Paediatric oncology simulation training for resident education

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ABSTRACT

Introduction We sought to evaluate paediatric oncology simulations intended to improve paediatric residents' skills and comfort in caring for children with cancer.

Method In a non-randomised trial, controls (the first three rotations) received a standard set of lectures, and the intervention arm received these lectures plus five simulation training scenarios—fever/neutropaenia, a new leukaemia diagnosis, end-of-life care discussion, tumour lysis syndrome and a mediastinal mass. All residents were tested after the rotation on the first three scenarios; management skills were evaluated independently by two raters. Before and after training, all residents completed an emotional-appraisal questionnaire evaluating each scenario as a perceived challenge or threat. Analysis of variance (ANOVA) measured differences by study arm in skills checklist assessments and appraisals; repeated measures ANOVA measured changes in emotional-appraisal scores.

Results Forty-two residents (9 controls, 33 interventions) participated. Inter-rater agreement for skills checklist scores using average-measures intraclass correlation was high (0.847), and overall mean scores were significantly higher for the intervention than control group across both raters ($p=0.005$). For all residents, perceived challenge increased in the end-of-life simulation, and perceived threat decreased in all three test scenarios. The intervention group, regardless of training year, evaluated the teaching scenarios favourably and felt that challenging oncology situations were addressed, skills were enhanced and the simulations should be offered to other residents.

Conclusions It was feasible to introduce residents to difficult paediatric oncology scenarios using simulation. The intervention group performed more skills than controls when tested and perceive threat declined in all residents after their paediatric oncology rotation.

INTRODUCTION

A concern that work-hour restrictions in postgraduate medical training reduces patient exposure and leads to underdeveloped skills to care for critically ill patients and their families has prompted the development of alternative innovative teaching modalities including simulation.¹ Simulation is used in a variety of settings and adapting this modality to paediatric oncology may improve the quality of residents' training and enhance care delivery. Simulation has been used in medical education and has been shown to be superior to problem-based learning for teaching patient assessment and management skills.² Simulation has been

incorporated into nursing training to improve recognition of deteriorating patients and in graduate medical education including internal medicine, surgery, anaesthesia, emergency medicine and paediatric resident education programmes.^{3–11} In paediatrics, specifically, simulation has been used to teach resuscitation, trauma, airway management and procedures^{3 8 12 13} and has been associated with an increase in residents' technical and communication skills.^{7 8 12–14}

Optimal paediatric oncology care requires providers who are skilled at medical management and compassionate care delivery. Resident training often focuses on the complexities of medical care but does not always effectively teach communication skills needed in the care of children. Caring for critically ill patients, such as paediatric cancer patients, is stressful for new physicians, who may feel unprepared to manage these patients and anxious talking with families.^{14–17} Communication skills are difficult to teach, although parents value good communication with the healthcare team.¹⁸ The complexity of medical management, with the emotional stress of communicating with families, makes teaching residents proper management of paediatric oncology emergencies difficult and thus is a prime area where the safe, non-threatening modality of simulation could be impactful.

Ninety paediatric residents at Washington University were surveyed in 2011 about their perceptions of the paediatric oncology curriculum; 50% felt that their educational needs were not met, and 25% stated that they did not have a positive experience during this rotation. Residents consistently reported high levels of anxiety caring for paediatric oncology patients. In response to these concerns, a simulation programme was developed and implemented with the goal to enhance residents' experiences, improve skills and alleviate anxiety while caring for this special patient population.

To our knowledge, there are no published studies of simulation-based training for paediatric residents in paediatric oncology. These patients present unique challenges in their disease processes, medical treatments and emotional support needed by patients and families. The acuity of illness and potential for rapid deterioration requires physicians swiftly handle emergent situations while maintaining composure and remaining attentive to the emotional needs of the patient and family. Through simulation, complex medical problems are presented in a controlled and supportive environment to enrich learning and improve clinical care. Emotional appraisals are used in other settings to determine the perceived challenge or threat of a

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situation,^{19–22} but these measures have not been used in paediatric oncology. Implementation of such a tool is a novel way to assess resident's perceptions of caring for this unique patient population. We hypothesised that simulation training would improve residents' clinical management skills and emotional appraisals of difficult situations.

METHODS

Following Institutional Review Board approval, all paediatric residents (postgraduate years (PGY) 1, 2 and 3) in 2011–2012 at Washington University were invited to participate in a pilot feasibility study during their 1 month oncology rotation. All residents who rotated during the study period consented to participate, and each was given a unique identifier. To avoid cross-contamination of controls to the simulation training intervention, residents who completed the first three paediatric oncology rotations at the beginning of the academic year comprised the control group; this group attended only the rotation-specific, mandatory, standard set of paediatric oncology lectures, which all residents received on the rotation. Residents completing the paediatric oncology rotation after that comprised the intervention group and received the lectures plus simulation training.

Simulation training included five newly created paediatric oncology scenarios: management of (1) fever/neutropaenia, (2) disclosure of a new leukaemia diagnosis, (3) end-of-life discussion, (4) tumour lysis syndrome and (5) mediastinal mass. These clinical scenarios, commonly encountered by residents, were chosen and developed by paediatric oncology faculty because they require substantial understanding of paediatric oncology complications and management. Development of cases included choosing paediatric oncology cases and developing a brief history of the present illness, simulated clinical findings, including vital signs and physical exam findings, and algorithms for changes in the mannequin when various interventions were proposed. The simulation was conducted in the Saigh Simulation Center at St. Louis's Children's Hospital, using the METI manikin. After orientation to the manikin's capabilities, residents in the intervention group participated in a group simulation training led by a faculty member specially trained to deliver the simulated cases. Training for faculty members who led the simulations took 1 hour and involved reviewing the design and goals of the simulated scenario, the physiological changes occurring with each simulation and the tasks expected to be completed to manage the scenario. The five simulations were delivered in the same order each time and lasted 15–20 min each, for a total of 1.5–2 hours of simulation training. Following each case, the faculty trainer provided feedback, addressing optimal management of the scenario, reviewing the skills checklist for each case and giving verbal feedback on the residents' performance as a group.

At the end of the rotation, each resident's management of acute oncology situations was evaluated by completing three of the training scenarios (fever/neutropaenia, disclosing a new leukaemia diagnosis and discussing end-of-life care). The new leukaemia diagnosis and end-of-life care discussions included interaction with a standardised parent actor to create the intense nature and anxiety-provoking potential for paediatric residents. Only three cases were tested due to limited time and feasibility of testing all residents at the completion of their rotation. Each resident's performance was independently evaluated by two raters using a case-specific skills checklist (fever/neutropaenia: 11 tasks; disclosing a new diagnosis: 12 tasks;

and discussing end-of-life care: 7 tasks); residents also were given a global performance score (rated 1 (unsatisfactory/inadequate) to 9 (superior/effective and efficient)) for each scenario based on the rater's overall impression of the resident's management of the case. To assess residents' skills for each clinical scenario, we developed a skills checklist for each scenario based on the literature, paediatric oncology faculty members' experience and the *Accreditation Council for Graduate Medical Education* residency core competencies.^{23–25} We computed the total number of tasks each resident completed for each scenario.

Residents in both the control and intervention groups completed a prerotation questionnaire before the lectures and simulation training, providing demographic data, information about prior medically related work experience and self-reported emotional appraisals of each of the three test case scenarios on which their skills were assessed at the end of the rotation. Including a measure of residents' emotional appraisals of paediatric oncology case scenarios was a unique aspect of this study. This appraisal measure was originally designed to assess positive and negative emotions related to a stressor^{19 20}; in our study, the stressors were the case scenarios on which all residents were evaluated. Residents indicated the extent to which each stressor (case) evoked each of 15 emotions using a five-point scale (0=not at all; 4=agreat deal). In a study of patients with cancer, these items were shown to assess two appraisal constructs: whether a stressor was appraised positively as a challenge to overcome (seven items) or negatively as a threat (eight items).²¹ Higher total scores for items on each subscale indicate greater challenge or threat appraisals. The reliability of items on these scales using Cronbach's alpha was reported to be 0.76 for challenge and 0.82 for threat.²² All residents completed the emotional-appraisal questionnaire for each case scenario again at the conclusion of their paediatric oncology rotation. In addition, after testing, participants in the intervention group evaluated the simulation training experience.

Data analysis

Descriptive statistics and differences between the intervention and control groups were measured using χ^2 tests and analysis of variance (ANOVA). Endpoints included the skills checklist scores, global performance ratings, emotional appraisals of each of the three test case scenarios and resident satisfaction with the simulation session.

We assessed inter-rater reliability using kappa for each item on the checklist for each case scenario²⁶ and computed average measures intraclass correlations (ICCs) and 95% CIs to evaluate inter-rater agreement in total scores for each scenario using the SAS Macro %INTRACC.²⁷ Bland-Altman plots illustrate the inter-rater agreement in skills checklist scores for each scenario and overall.²⁸

For each rater, ANOVAs were used to measure between-groups differences in the checklist scores for each scenario and total scores for all three scenarios by training year (PGY 1 vs PGY 2/3) and study arm (intervention vs control); Spearman rank-order correlations were used to measure correlations between the checklist scores and global performance ratings for each case. We used one-way ANOVAs to measure between-group differences in emotional-appraisal scores, both before and after the paediatric oncology rotation, and used repeated measures ANOVAs to describe the change in appraisal scores for each scenario at the end of rotation, for all residents and by group. Analyses were performed using SAS statistical software V.9.3 and IBM SPSS Statistics V.25.0.

Table 1 Demographic and educational characteristics of the sample (n=42)

	Control n=9 (%)	Intervention n=33 (%)	P values
Age (years)			0.76
25–28	5 (55.6)	22 (66.7)	
29–31	2 (22.2)	6 (18.2)	
32–35	1 (11.1)	4 (12.1)	
>35	1 (11.1)	1 (3.0)	
Gender			1.00
Female	6 (66.7)	23 (69.7)	
Male	3 (33.3)	10 (30.3)	
Work experience prior to medical school			1.00
No	4 (44.4)	17 (51.5)	
Yes	5 (55.6)	16 (48.5)	
Was work-related experience medically related?			<0.001
Medically related	4 (44.4)	5 (15.2)	
Not medically related	2 (22.2)	28 (84.9)	
N/A	3 (33.3)	0 (0.0)	
Postgraduate year (PGY) of training			0.868
PGY 1	6 (66.7)	21 (63.6)	
PGY 2	3 (33.3)	11 (33.3)	
PGY 3	0 (0.0)	1 (3.0)	
	Mean (SD)	Mean (SD)	
USMLE step 1 score	233.6 (15.3)	228.6 (19.4)	0.49
USMLE step 2 CK score	235.6 (12.6)	239.4 (20.1)	0.59

CK, clinical knowledge; USMLE, United States Medical Licensing Examination.

RESULTS

All residents on the paediatric oncology rotation consented to participate. Of 42 residents, 9 were in the control group and 33 in the intervention group (table 1). A greater proportion of controls had medically related work experience before residency, but the two groups did not differ significantly on any other characteristic.

Skills performance

Performance was assessed during the test scenarios using a case-specific skills checklist (table 2). Most participants preformed certain skills including: (1) giving a saline bolus, starting antibiotics and ordering blood cultures in the fever/neutropaenia case; (2) ordering appropriate studies and discussing the cause of bruising in the new leukaemia diagnosis case; and (3) explaining cardiopulmonary resuscitation, pain management and the dying process in the end-of-life case scenario. Skills commonly omitted by participants in each scenario included: (1) considering inotropic support, steroid replacement for adrenal insufficiency, ordering a chest radiograph and calling a code in the fever/neutropaenia scenario; (2) ordering a blood culture and starting antibiotics in the new leukaemia diagnosis scenario; and (3) calling the primary oncologist in the end-of-life scenario.

Using the skills checklist for each scenario, two raters, who were not blinded to arm and did not deliver the intervention, independently evaluated videotapes of each resident's performance. Kappa statistics indicated moderate (0.41–0.60) to near-perfect (0.81–1.00) inter-rater agreement for most skills on each case's checklist.²⁶ Inter-rater agreement for total scores using average measures ICC (95% CI) was high for fever/neutropaenia

Table 2 Number of trainees completing each skill on the checklist for each test case scenario, by rater, and kappa statistics for the inter-rater agreement (n=42)

Scenario	Rater 1	Rater 2	Kappa
Fever and neutropaenia			
1. Recheck vitals	23	37	0.33
2. Start antibiotics	36	33	0.38
3. Normal saline bolus 1–2 times	38	38	1.00
4. Consider starting steroids	1	1	1.00
5. Order chest X-ray	9	8	0.92
6. Orders blood culture	37	37	1.00
7. Calls code/rapid response	9	8	0.92
8. Reassess vital signs	30	34	0.66
9. Orders laboratory studies	29	31	0.57
10. Orders blood transfusion	14	13	0.94
11. Considers inotropic support	1	1	1.00
New leukaemia diagnosis			
1. Orders laboratory studies	36	36	–0.06
2. Orders chest X-ray	12	10	0.87
3. Orders blood culture	11	10	0.93
4. Starts antibiotics	3	3	1.00
5. Discusses cause of bruising with parent	25	29	0.5
6. Discusses leukaemic blasts with parent	31	34	0.48
7. Normal saline bolus	20	19	0.95
8. Comforts family	28	37	0.14
9. Asks for social work to be contacted	14	11	0.70
10. Discusses the role of blood transfusions	18	23	0.64
11. Discusses treatment plan/admission	18	19	0.53
12. Calls paediatric oncology team	23	21	0.78
End-of-life care			
1. Discuss with the parent that the patient is dying	26	34	0.32
2. Explain cardiopulmonary resuscitation	35	38	0.37
3. Discusses treatments still available to patient (eg, pain control)	28	37	0.07
4. Starts oxygen with desaturation	22	19	0.74
5. Gives pain medication bolus	18	17	0.74
6. Increases continuous pain medication	26	19	0.64
7. Calls paediatric oncology	1	3	0.48

(0.839 (95% CI 0.692 to 0.915)) and discussing a new leukaemia diagnosis (0.893 (95% CI 0.793 to 0.944)) simulations, overall checklist scores (0.847 (95% CI 0.708 to 0.920)) and overall global performance scores (0.806 (95% CI 0.629 to 0.898)); ICC was moderate for discussing end-of-life care (0.657 (95% CI 0.346 to 0.820)). Inter-rater agreement for each case and for all three cases is illustrated in online supplementary figure 1. Since inter-rater agreement was acceptably high, we totalled the checklist scores for both raters and computed mean scores for further analysis.

Table 3 shows that senior residents had significantly higher total checklist scores than interns for all three cases combined. The intervention group had significantly higher total checklist scores than controls for all cases combined and for the new leukaemia diagnosis case.

Table 4 shows that the number of skills performed during each case correlated positively with their respective global performance scores for that scenario. Spearman correlations between total checklist scores for a given case and the global performance ratings for that case were very high, and the correlations were very low between checklist scores for

Table 3 One-way analyses of variance testing the differences in mean skills checklist scores (both raters combined) for each case scenario and for total of all three scenarios by training level and study arm for both raters* (n=39)

Group	N	Case 1 Fever and neutropaenia		Case 2† New leukaemia diagnosis		Case 3 End-of-life care		Mean total scores for all three cases	
		Mean (SD)	P values	Mean (SD)	P values	Mean (SD)	P values	Mean (SD)	P values
Training level	39		0.06		0.16		0.70		0.046
PGY 1	24	5.7 (1.1)		6.1 (1.7)		4.2 (1.1)		15.8 (2.7)	
PGY 2/3	15	6.4 (1.0)		7.0 (1.8)		4.1 (0.7)		17.5 (2.1)	
Study arm			0.24		0.002		0.27		0.005
Control	9	5.6 (1.6)		4.9 (1.8)		3.8 (1.0)		14.4 (2.1)	
Intervention	30	6.1 (1.0)		6.9 (1.5)		4.2 (0.9)		17.0 (2.4)	

One PGY 1 resident in the intervention group did not complete independent simulation testing for case 2.

*Since agreement between raters was acceptably high, we computed mean scores for both raters combined.

†N=38.

PGY, postgraduate year.

a specific case and the global performance ratings for the other two cases.

Appraisals: perceived challenge and threat

Neither prerotation nor postrotation appraisals of the scenarios differed significantly by training level or by arm, except that prerotation positive appraisals (challenge) for the end-of-life care scenario were significantly lower in controls compared with the intervention group (means (SD), 1.7 (1.3) vs 3.4 (2.2), respectively; one-way ANOVA, $p=0.03$).

As shown in table 5, for all residents regardless of study arm or training level, positive appraisals of end-of-life care discussions increased significantly and negative appraisals of all three cases decreased significantly. In separate models that included either study arm or training level, changes in positive and negative appraisals did not vary significantly by arm or by training level for any of the three cases.

Simulation training evaluation

Residents in the intervention group were asked to rate their satisfaction and value of the simulation session. Most residents either strongly agreed or agreed that the simulation training was helpful for the paediatric oncology rotation (93%), realistic (84%) and addressed common oncology emergencies (100%). Residents felt that the simulation training made them better equipped to care for these patients (91%) and they could apply skills learnt during simulation training to patient care (97%). All

residents in the intervention group would recommend the simulation training session to others.

DISCUSSION

Barriers to mastering skills in caring for paediatric oncology patients during residency include the random nature and infrequent occurrence of clinical presentations, duty hour restrictions limiting opportunities for direct patient contact and expanded roles of advanced practice providers. Simulation training is used to enhance training in a variety of clinical settings.^{3–10 12–14} The paediatric oncology simulations used in this pilot study were prompted by a 2011 survey of paediatric residents who reported feeling anxious and ill-equipped to care for these patients. We aimed to demonstrate the feasibility of implementing a simulation curriculum during the paediatric oncology rotation and assess residents' emotional appraisal and patient management skills in caring for simulated paediatric oncology patients. We demonstrated the feasibility of implementing a simulation-based curriculum for residents during their paediatric oncology rotation.

Simulation has been used in other challenging and emotional settings, such as managing deteriorating patients or successfully guiding difficult discussions about the care of a loved one.^{16 17} Simulation training has been associated with increased confidence of nurses and nursing students caring for critically ill patients^{11 17 29} and with improvements in residents' clinical and communication skills.^{9 14} Our study sought to assess whether residents' performance of certain skills when caring

Table 4 Spearman correlations between the total checklist scores and global performance (GP) ratings for each case scenario across both raters†

Skills checklist	Spearman rho coefficients			
	Case 1 GP	Case 2 GP	Case 3 GP	Overall GP
Case 1 Fever and neutropaenia†	0.797***	0.091	−0.048	0.187
Case 2 New leukaemia diagnosis‡	0.080	0.826***	0.290	0.591***
Case 3 End-of-life care*	−0.081	0.249	0.602 ^c	0.381*
Total scores for three cases	0.356*	0.741***	0.436*	0.766***

* $P<0.05$; *** $p<0.001$.

†N=39; four residents did not complete independent simulation testing.

‡N=38; one additional PGY 1 resident in the intervention group did not complete independent simulation testing for case 2.

PGY, postgraduate year.

Table 5 Repeated measures analysis of variance testing the change in positive (challenge) and negative (threat) appraisals before and after the oncology rotation for all residents

	N	Prerotation Mean scores (SD)	Postrotation Mean scores (SD)	P values
Fever and neutropaenia				
Positive appraisal (challenge)	40	8.7 (4.8)	8.9 (5.6)	0.82
Negative appraisal (threat)	39	10.3 (4.5)	8.7 (3.9)	0.04
New leukaemia diagnosis				
Positive appraisal (challenge)	41	3.4 (3.1)	4.1 (3.1)	0.15
Negative appraisal (threat)	37	12.5 (4.9)	7.7 (3.1)	<0.001
End-of-life care				
Positive appraisal (challenge)	41	3.0 (2.2)	4.0 (3.1)	0.02
Negative appraisal (threat)	39	14.2 (5.7)	10.5 (4.4)	<0.001

for paediatric oncology patients would be higher for the simulation training group compared with controls; we also assessed whether simulation-trained residents would feel less threatened and more empowered to deal with the challenges they confronted managing paediatric oncology scenarios. To our knowledge, no studies have examined simulation training in association with residents' patient care skills and their positive and negative emotional appraisals of stressful clinical conditions, such as those represented by these paediatric oncology scenarios.

Using the mean total checklist scores for all three cases combined (for both raters), more senior residents (vs interns) and the intervention group (vs controls) received significantly higher scores. Residents' performance differed significantly by study arm only for the new leukaemia diagnosis case. This pilot feasibility study was not powered to detect statistically significant, between-groups differences in skills checklist scores. All participants performed certain skills, while other skills were routinely missed, and senior residents outperformed interns on many skills assessed, as expected by virtue of experience. Simulation training can help identify skills that are not routinely performed and tailor instruction to address these deficiencies. Also, simulation can help assess if residents are performing at training level compared with peers. We assessed global performance scores, which highly correlated with number of skills performed. As a simple scaled measure, the global performance rating could be used to assess a resident's progress through the rotation.

A significant improvement in perceived challenge (positive appraisal) was observed for the end-of-life discussion case for all residents regardless of arm (table 5). This may be due to residents' exposure, throughout the rotation, to this difficult topic. Although controls had more medically related work experience prior to residency, they scored lower on the prerotation positive appraisal assessment for the end-of-life scenario, suggesting that prior work experience does not mitigate the negative perception of this clinical scenario. Residents demonstrated a significant reduction in levels of perceived threat (negative appraisal) in all three clinical scenarios for all participants. The decline in perceived threat for the fever/neutropaenia scenario was not as large as the other two cases, suggesting that this emergency continues to be perceived as stressful even after simulation training. A sufficiently powered randomised controlled trial would be needed to more definitively determine if simulation training improves residents' emotional appraisals of paediatric oncology situations as well as their clinical skills performance improvement, which was not demonstrated by this study. This novel approach of measuring residents' emotional appraisal prior to exposure to this patient population could be used to determine a baseline level of comfort with a stressful clinical scenario and tailor educational approaches to enhance residents' comfort level. Higher appraisals of threat in times of uncertainty are correlated with greater emotional distress.²¹ Residents had previously reported being anxious caring for paediatric oncology patients; thus, we designed these less stressful but comprehensive medical simulation scenarios to enhance their training. Residents who received simulation training reported a benefit of having the opportunity to practice challenging conversations with a parent actor in a controlled and safe learning environment, which has previously been demonstrated as an effective tool to improve communication skills during difficult conversations.^{30 31} With heightened societal awareness of physician burnout, it is critical for physician educators to design methodologies whereby difficult clinical material can be delivered in a safe and supportive fashion to trainees. The added benefit is that simulation allows iterative practice while placing no patient at harm.

Children with cancer represent a vulnerable patient group that engenders a great deal of anxiety in both novice and experienced providers. Optimal training would provide simulation-based practice of stressful, acute-care management scenarios in a setting that is safe for patients and trainees. Simulation can provide repetitive experiential practice as well as insight into the psychosocial domains that are critical to empathic and holistic care. More research is needed to rigorously evaluate the impact of simulated case scenarios on residents' patient-care skills and their emotional appraisals of stressful situations encountered while caring for paediatric oncology patients.

As a pilot/feasibility study conducted at one academic medical centre, these findings may not be generalisable to other institutions or other healthcare workers caring for paediatric oncology patients. The study is underpowered to evaluate the impact that simulation training had on resident behaviours and emotional appraisals. Also, residents who participated in the simulation training later in the academic year might have gained experiences apart from their paediatric oncology rotation, which could have impacted their performance and appraisal measures. Yet, we showed that it is feasible to implement simulation training during the paediatric oncology rotation and to use it to evaluate residents' performance with a high level of inter-rater agreement in evaluation of clinical skills. Moreover, we demonstrated that as they progress through the rotation, residents reported significant improvements in their emotional appraisals through the reduction of perceived threat for the three scenarios at the end of their rotation. Although we did not show a difference in changes in perceived challenge or threat by study arm, the intervention arm did perform a significantly greater number of skills than controls performed in the new leukaemia diagnosis case and in all three cases combined. Residents who participated in the simulation training felt this training prepared them to care for paediatric cancer patients. This coupling of emotional appraisal with simulation education offers a novel approach that could be applied to other stressful care domains including paediatric critical care, trauma and perioperative care.

CONCLUSION

Residency programmes are challenged by duty hour restrictions and reduced exposure to patient emergencies that provide residents with adequate opportunities for training in intense, acute paediatric oncology scenarios. Through simulation, residents can gain experience with challenging clinical situations that they might not otherwise encounter during training. Significantly, higher mean total skills checklist scores for the new leukaemia diagnosis case and for all three cases combined were observed in the intervention group (vs controls). This is consistent with literature demonstrating improved skills and comfort caring for patients following simulation-based education.^{10 11 15 30} Emotional appraisals of stressful situations also were shown to be feasible and can be used to detect change in residents' comfort in caring for difficult medical cases over the course of their rotation. Residents in this pilot programme felt that simulation was very helpful in acquiring the skills necessary in caring for ill paediatric oncology patients and that the scenarios were clinically relevant. Simulation training of stressful and infrequently experienced clinical scenarios might provide residents with opportunities to improve their medical skills and lead to reduced anxiety about caring for paediatric oncology patients. Higher perceptions of threat can lead to greater anxiety and inability to act quickly. Further empirical testing of these hypotheses is needed.

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