31.6)	19 (50.0)	0.14	-18.4 (-37.5, 2.9) ^c
With nurse (reporting clinical handover at end of shift) N (%)	3 (7.9)	2 (5.3)	NA ^h	

^a paired t-test and effect size (Cohen's d): small=0.20 medium=0.50, large=0.80 (Cohen 1988)

^b Wilcoxon matched paired test and effect size (r coefficient): small = 0.10, medium = 0.30, large = 0.50 (Cohen 1988, Cohen 1992)

^c McNemar test and percentage difference Pre-HIRAID to Post-HIRAID (95% CI) (Swinscow 1997)

^d 52.6% of sample had a corrected proportion score of 0.5%

^e 71% of sample had a corrected proportion score of 0.5%

^f 55.3% of sample had a corrected proportion score of 0.5%

^g n=35 as three cases were excluded as the nurse handover was not video recorded and therefore could not be assessed

^h Sample size too small to compare difference

Table 4 Changes in non-technical skills from pre to post intervention

Non-technical skills category	Pre-intervention Mean(SD)	Post-intervention Mean(SD)	P value	Effect size (Cohen's d)^a
Total Score	19.13 (6.00)	23.66 (7.81)	<0.01	-0.71
Communication	4.66 (1.68)	6.26 (2.02)	<0.01	-0.85
Decision Making	4.89 (1.45)	5.71 (1.93)	0.01	0.-46
Situational awareness	4.68 (1.77)	5.58 (2.11)	<0.01	-0.48
Task management	4.90 (1.66)	6.12 (2.22)	<0.01	-0.70

^a paired t-test and effect size (Cohen's d): small=0.20 medium=0.50, large=0.80 (Cohen 1988)

Figure 1: HIRAID: An evidence-informed emergency nursing assessment framework © Curtis, Murphy, Strachan, Munroe, Lewis & Buckley (2014), adapted from Curtis et al (2009) reprinted with permission

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Title:

A structured framework improves clinical patient assessment and nontechnical skills of early career emergency nurses: a pre-post study using full immersion simulation.

Date:

2016-08

Citation:

Munroe, B., Curtis, K., Murphy, M., Strachan, L., Considine, J., Hardy, J., Wilson, M., Ruperto, K., Fethney, J. & Buckley, T. (2016). A structured framework improves clinical patient assessment and nontechnical skills of early career emergency nurses: a pre-post study using full immersion simulation.. J Clin Nurs, 25 (15-16), pp.2262-2274. <https://doi.org/10.1111/jocn.13284>.

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