

Original Publication

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Neonatal Intensive Care Unit Boot Camp: A Preparatory Curriculum for Pediatric Residents

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Citation: Surcouf JW, Mumphrey CG, Barkemeyer BM, et al. Neonatal intensive care unit boot camp: a preparatory curriculum for pediatric residents. *MedEdPORTAL*. 2018;14:10720. https://doi.org/10.15766/mep_2374-8265.10720

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Abstract

Introduction: Resident training has changed significantly in recent years, resulting in reduced experiences and practice. Because pediatric residents have fewer required intensive care unit (ICU) rotations, we introduced a neonatal ICU (NICU) boot camp (2014-2015) that continues today to prepare residents immediately prior to beginning an NICU rotation. **Methods:** The NICU boot camp consists of three 1-hour sessions: two interactive lectures with case-based application and one hands-on, integrative learning using simulation. The sessions are designed to cover basic information to assist in daily rounding and decision making while in the NICU. After their NICU rotation, residents complete a 12-item questionnaire. Program evaluation includes direct observation during sessions, faculty debriefing, and a postprogram resident survey. **Results:** Fifty-seven residents participated; questionnaire responses were available from 46 (80.70%). Combined percentages of *very useful* and *extremely useful* responses for the three sessions were 82.61%, 78.26%, and 82.60%, with 86.95% for the overall program; 80.40% agreed that repeating boot camp prior to each NICU rotation would be useful. Analysis of narrative responses revealed that participation in boot camp enhanced residents' readiness and confidence for patient care in the NICU and as stated for each educational objective. **Discussion:** Program evaluation results support highly effective and sustainable implementation and achievement of educational objectives. Minor refinements continue for enhancing active learning and content materials and for increasing rigor of program evaluation. Results also suggest that our boot camp may benefit other pediatric programs and serve as a model for use in other resident specialty programs.

Keywords

Curriculum, Neonatology, Pediatrics, Boot Camp, Neonatal Intensive Care Unit

Educational Objectives

By the end of this resource, trainees will be able to:

1. Report increased overall confidence in caring for infants in the neonatal intensive care unit (NICU).
2. Recognize common problems and emergencies encountered in the NICU and understand their management.
3. Interpret and manage basic lab, blood gas, and X-ray findings commonly encountered in the NICU.
4. Determine appropriate nutritional needs, fluid management, and calculations for patients in the NICU.
5. Demonstrate basic respiratory support and management in NICU patient scenarios.

Introduction

Medical education and resident physician training have undergone significant changes in recent years. In 2003, the Accreditation Council for Graduate Medical Education (ACGME) mandated an 80-hour workweek, averaged over a 4-week period, emphasizing the importance of minimizing resident fatigue.¹⁻³ In 2011, further restrictions were imposed, and maximum duty-length guidelines were put in place for interns.¹⁻³ With these new guidelines, interns could work for only 16 consecutive hours and have no less than an 8-hour duty-free period between shifts.¹⁻³ In 2013, pediatric program requirements were further changed as a result of ACGME recommendations to adopt a competency-based and enhanced career-

Appendices

- A. Session 1 Slides Interpret NICU.pptx
- B. Session 1 Script Interpret NICU.docx
- C. Session 1 Handout Interpret NICU.docx
- D. Session 1 Slides Calculations Nutrition.pptx
- E. Session 1 Script Calculations Nutrition.docx
- F. Session 1 Handout Calculations Nutrition.docx
- G. Session 2 Slides NICU Respiratory Support.pptx
- H. Session 2 Script NICU Respiratory Support.docx
- I. Session 2 Handout NICU Respiratory Support.docx
- J. Session 2 Slides On Call in the NICU.pptx
- K. Session 2 Script On Call in the NICU.docx
- L. Session 3 Simulation Cases .docx
- M. Survey for NICU Boot Camp.docx

All appendices are peer reviewed as integral parts of the Original Publication.

centered curriculum focusing on training towards residents' specific long-term goals.¹ With this change, trainees are required to do only "two units of NICU [neonatal intensive care unit]" during 3 years of training.⁴ While resident and patient safety is at the forefront, residents have fewer opportunities for hands-on experience, particularly in the high-stakes, high-stress NICU environment.

The NICU is a unique environment that is vastly different from other pediatric rotations. Opportunities to learn NICU-specific material are generally not found in other rotations, decisions made in the NICU are sometimes urgent and pressured, and patient risk for morbidity and mortality is uniquely high. Our educational resource addresses important topics related to common problems and emergencies that a resident will encounter starting from day one and throughout the NICU rotation (e.g., everyday evaluation of vital signs, labs, input/output, nutrition and calculations, respiratory management, and on-call problems). A concise and focused curriculum, juxtaposed with the start of an NICU rotation, was intended to raise awareness and enhance application of foundational knowledge and skills for maximizing learning and engagement in NICU patient care. A review of published educational resources in *MedEdPORTAL* was completed through multiple keyword searches using the following search terms: *neonatal intensive care*, *neonatal resuscitation*, *neonatology*, and *infant critical care*. A total of 48 citations were identified, of which only 15 were related in some way to patient care and preparation for engagement in the NICU. Further review of these 15 citations revealed seven that each addressed a specific procedural training (e.g., neonatal resuscitation, lumbar puncture, mechanical ventilation, placement of peripherally inserted central catheter),⁵⁻¹¹ four addressing application of ethics principles in the NICU (end-of-life management decisions and communications with family),¹²⁻¹⁵ and one each for the following aspects of patient care in the NICU: a patient case of jaundice,¹⁶ application of evidence-based medicine to neonatal-perinatal patient care,¹⁷ management of late preterm neonates in the Level II NICU,¹⁸ and postdischarge nutrition for NICU graduates.¹⁹ No published resources in *MedEdPORTAL* were identified that addressed the primary purpose, educational goals, and specific content focus we set for the preparatory (boot-camp) curriculum. Similar and multiple searches of published literature (e.g., through PubMed) did not reveal prior work fitting our purposes. Thus, our preparatory work provided evidence of the unique contribution of this resource to the medical education community.

Our prior experiences with resident education and the use of simulation-based education suggested a boot-camp approach would meet content, instructional, and logistical needs. Similarly, many medical and surgical specialties have gone beyond independent simulation events and developed high-yield boot camps to enhance specific skills and knowledge needed for training.²⁰ Medical schools have designed boot camps to aid in the transition from medical student to intern, while residency programs have designed such curricula for the transition from resident to fellow.²¹⁻²² For example, Minha, Shefet, Sagi, Berkenstadt, and Ziv²³ described a national, mandatory, 5-day preintern boot camp in Israel that was conducted on 85 separate occasions from 2004-2011. This boot camp targeted simulation-based education for general patient safety and quality competencies (e.g., resuscitation; essential manual, cognitive, and communication skills; and integrative abilities such as teamwork and handoffs) to facilitate entry to a generic internship year. While feedback data were available from only 36% of the 4,721 individuals who completed the boot camp, participants consistently reported positive impact of the boot-camp training on their preparedness for entry and effectiveness during the internship year. In addition, participants strongly endorsed mandatory participation for all interns prior to starting the year. Blackmore, Austin, Lopushinsky, and Donnon's meta-analysis²⁴ also provided evidence of the positive impact of boot-camp-type training on improving participants' clinical skills, such as lumbar punctures, use of forceps, and suturing, in addition to improved knowledge and learner confidence across different specialties, including surgery, obstetrics, and internal medicine.

Regarding a boot-camp approach as an appropriate method, as previously mentioned, review of *MedEdPORTAL* publications revealed several examples. Two targeted learning for specific clinical skills,²⁵⁻²⁶ three addressed specific patient care scenarios,²⁷⁻²⁹ and one was available to facilitate transition from pediatric residency training to independent clinical practice.³⁰ In each of these examples, the instructional

design reflected implementation with a large learner audience at one point in time (e.g., at either the beginning or the end of a training program), and none offered a broad-based preparation for initial engagement in the highly specialized neonatal intensive care environment. Our educational resource is unique in several ways. First, it is designed to prepare pediatric residents for entry engagement in a very specific patient care environment, the NICU, for which residents have no prior experience and few preparatory learning opportunities for addressing the unique needs of high-risk neonatal patients. Second, this boot-camp curriculum is designed for just-in-time learning and hands-on practice, that is, immediately prior to starting a rotation. Thus, the resource presents a recurring curriculum offered monthly with a small learner group, thereby affording increased individualized learning support. Third, the timing and focus of knowledge and skills are viewed as critical to enhancing pediatric residents' clinical knowledge and skills, confidence, and self-awareness for effective response and care in the NICU. Fourth, a unique and important contribution of this educational resource is the focus on broad, entry-level neonatal specialty care for common, high-frequency, and high-consequence conditions that pediatric residents typically encounter during their NICU rotations. Finally, implementation and evaluation of the NICU boot-camp curriculum supported the idea that it is a sustainable, high-quality curriculum that is relevant, useful, and generalizable for facilitating residents' successful entry to the NICU and preparedness for recognizing and addressing common neonatal problems and emergencies.

Methods

This section describes the materials and objectives-based content for each session, as well as how we implemented the NICU boot camp, so that future users can replicate it at their respective institutions. The section also includes a description of the program evaluation data-collection and data-analysis methods.

Boot Camp

All pediatric and combined internal medicine/pediatric residents from the Louisiana State University Health Sciences Center New Orleans rotating through the NICU at Children's Hospital of New Orleans participated in the curriculum. The boot-camp curriculum consisted of three 1-hour sessions that residents completed 1 or 2 months prior to starting an NICU rotation. In our setting, sessions occurred in the morning; residents signed in and received attendance credit for morning report. A yearlong boot-camp schedule was created at the beginning of the academic year, and residents registered for the boot camp that would occur 1 month prior to their NICU rotation. When schedule conflicts arose, residents could register for the boot camp occurring 2 months in advance of their NICU rotation. Each boot camp included a class of two to five residents. Each of the interactive lecture-format Sessions 1 and 2 was taught by one of eight NICU faculty members who were rotating as the secondary attending during the time of the monthly boot camp. Session 3 (simulation) was led by one of three NICU faculty who were facilitators experienced with using high-fidelity simulation and available at the scheduled times.

One week prior to attending the sessions, residents received all boot-camp handouts via email attachments. Because all three sessions promoted active learning and contained a large amount of information, the residents were required to preview the relevant handouts prior to Sessions 1 and 2, respectively. The content of each boot-camp session is described below.

Session 1: At the beginning of Session 1, residents asked questions to clarify expectations for the rotation. Two PowerPoint slide sets, resident handouts, and faculty notes were used to facilitate interactive learning activities and discussion on the following: (1) "Interpreting the NICU" (Appendices A-C) targeted lab values, vital signs, and X-rays for neonates, and (2) "Calculations, Total Parenteral Nutrition (TPN), and Formula" (Appendices D-F) facilitated residents' learning about nutritional goals, methods to deliver nutrition, and common calculations in the NICU (Educational Objectives 1-4).

Session 2: Interactive, applied learning was facilitated using two PowerPoint slide sets with corresponding resident handouts and faculty guides. "Respiratory Support in the NICU" (Appendices G-I) facilitated learning about various modes of ventilation and blood gas analysis. "On-Call Problems" (Appendices J-K)

engaged residents in case-based discussions reflecting common on-call problems encountered in the NICU and effective management strategies (Educational Objectives 1-3, 5).

Session 3: Simulation-based training utilizing a high-fidelity simulator and a series of three realistic NICU patient scenarios was completed in this session using patient scenario protocols and corresponding faculty guides. Upon arrival, residents were oriented to the mannequin and its capabilities. Residents then received a description of a realistic patient scenario for each of the three simulation-based exercises (Appendix L) and subsequently performed as a team, applying what they had learned in Sessions 1 and 2 (Educational Objectives 1-5).

- Scenario 1: A previously stable neonate has a sudden deterioration due to a blocked and malpositioned endotracheal tube (ETT). This scenario required the ETT to be suctioned and ultimately replaced with a new tube.
- Scenario 2: An infant has new onset apnea secondary to infection. Residents were expected to obtain labs, including a complete blood count and blood culture, and begin antibiotics. The scenario also required residents to place the infant on respiratory support and ultimately intubate the patient.
- Scenario 3: A newly diagnosed necrotizing enterocolitis required respiratory support, fluid support, broad spectrum antibiotics, a surgical consult, and an update to the family.

Residents worked through each case and then engaged in 5-10 minutes of an action-oriented debriefing discussion. During debriefings, the faculty engaged residents in reflective practice and emphasized key content and relevant points. Residents were prompted to identify their respective strengths and weaknesses, with explicit feedback and coaching from faculty to enhance specific knowledge and skills. The debriefing concluded by summarizing the scenario-based experiences, reinforcing strengths, and identifying learner-specific actions and/or strategies for further improvement.

Program Evaluation

Faculty observation of resident performance during each session, informal faculty debriefing after sessions, and a postprogram resident questionnaire constituted the basis of formative and summative program evaluation. Questionnaire responses provided quantitative and qualitative data that were useful for evaluating processes (implementation) and outcomes (self-reported for sessions and actual use and impact in the NICU rotation). At the end of each quarter, a web-based, 12-item feedback questionnaire (Appendix M), of which three items solicited narrative responses, was distributed to residents who had completed the boot-camp curriculum during that period. Administration of the questionnaire after completing both the boot camp and actual NICU rotation experiences afforded residents opportunities to reflect upon the extent to which the boot-camp experience enhanced their actual NICU rotation experiences (e.g., confidence, patient care, and overall performance) before providing feedback on the usefulness of each session and residents' overall experience (see Appendix M). For this initial program evaluation, questionnaire data collected between November 2014 and February 2017 were used.

Quantitative data analysis was limited to calculations of frequency and valid percentages. Qualitative data were analyzed by one author not involved in the teaching of the boot camp who had expertise in qualitative methods. Qualitative results were then reviewed for accuracy and completeness by the two lead authors who had the most direct and comprehensive knowledge of all boot-camp activities and implementation. Follow-up examination by all three individuals was used to finalize thematic interpretations and to examine consistency and expanded understanding achieved by comparing quantitative and qualitative results.

Questionnaire Item 9 (usefulness in repeating the boot-camp experience) provided residents with the opportunity to expand on their yes/no response through narrative. Items 11 (most helpful and beneficial in NICU) and 12 (improvements) were open-ended, and narrative responses contributed to evaluating implementation effectiveness (process and outcomes) and planning next steps for future program

refinement. A constant comparative method was used for qualitative data analysis. For Item 11 responses, the first analysis did not use a priori categories; thus, themes were identified as they emerged from the data analysis. A second analysis of these responses used the educational objectives as an initial set of a priori categories to identify evidence for achievement of the educational objectives for this resource. For Item 12 responses, no a priori categories were used, and themes were identified as they emerged from the analysis. Analysis also included examination of the relationship between themes to better understand effectiveness and opportunities for future refinement.

Results

This section summarizes first the quantitative results, then the qualitative results. Quantitative results are reported as descriptive statistics. Qualitative results reflect common themes that confirm or refute the quantitative results and provide further explanation of them.

Quantitative Results

To date, 57 residents have completed the NICU boot camp, and questionnaire data were available for 46 (80.70%). Of the 46 responders to Items 1-3 of the feedback questionnaire (Appendix M), 50.00% reported less than 1 month of NICU experience at the time they completed the boot camp, with nine reporting 1 month (19.57%), five reporting 1.5 months (10.87%), eight reporting 2 months (17.39%), and one reporting more than 2 months (2.17%) of NICU experience. In addition, 78.26% reported this to be their first NICU boot-camp experience.

As reflected in the Table, combined percentages of *very useful* and *extremely useful* responses were as follows: Session 1 (Introduction to the NICU and TPN/Calculations): 82.61%, Session 2 (Respiratory and On-Call Problems): 78.26%, and Session 3 (Simulation): 82.60%, with 86.95% combined *very useful* and *extremely useful* responses for the overall boot camp (usefulness scale: 1 = *Not*, 2 = *Somewhat*, 3 = *Very*, 4 = *Extremely*). Responses to Item 7 revealed participants' perceptions of the most useful session as follows: Session 1 (Interpreting the NICU and TPN/Calculations): 13.04%, Session 2 (Respiratory and On-Call Problems): 39.13%, and Session 3 (Simulation): 36.96%. Responses to Item 8 revealed that 80.40% agreed that holding the boot camp prior to each NICU rotation would be useful. Residents were asked if they would find it useful to repeat the boot camp prior to future NICU rotations (Item 9), and 80.43% responded yes. Finally, 10 of the 46 (21.74%) responses to Item 10 indicated previous participation in the NICU boot camp, with eight of the 10 (80.00%) reporting that the repeat session was useful.

Table. Summary of Resident Responses to the Feedback Questionnaire

Questionnaire Item	N	% (n) of Responses				
		Not Useful	Somewhat Useful	Very Useful	Extremely Useful	Did Not Attend
How useful was Session 1 (Interpreting the NICU, TPN/Calculations)?	46	0 (0)	13.04 (6)	58.70 (27)	23.91 (11)	4.35 (2)
How useful was Session 2 (Respiratory and On-Call Problems)?	46	0 (0)	13.04 (6)	41.30 (19)	36.96 (17)	8.69 (4)
How useful was Session 3 (Simulation)?	45	0 (0)	6.67 (3)	42.22 (19)	42.22 (19)	8.89 (4)
Overall, how useful was the NICU boot camp?	46	0 (0)	13.04 (6)	41.30 (19)	45.65 (21)	0 (0)

Abbreviations: NICU, neonatal intensive care unit; TPN, total parenteral nutrition.

Qualitative Results

Qualitative data were obtained using the following three questionnaire items:

- Item 9: Would you find it useful to repeat the boot-camp experience prior to future Children's Hospital NICU months? One no and six yes responses were received. No response indicated "probably only necessary for new second years." Of the yes responses, three explained that repeat opportunities would be welcomed, and three desired repeat review only on an optional basis.
- Item 11: What did you find most helpful about the NICU boot camp, and can you describe an event during your rotation where boot camp was beneficial? Forty-two of 46 participants responded (91.30% response rate).

- Item 12: What improvements/changes would you like to enhance the NICU boot-camp experience?
Forty-three of 46 participants responded (93.48% response rate).

Important to the qualitative results, remember that residents submitted responses to the questionnaire after completing both the boot camp and subsequent actual NICU rotation; thus, residents had opportunity to reflect on their knowledge, skills, and confidence prior to and following both the boot camp and their NICU rotation experiences and corresponding performance. Overall, qualitative data analysis revealed that participation in the boot camp enhanced residents' confidence and readiness for managing patient care in the NICU as reflected in each of the educational objectives. Results of the first analysis were consistent with the quantitative results shown in the Table and provided descriptions that further explained effectiveness of both process (implementation) and outcomes (confidence, readiness, and specific abilities, such as those reflected in the educational objectives). Four prominent themes emerged. The second round of analysis specifically targeted evidence of achieving each of the five educational objectives.

Qualitative responses from the open-ended Items 11 and 12 are summarized below.

Item 11: What did you find most helpful about the NICU boot camp, and can you describe an event during your rotation where boot camp was beneficial?

Theme 1: Confidence and readiness for performing in the NICU rotation. (This theme was also reflected in each of the other three themes that were observed for specific elements of the curriculum.)

- Description:
 - Enhanced clarity and confidence for meeting resident expectations in the NICU.
 - Active engagement from the very first day of the rotation.
 - Providing safe and competent patient care.
 - Knowing what to do and what to think about when faced with common problems and emergencies in the NICU.
 - Enhanced abilities in knowing one's own limits and when to ask for help.
- Objective achieved: strong evidence for Educational Objective 1.
- Representative quotes:
 - "Always good to review calculations. Really helped to speed things up on the first mornings of NICU."
 - "Simulation was most helpful—I felt more confident on how to approach a de-sating baby."
 - "The simulations were extremely beneficial on every independent call."

Theme 2: Value of learning about and working through common problems and emergencies in the NICU environment.

- Description:
 - Recognition of the NICU as very different from the inpatient setting.
 - Opportunity to learn and practice in boot camp prior to first NICU rotation was especially valued.
 - Value of just-in-time learning, realistic case-based application activities, and handouts that were practical and highly useful resources throughout actual NICU experiences.
- Objective achieved: strong evidence for Educational Objective 2.
- Representative quotes:
 - "Going through on-call scenarios so I felt more comfortable dealing with them when they actually happened."
 - "Sim lab and on call problems (most helpful)—had many similar scenarios occur during the month."

- “The on-call section was particularly useful, it helped me to know what to do for some of my patients in a timely manner, rather than having to wait to get a response from someone.”

Theme 3: Use of findings to effectively manage daily patient care and address common patient problems.

- Description:
 - Handouts, case discussions, and hands-on application during the on-call problems and simulation activities were most helpful in enhancing abilities to use findings and calculations to work through patient problems effectively.
 - Experiences with calculating TPN and knowledge of formula were facilitated for effective management of nutritional and fluid needs.
 - On-call pearls and handouts were used throughout rotation experiences in managing actual patients.
- Objectives achieved: Educational Objectives 3 and 4. Narrative responses did not always include sufficient details regarding specific content (e.g., basic labs, blood gas) that was most helpful, but reference to specific cases, examples, and simulation scenarios provided sufficient evidence that these objectives were achieved.
- Representative quotes:
 - “Simulations, learning calculations prior to starting [were most helpful].”
 - “Working through cases, as that was most helpful for call nights, etc.”

Theme 4: Managing respiratory problems.

- Description:
 - A key benefit of the boot camp was learning how to manage respiratory problems and ventilation from beginning to end.
 - Boot-camp activities and handouts helped participants to reduce nervousness and be more confident and ready to effectively carry out patient care responsibilities.
- Objective achieved: Educational Objective 5.
- Representative quotes:
 - “The most helpful part for me was learning about vent settings. This became helpful when I was expected to wean the vents overnight.”
 - “Recognizing common MRSOPA situations and exercising them in the field during respiratory decompensation where a pt [patient] required bag ventilation via ETT and chest compressions, improving with both [was most helpful].”

Item 12: What improvements/changes would you like to enhance the NICU boot-camp experience?

Analyses of responses revealed strong positive perceptions of the boot-camp experience and overall program effectiveness reflecting three closely related themes.

Theme 1: Instructional format.

- The most prominent and consistent perspective reflected the value of hands-on learning through cases, calculations, and simulation scenarios.
- The format maximized learning and preparation for the NICU rotation.
- Respondents desired additional opportunities for these types of learning experiences.
- Suggestions for improvement included the following:
 - Increase hands-on learning during in-person sessions by condensing use of lectures and PowerPoint presentations.

- Move factual and preparatory learning to completion prior to sessions (e.g., review handouts, complete problems and calculations) to increase active, hands-on learning during the 1-hour, in-person sessions.

Theme 2: Timing of sessions was effective for maximizing learning and preparedness for performance in the NICU rotation.

- Morning sessions (e.g., 8:00-9:00 a.m.) for 3 days, 1-2 months prior to the NICU rotation were effective.
- Respondents strongly supported mandatory participation prior to the first NICU rotation.
- Regarding repeat participation in the NICU boot camp, the common view among respondents was in favor of repeating Session 2 (common problems and emergencies) and Session 3 (integrative learning with simulation scenarios) while using a self-directed format for reviewing/refreshing relevant lab values and calculations (e.g., using handouts, practice problems, pocket cards of slides showing normal gas values).

Theme 3: Content breadth and depth were effective for achieving curriculum purposes and objectives.

- There were no suggestions for removing or decreasing content emphasis.
- Do not add more or significantly different content.
- Increase the use of hands-on, application, and simulation for integrating the existing breadth and depth of content (e.g., knowledge and skills) relevant to real-life situations—maximize higher level learning versus recalling and reviewing facts.
- Additional learning and practice for managing respiratory problems were viewed as most beneficial (e.g., new admission/transfer to NICU, neonatal resuscitation).
- Suggestions: meeting the NICU nurse coordinator during Session 1, getting familiar with equipment (e.g., hands-on introduction with a ventilator) when working through problems and cases/scenarios.

Discussion

The unique nature of our monthly NICU boot camp allowed residents to participate in the curriculum immediately prior to beginning a rotation in the high-stakes, high-stress NICU environment where previous exposure and experience are often lacking. Residents' responses revealed that an important feature was the just-in-time relevance of the boot camp's juxtaposition with starting the rotation. Quantitative and qualitative results provided consistently supportive evidence that residents perceived each session—and the boot camp as a whole—to be a positive and useful experience for enhancing their readiness and confidence for learning and engaging in an NICU rotation. Despite evaluation data being limited to resident self-report, data collection occurred after residents had completed both the boot camp and NICU rotation, thus facilitating reflection on self-perceived abilities before and after the boot camp and during the actual NICU experience. Residents' self-reported use of boot-camp materials (e.g., resource handouts) throughout their NICU rotation also provided evidence regarding what they perceived as meaningful contributions to their real-life behavior/performance and their learning experiences in the NICU rotation. Although not captured in the formal program evaluation's data collection, faculty members' informal observation of residents in both the boot camp and NICU rotations and unsolicited anecdotal comments from others not involved in the boot camp were encouraging regarding the effectiveness and added value of the boot-camp curriculum. Going forward, more rigorous program evaluation beyond self-report data will be used, including observation-based performance measures and direct measures of transfer of learning and curricular impact.

Since the initial implementation of the NICU boot camp, program improvements have been made based on our observations during sessions, faculty debriefings and ongoing discussions, and residents' responses to the feedback questionnaire. For example, less time is now spent on reviewing NICU

expectations, and more emphasis is devoted to active, hands-on learning for bedside management, including on-call scenarios and respiratory/ventilator management. Prior to the initiation of NICU boot camp, residents were required to complete three 1-month NICU rotations, one per postgraduate year (PGY). Currently, residents are required to complete only two NICU rotations, one in each of the PGY-2 and PGY-3 years. Thus, the boot camp is becoming an even more important resource for resident learning and performance. Consequently, additional consolidation of factual content (e.g., normal values, content, and skills already learned in PGY-1 that are applicable to the NICU) and presession preparation is being explored for future refinement and to accommodate increased application and integrative learning through cases, problems, and simulation scenarios.

One of the limitations of our program, particularly with more inexperienced resident involvement, has been covering the material in 1-hour intervals. We have negated some of this by having the residents review the information prior to arrival and come prepared to the sessions. If this is not feasible, or if more time is available to other institutions, this boot camp can be expanded to four sessions, with an additional didactic learning session put in place. For the simulation session, thoughtful critique and action-focused debriefing of the scenarios are often dependent on group dynamics and decision making during the simulation. With groups of varying experience, there is often an experienced participant who facilitates group decision making and flow of simulation scenarios and debriefing. With a more inexperienced group, time for scenario and debriefing can be a challenge.

Another limitation/challenge has been scheduling. Common challenges of time and scheduling for programs like our NICU boot camp can influence participation by both facilitators and participants. For example, despite our scheduling the sessions concurrently with morning report and allowing attendees to receive morning report credit, a few residents said that it was often difficult to attend while on another busy service. A remedy to this challenge was to allow residents to sign up during months that fit more easily into their schedule (e.g., 2 months prior to the NICU rotation, instead of the month immediately preceding). This might be considered by future users as one way to avoid or resolve scheduling conflicts and challenges. However, users should take care to ensure the just-in-time learning potential and limit how far in advance residents may schedule their NICU boot-camp experience to preserve proximity between boot camp and the NICU rotation (e.g., not more than 2 months prior to the rotation).

Scheduling faculty members to teach the first two sessions during their secondary Children's Hospital rotation worked well, as this rotation had a much smaller patient census. Faculty members could dedicate time to teaching without incurring a significant burden on their clinical responsibilities. Scheduling specific faculty members to give the simulation portion during a time when they were free from clinical service was also effective for ensuring protected faculty time and attention to this simulation-based session. These strategies may facilitate future implementation by others in similarly busy clinical settings. Future users of this boot camp can adapt it to meet their individual program's scheduling needs. These sessions could be given during noon conference, orientation to the rotation, or intern orientation. The lectures could also be adapted into an electronic resource such as a podcast. However, we recommend that users strongly consider the value of both face-to-face interaction with faculty and just-in-time learning. Access to an existing high-fidelity simulator on site facilitated flexibility and its use in the simulation sessions. This could be a challenge for some institutions and might limit options for scheduling.

Substantial attention to developing and refining detailed faculty notes and guidance produced a high yield for maintaining consistency and integrity of the boot-camp content, activities, and implementation. We think this attention is essential to both educational quality and the extent to which learning in boot camp transfers to real-life practice, especially when different faculty take turns teaching sessions. We also see it as key to sustainability and long-term viability. We thus recommend that future users give special attention to training and monitoring how different faculty deliver the program. In the end, for us, the overall cost for developing, implementing, and sustaining this boot camp was faculty time and effort. In our environment, clear expectations and faculty protected time for teaching made the boot camp possible without the need

for additional resources (e.g., people, time, money). We already had the necessary dedicated space and equipment. Fitting the NICU boot camp into the existing infrastructure played an important role in minimizing cost and optimizing sustainability, including the small faculty-to-resident ratio for teaching sessions. Future users should consider the extent to which existing faculty, educational, and clinical infrastructures would support implementation, sustainability, and need for additional resources.

Early in the implementation, three open-ended items were added to gather narrative feedback that would aid in interpreting quantitative results and using program evaluation results for improvements. While the meaning of questionnaire items has not changed, wording for a few items and page layout were improved to enhance clarity and completeness of responses. The enhanced and current form of the questionnaire is included as Appendix M. We are now working on a more comprehensive and rigorous program evaluation model. Our future resident questionnaire will include items directly reflective of the educational objectives and more explicit prompts for knowledge, skills, and perspectives to capture data pre-, post-, and delayed post-boot camp and rotation experiences. We also intend to measure more directly the learning that occurs, the transfer of learning to practice in the NICU, and the extent to which knowledge and behavior are retained over time (e.g., PGY-2 to PGY-3). Of course, evaluation of results and impact on actual patient care is also important to pursue.

In conclusion, our observations and experiences with this NICU boot camp offer promising evidence that this supplemental curriculum is a practical and sustainable solution to enhancing pediatric residents' specific knowledge and hands-on skills for an NICU rotation, where exposure and experience may be limited but stakes are unprecedentedly high. Resident feedback provides supporting evidence that the content, active learning format, and just-in-time learning enhanced residents' self-perceived readiness and confidence for performing and meeting expectations in the NICU rotation. Finally, our experiences with the NICU boot camp suggest that the instructional model may be amenable to designing similar orientation and initial preparedness experiences in other clinical areas and specialties.

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Disclosures

None to report.

Funding/Support

None to report.

Ethical Approval

Reported as not applicable.

References

1. Common Program Requirements. Accreditation Council for Graduate Medical Education website. <https://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/CPRs2013.pdf>. Accessed November 2016.
2. Krajewski A, Filippa D, Staff I, Singh R, Kirton OC. Implementation of an intern boot camp curriculum to address clinical competencies under the new Accreditation Council for Graduate Medical Education supervision requirements and duty hour restrictions. *JAMA Surg*. 2013;148(8):727-732. <https://doi.org/10.1001/jamasurg.2013.2350>
3. Schoolfield CS, Samra N, Kim RH, Shi R, Zhang WW, Tan T-W. Evaluating the effectiveness of the general surgery intern boot camp. *Am Surg*. 2016;82(3):243-250.
4. Accreditation Council for Graduate Medical Education. ACGME program requirements for graduate medical education in pediatrics. Accreditation Council for Graduate Medical Education website. https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/320_pediatrics_2017-07-01.pdf. Accessed November 2016.
5. Aurora ME, Kopek K, Weiner GM, Donn SM. Basics of infant conventional mechanical ventilation: an interactive animated teaching module. *MedEdPORTAL*. 2017;13:10658. https://doi.org/10.15766/mep_2374-8265.10658
6. Shafer S, Rooney D, Schumacher R, Chapman R, House J. Neonatal lumbar punctures: bridging the clinical gap. *MedEdPORTAL*. 2013;9:9597. https://doi.org/10.15766/mep_2374-8265.9597
7. House J, Iyer M, Santen S, et al. OSATS assessment instrument for neonatal lumbar puncture. *MedEdPORTAL*. 2014;10:9758. https://doi.org/10.15766/mep_2374-8265.9758
8. Auerbach M, Chang T, Krantz A, et al. Infant lumbar puncture: POISE pediatric procedure video. *MedEdPORTAL*. 2011;7:8339. https://doi.org/10.15766/mep_2374-8265.8339
9. Rosen O, Campbell D, Bruno C, Gabelman L, Goffman D, Angert R. Low cost, easy to assemble neonatal procedural trainers: chest tube, pericardiocentesis and exchange transfusion. *MedEdPORTAL*. 2014;10:9787. https://doi.org/10.15766/mep_2374-8265.9787
10. Butler-O'Hara M, Reiningger A, Dadiz R. Training in placement of peripherally inserted central catheters in the neonate. *MedEdPORTAL*. 2014;10:9780. https://doi.org/10.15766/mep_2374-8265.9780
11. Patricia K, Arnold J, Lemke D. Rapid cycle deliberate practice: application to neonatal resuscitation. *MedEdPORTAL*. 2017;13:10534. https://doi.org/10.15766/mep_2374-8265.10534
12. Daboval T, Ferretti E, Rohde K, Muirhead P, Moore G. Neonatal Ethics Teaching Program - Scenario-Oriented Learning in Ethics: antenatal consultation at the limit of viability. *MedEdPORTAL*. 2015;11:10043. https://doi.org/10.15766/mep_2374-8265.10043
13. Moore G, Ferretti E, Rohde K, Muirhead P, Daboval T. Neonatal Ethics Teaching Program - Scenario-Oriented Learning in Ethics: critically ill newborn in the neonatal intensive care unit. *MedEdPORTAL*. 2015;11:10083. https://doi.org/10.15766/mep_2374-8265.10083
14. Boggs S, Daboval T, Ben Fadel N, Moore G, Ferretti E. Neonatal Ethics Teaching Program - Scenario-Oriented Learning in Ethics: announcing the diagnosis of trisomy 21. *MedEdPORTAL*. 2017;13:10575. https://doi.org/10.15766/mep_2374-8265.10575
15. Ferretti E, Moore G, Rohde K, Muirhead P, Daboval T. Neonatal Ethics Teaching Program - Scenario-Oriented Learning in Ethics: unexpected birth malformation. *MedEdPORTAL*. 2015;11:10044. https://doi.org/10.15766/mep_2374-8265.10044
16. Merricks P, Steffey C. Infant with jaundice: a pediatric standardized patient OSCE case. *MedEdPORTAL*. 2014;10:9921. https://doi.org/10.15766/mep_2374-8265.9921
17. Pammi M, Lingappan K, Carbajal MM, Suresh GK. Focused evidence-based medicine curriculum for trainees in neonatal-perinatal medicine. *MedEdPORTAL*. 2017;13:10664. https://doi.org/10.15766/mep_2374-8265.10664
18. Aragona E, Conroy R. Newborn care curriculum: the late preterm infant in the level II neonatal intensive care unit. *MedEdPORTAL*. 2017;13:10657. https://doi.org/10.15766/mep_2374-8265.10657
19. Ernst K. A pediatrician's guide to post-discharge nutrition in NICU graduates. *MedEdPORTAL*. 2009;5:7820. https://doi.org/10.15766/mep_2374-8265.7820
20. Fernandez GL, Page DW, Coe NP, et al. Boot camp: educational outcomes after 4 successive years of preparatory simulation-based training at onset of internship. *J Surg Educ*. 2012;69(2):242-248. <https://doi.org/10.1016/j.jsurg.2011.08.007>
21. Ambardekar AP, Singh D, Lockman JL, et al. Pediatric anesthesiology fellow education: is a simulation-based boot camp feasible and valuable? *Paediatr Anaesth*. 2016;26(5):481-487. <https://doi.org/10.1111/pan.12865>
22. Burns R, Adler M, Mangold K, Trainor J. A brief boot camp for 4th-year medical students entering into pediatric and family medicine residencies. *Cureus*. 2016;8(2):e488. <https://doi.org/10.7759/cureus.488>
23. Minha S, Shefet D, Sagi D, Berkenstadt H, Ziv A. "See one, sim one, do one"—a national pre-internship boot-camp to ensure a safer "student to doctor" transition. *PLoS One*. 2016;11(3):e0150122.
24. Blackmore C, Austin J, Lopushinsky SR, Donnon T. Effects of postgraduate medical education "boot camps" on clinical skills, knowledge, and confidence: a meta-analysis. *J Grad Med Educ*. 2014;6(4):643-652. <https://doi.org/10.4300/JGME-D-13-00373.1>

25. Antonoff MB, Green CA, D'Cunha J. Critical skills for the senior medical student entering surgery. *MedEdPORTAL*. 2013;9:9372. https://doi.org/10.15766/mep_2374-8265.9372
 26. Bollag L. Spinal anesthesia (SPA) - a clinical skill bootcamp. *MedEdPORTAL*. 2013;9:9399. https://doi.org/10.15766/mep_2374-8265.9399
 27. Lai J, Thompson R. Isoniazid overdose: a pediatric simulation case. *MedEdPORTAL*. 2017;13:10573. https://doi.org/10.15766/mep_2374-8265.10573
 28. Rideout M, Raszka W. Fever and seizure in a young infant: a simulation case. *MedEdPORTAL*. 2016;12:10468. https://doi.org/10.15766/mep_2374-8265.10468
 29. Thomas A, Sanseau E, Uspal N, et al. Pediatric Emergency Medicine Simulation Curriculum: submersion injury with hypothermia and ventricular fibrillation. *MedEdPORTAL*. 2017;13:10643. https://doi.org/10.15766/mep_2374-8265.10643
 30. Kelly M, Posa M. Transition to pediatric practice: a residency elective experience to prepare senior pediatric residents for general pediatric primary care. *MedEdPORTAL*. 2016;12:10506. https://doi.org/10.15766/mep_2374-8265.10506
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Received: November 6, 2017 | **Accepted:** May 17, 2018 | **Published:** June 1, 2018