

The Need for an Adult Intensive Care Unit Boot Camp for Residents and Fellows: A Cross-Sectional Survey among Intensive Care Unit Directors

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Background: The concept of “see one, do one, teach one” raises concerns regarding patient safety in the intensive care unit (ICU) and highlights the need for prior preparation of residents/fellows for ICU rotation. This study assessed the need for an adult pre-ICU “boot camp” training course.

Methods: An online questionnaire regarding the current ICU training and desirable course framework was distributed via e-mail to the ICU directors of 269 educational centers certified by the Japanese Society of Intensive Care Medicine.

Results: The response rate was 39% (106/269). The number of residents/fellows undergoing ICU rotation was 5.5 (IQR 2-12)/ICU/year, and the majority (63%) were second to fourth year post-graduate residents and fellows. ICU directors opined that of the fundamental critical care skills, residents/fellows performed well or very well in only seven out of 29 skills (24%). Only 18% of the ICU directors had an established ICU training curriculum. Overall, 72% of the directors were interested in the boot camp. The desirable course framework was 3-5 hours per day with simulations and lectures. The core skills that directors considered as important to acquire during ICU rotation were central venous catheter insertion, tracheal intubation, defibrillation, initiation of mechanical ventilation, physical examination of critically ill patients, and shock assessment.

Conclusions: Residents/fellows began ICU rotations with suboptimal skills as reported by ICU directors. In addition, most of the ICUs had not established a training curriculum. Therefore, having an ICU boot camp is necessary to enhance critical care skills and to decrease medical errors.

(J Nippon Med Sch 2022; 89: 443-453)

Key words: boot camp, intensive care units, surveys and questionnaires, clinical competence, patient safety

Introduction

The concept of “see one, do one, teach one” pervades medical training¹⁻³. However, implementation of this conceptual approach is challenging and inconsistent, especially for clinical critical care training in the intensive care unit (ICU)¹⁻⁴. Residents/fellows who elect to participate in ICU training struggle to understand and simultaneously manage concepts of physiologic compromise in

critically ill patients⁵⁻⁷. This is due to the complex and dynamic nature of critically ill patients and the lack of opportunities to develop the knowledge and skills necessary for managing critical care patients during medical school training⁸. Clinical educators also struggle to balance optimal care with patient safety while providing bedside teaching for residents/fellows^{9,10}. Additionally, patients expect healthcare professionals to be fully com-

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https://doi.org/10.1272/jnms.JNMS.2022_89-412

Journal Website (<https://www.nms.ac.jp/sh/jnms/>)

petent and increasingly do not wish to be managed by inexperienced learners in training^{2,4}.

To enhance learning and preparation of residents/fellows entering new clinical roles, short intensive simulation-based pre-training courses called “boot camp” have been an effective educational strategy in medical education¹¹. The boot camp curricula comprise a 1 to 3-day intensive program designed to improve procedural, management, communication, and teamwork skills^{6,11-15}. In neonatal/pediatric ICU boot camps, residents and fellows who participated agreed that boot camps were an invaluable learning experience and helped increase their comfort levels^{6,15,16}. However, there is a paucity of literature describing the need, development, and effectiveness of boot camps for residents/fellows undergoing adult ICU rotations¹⁷.

Thus, this study was conducted to assess the need for an adult ICU boot camp before the establishment of the proposed training course. To determine this, an online survey on the current ICU training was conducted among ICU directors. The desirable course framework for an adult ICU boot camp was also included in the survey questions.

Materials and Methods

Study Design

This study was approved by the University of Hawaii Institutional Review Board (no. 22168) and the clinical trial group of the Japanese Society of Intensive Care Medicine (JSICM) (no. 0010).

A cross-sectional electronic Japanese language survey was administered between July 17, 2015, and January 31, 2016. Two hundred and sixty-nine program directors of JSICM certified educational center ICUs were sent e-mail invitations to participate in an online survey using SurveyMonkey[®] (SurveyMonkey Inc., CA, USA). The invitation described the aims of the study and was sent twice during the study period. The survey tool was developed by the authors (**Table 1**). All responses were voluntary and confidential, and no compensation was provided for participation.

Data Collection

The survey consisted of 22 questions and focused on (1) the characteristics of the ICU, (2) the current ICU training, and (3) the desirable framework for a pre-critical care training course.

Characteristics of ICU

The following questions were asked to characterize the ICU training environments: number of ICU beds, number

of total daytime doctors and certified intensivists, patient visiting hours, type of ICU, and the presence/absence of post-operative cardiovascular surgery patients.

Current ICU training

For the current ICU training, the following questions were asked: the annual number of residents/fellows on ICU elective rotation, teaching time, the presence/absence of a formal training curriculum, utilization of simulation, post-graduate year level, training duration, and the level of fundamental critical care procedural and management skills acquisition before rotation. One- and two-year post-graduate physicians were defined as residents; and physicians who had completed the resident program but had not been licensed by the appropriate board were defined as fellows. The level of fundamental critical care procedural and management skills acquisition was evaluated using a 5-point Likert scale, with responses ranging from 1 (extremely poor) to 5 (very well). The selected skills queried were based on existing literature, guidelines, and expert opinion from a clinical trial group of JSICM¹⁸⁻²¹. The fundamental procedural skills included bag valve mask ventilation, tracheal intubation, chest compression, arterial catheter insertion, central venous catheter insertion, pulmonary artery catheter insertion, chest tube insertion, nasogastric tube insertion, pacemaker settings, defibrillation, and cardioversion. The fundamental management skills included physical examination of critically ill patients, oxygen mask placement, initiation of non-invasive positive pressure ventilation, initiation of mechanical ventilation, selection of intravenous fluid infusion therapies, assessment of the four categories of shock (distributive, obstructive, hypovolemic, and cardiogenic), initiation of treatment for septic shock, initiation of catecholamine treatment, initiation of treatment for life-threatening arrhythmia, identification of acid-base disturbances, initiation of treatment for hyperkalemia, initiation of continuous hemodiafiltration, management of liver failure, management of acute pancreatitis, administration of sedation and anesthesia, selection of nutritional support, initiation of treatment for burns, and conducting a relevant literature search.

Desirable framework for a pre-ICU “boot camp” training course

The interest in simulation-based pre-ICU training course was queried. Information on the desirable educational modalities, ideal duration of the training course, and ideal duration of training per day were collected. Furthermore, five of 11 procedural skills and five of 18 management skills that ICU directors considered to be

Table 1 Survey questions

1. Characteristics of ICU

- Q1. How many beds are there in your ICU?
 Q2. How many doctors are there during the daytime in your ICU?
 Q3. How many certified intensivists are there during the daytime in your ICU?
 Q4. How many visiting hours for families are available at your ICU?
 Q5. What type of ICU is it?
 Emergency Medicine Anesthesiology Independent ICU
 Q6. Do you provide care for post-operative cardiovascular surgery patients?
 Yes No

2. Current ICU training

- Q7. How many residents/fellows elect ICU training?
 Q8. Do you have enough time to train those residents/fellows?
 Yes No
 Q9. Does your ICU have a specialized training program?
 Yes No In progress
 Q10. Do you use a simulator for training?
 Yes No
 Q11. What are the post-graduate years of residents/fellows?
 Q12. How long do residents/fellows rotate through the ICU?
 Q13. How well do residents/fellows perform the following skills at the beginning of their ICU rotations?
 Extremely poor Poor Neutral Well Very well

(Items)

Bag valve mask ventilation

Tracheal intubation

Chest compression

Arterial catheter insertion

Central venous catheter insertion

Pulmonary artery catheter insertion

Chest tube insertion

Nasogastric tube insertion

Pacemaker setting

Defibrillation

Cardioversion

- Q14. How well do residents/fellows perform a physical examination of critically ill patients at the beginning of their ICU rotations?
 Extremely poor Poor Neutral Well Very well

- Q15. How well do residents/fellows perform the following clinical skills at the beginning of their ICU rotations?

Extremely poor Poor Neutral Well Very well

(Items)

Oxygen mask placement

Initiation of non-invasive positive pressure ventilation

Initiation of mechanical ventilation

Selection of intravenous fluid infusion therapies

Assessment of the four categories of shock

Initiation of treatment for septic shock

Initiation of catecholamine treatment

Initiation of treatment for life-threatening arrhythmia

Identification of acid-base disturbances

Initiation of treatment for hyperkalemia

Initiation of continuous hemodiafiltration

Management of liver failure

Management of acute pancreatitis

Administration of sedation and anesthesia

Selection of nutritional support

Initiation of treatment for burns

Conducting a relevant literature search

Table 1 Survey questions (continued)

-
3. Desirable curriculum content for a pre-critical care training course
- Q16. Are you interested in a simulation-based pre-critical care training course?
 Not at all Slightly Moderately Very Extremely
- Q17. Which educational modalities are desirable?
 Lectures and simulation e-Learning and simulation Simulation
- Q18. Which course duration is desirable for your learners?
 1-day 2-days 3-days 4-days
- Q19. Which training time per day is desirable for your learners?
 0–2 hours 3–5 hours 6–8 hours
- Q20. Of the following procedural skills, which are the five procedural skills that you thought were important for residents/fellows to possess during ICU rotations? (Select five skills)
- Bag valve mask ventilation
 - Tracheal intubation
 - Chest compression
 - Arterial catheter insertion
 - Central venous catheter insertion
 - Pulmonary artery catheter insertion
 - Chest tube insertion
 - Nasogastric tube insertion
 - Pacemaker setting
 - Defibrillation
 - Cardioversion
 - Other
- Q21. Of the following management skills, which are the five management skills that you thought were important for residents/fellows to possess during ICU rotations? (Select five skills)
- Oxygen mask placement
 - Initiation of non-invasive positive pressure ventilation
 - Initiation of mechanical ventilation
 - Selection of intravenous fluid infusion therapies
 - Assessment of the four categories of shock
 - Initiation of treatment for septic shock
 - Initiation of catecholamine treatment
 - Initiation of treatment for life-threatening arrhythmia
 - Identification of acid-base disturbances
 - Initiation of treatment for hyperkalemia
 - Initiation of continuous hemodiafiltration
 - Management of liver failure
 - Management of acute pancreatitis
 - Administration of sedation and anesthesia
 - Selection of nutritional support
 - Initiation of treatment for burns
 - Conducting a relevant literature search
4. Other
- Q22. What is your post-graduate year?
- Q23. Many thanks for taking the time to complete this survey. If you have further comments, please add them below.
-

important for residents/fellows to acquire during ICU rotation were surveyed. The 11 fundamental procedural skills and the 18 fundamental management skills were selected based on existing literature, guidelines, and expert opinion from a clinical trial group of JSICM¹⁸⁻²¹. The 11 fundamental procedural skills included bag valve mask ventilation, tracheal intubation, chest compression, arterial catheter insertion, central venous catheter insertion, pulmonary artery catheter insertion, chest tube in-

sertion, nasogastric tube insertion, pacemaker settings, defibrillation, and cardioversion. The 18 fundamental management skills included physical examination of critically ill patients, oxygen mask placement, initiation of non-invasive positive pressure ventilation, initiation of mechanical ventilation, selection of intravenous fluid infusion therapies, assessment of the four categories of shock (distributive, obstructive, hypovolemic, and cardiogenic), initiation of treatment for septic shock, initiation

Table 2 Intensive care unit directors' assessments of residents'/fellows' fundamental procedural skill acquisition levels

| Items | Likert scale (Median) | Likert scale > 3 (%) | Likert scale < 3 (%) |
|-------------------------------------|-----------------------|----------------------|----------------------|
| Chest compression | 4 (4-4) | 88 | 3 |
| Nasogastric tube insertion | 4 (4-4) | 79 | 7 |
| Bag valve mask ventilation | 4 (3-4) | 66 | 15 |
| Defibrillation | 4 (3-4) | 57 | 14 |
| Arterial catheter insertion | 4 (3-4) | 56 | 14 |
| Tracheal intubation | 4 (3-4) | 55 | 18 |
| Cardioversion | 3 (3-4) | 48 | 20 |
| Central venous catheter insertion | 3 (3-4) | 40 | 20 |
| Pulmonary artery catheter insertion | 2 (2-3) | 19 | 58 |
| Chest tube insertion | 2 (2-3) | 13 | 63 |
| Pacemaker setting | 2 (1-3) | 11 | 65 |

Categorical variables reported as n (%). Continuous variables reported as median (IQR). Median Likert scale scores and percentage of directors reporting performance category of well or very well (Likert scale > 3)/poor or extremely poor (< 3) in each skill.

of catecholamine treatment, initiation of treatment for life-threatening arrhythmia, identification of acid-base disturbances, initiation of treatment for hyperkalemia, initiation of continuous hemodiafiltration, management of liver failure, management of acute pancreatitis, administration of sedation and anesthesia, selection of nutritional support, initiation of treatment for burns, and conducting a relevant literature search. Free-text fields were provided at the end of the survey to allow for comments and suggestions.

Data Analysis

Survey responses were downloaded into a 2010 Excel spreadsheet (Microsoft Corporation, WA, USA). Descriptive statistics were used to summarize categorical and/or binary variables using frequency (percentages) and numerical variables using median and interquartile ranges (IQR).

Results

The response rate to the survey was 39% (106/269).

Characteristics of ICU

The median number of ICU beds was 10 (IQR 8-14), the median number of physicians on-duty during the daytime was 3 (IQR 2-5), the median number of certified intensivists during the daytime was 2 (1-2), and the median total number of visiting hours for families was 4 (IQR 2-6). The most common type of ICU was anesthesia-based ICU (39%), followed by emergency physician-based ICU (35%), and intensivist-based ICU (26%). The majority (77%) of ICUs cared for post-operative cardiovascular surgery patients.

Current ICU Training

The median number of residents/fellows undergoing ICU rotation was 5.5 (IQR 2-12) per year. They rotated for a median duration of 3 months (IQR 1-6). The majority (63%) were second year and fourth year post-graduate residents/fellows. Although 89% of the directors responded that they had enough time to train residents/fellows, only 18% reported utilization of an established critical care training curriculum, and only 31% reported utilization of simulation-based training.

Results of the assessments of the level of acquisition of the 11 fundamental procedural skills are shown in **Table 2**. The ICU directors thought that residents/fellows performed well or very well (above 3 on the Likert scale) in the following procedural skills: chest compression, nasogastric tube insertion, bag valve mask ventilation, defibrillation, arterial catheter insertion, and tracheal intubation. The directors thought that the residents/fellows performed poorly or extremely poorly (below 3 on the Likert scale) in the following skills: pulmonary artery catheter insertion, chest tube insertion, and pacemaker setting.

Results of the assessment of the level of acquisition of the 18 fundamental critical care management skills are shown in **Table 3**. The ICU directors considered that the level of acquisition of residents/fellows' management skills, except for oxygen mask placement, to be below 4 on the Likert scale. In management skills, the ICU directors thought that residents/fellows performed poorly or extremely poorly (below 3 on the Likert scale) in the following: initiation of continuous hemodiafiltration, man-

Table 3 Intensive care unit directors' assessments of residents'/fellows' fundamental management skill acquisition levels

| Items | Likert scale (Median) | Likert scale > 3 (%) | Likert scale < 3 (%) |
|----------------------------------------------------------|-----------------------|----------------------|----------------------|
| Oxygen mask placement | 4 (3–4) | 66 | 4 |
| Selection of intravenous fluid infusion therapies | 3 (3–4) | 45 | 14 |
| Assessment of the four categories of shock | 3 (3–4) | 41 | 14 |
| Identification of acid-base disturbances | 3 (3–4) | 42 | 16 |
| Initiation of treatment for hyperkalemia | 3 (3–4) | 41 | 18 |
| Initiation of catecholamine treatment | 3 (3–4) | 41 | 18 |
| Conducting a relevant literature search | 3 (3–4) | 37 | 19 |
| Physical examination of critically ill patients | 3 (3–4) | 36 | 25 |
| Administration of sedation and anesthesia | 3 (2–4) | 30 | 28 |
| Initiation of mechanical ventilation | 3 (2–4) | 32 | 37 |
| Selection of nutritional support | 3 (2–3) | 23 | 27 |
| Initiation of non-invasive positive pressure ventilation | 3 (2–3) | 24 | 39 |
| Initiation of treatment for life-threatening arrhythmia | 3 (2–3) | 19 | 45 |
| Initiation of treatment for septic shock | 3 (2–3) | 19 | 45 |
| Initiation of continuous hemodiafiltration | 2 (2–3) | 13 | 62 |
| Management of liver failure | 2 (2–3) | 7 | 63 |
| Initiation of treatment for burns | 2 (2–3) | 8 | 67 |
| Management of acute pancreatitis | 2 (2–3) | 6 | 66 |

Categorical variables reported as n (%). Continuous variables reported as median (IQR). Median Likert scale scores and percentage of directors reporting performance category of well or very well (Likert scale > 3)/poor or extremely poor (< 3) in each skill.

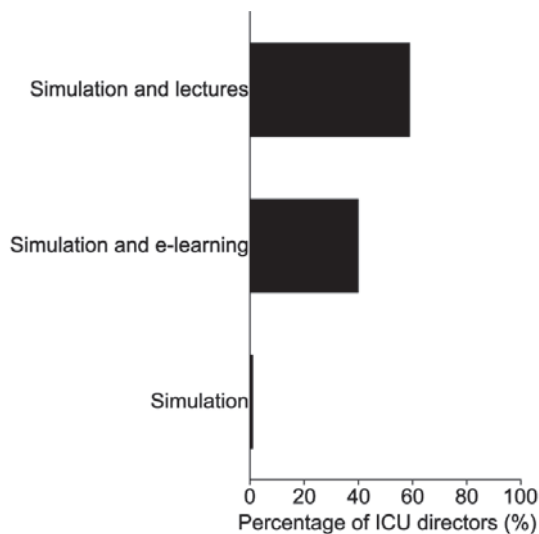


Fig. 1 Desirable components of an intensive care unit (ICU) boot camp.

The figure demonstrates the ideal design of an ICU boot camp. The figure shows the percentage of ICU directors who responded to each design.

agement of liver failure, initiation of treatment for burns, and management of acute pancreatitis.

Desirable Framework for a Pre-ICU “Boot Camp” Training Course

Seventy-two percent of directors responded that they were interested in a simulation-based pre-ICU training

course; 7% reported that they were not interested in the course, and the remainder neither agreed nor disagreed.

ICU directors identified simulation-based experiential learning and lectures as a component of an ideal curriculum (Fig. 1). The desirable course duration was 3-5 hours on a single day (Fig. 2). The top five out of the 11 fundamental procedural skills that directors considered important for residents/fellows to acquire during ICU rotation were central venous catheter insertion, tracheal intubation, defibrillation, bag valve mask ventilation, and arterial catheter insertion (Fig. 3). The top five out of the 18 management skills that directors thought residents/fellows should acquire were initiation of mechanical ventilation, assessment of the four categories of shock, physical examination of critically ill patients, initiation of treatment for septic shock, and oxygen mask placement (Fig. 4). Of these procedural and management skills, the ICU directors considered that the residents/fellows do not perform well or very well in the following: central venous catheter insertion, initiation of mechanical ventilation, assessment of the four categories of shock, physical examination of critically ill patients, and initiation of treatment for septic shock.

Representative narrative of the ICU directors' comments included the following: “JSICM should develop the training course,” “I need a standardized training program,”

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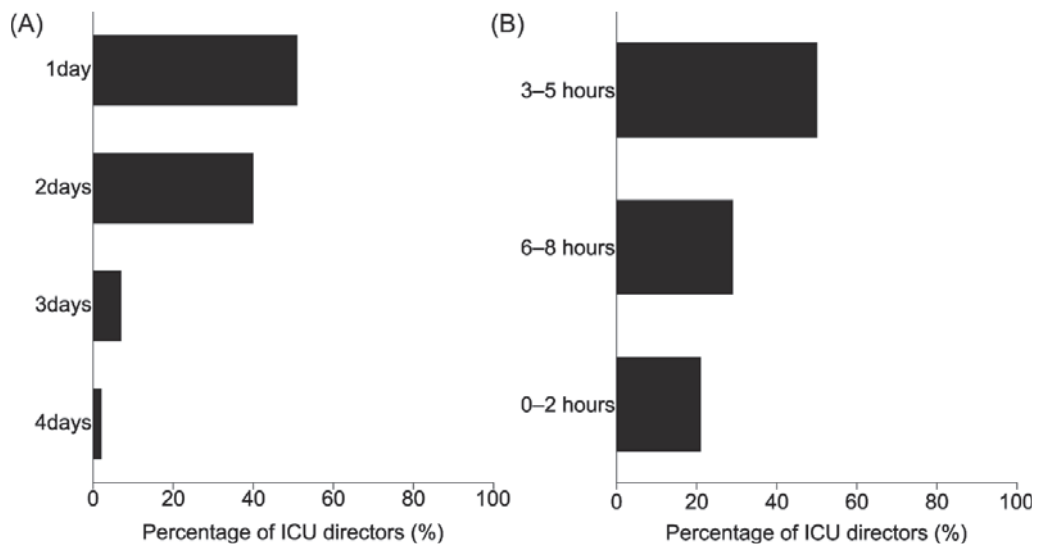


Fig. 2 Ideal duration of an intensive care unit (ICU) boot camp.

(A) This figure demonstrates the ideal duration of an ICU boot camp. The figure shows the percentage of ICU directors who selected each duration. (B) This figure demonstrates the ideal duration of training in a boot camp per day. The figure shows the percentage of ICU directors who selected each duration.

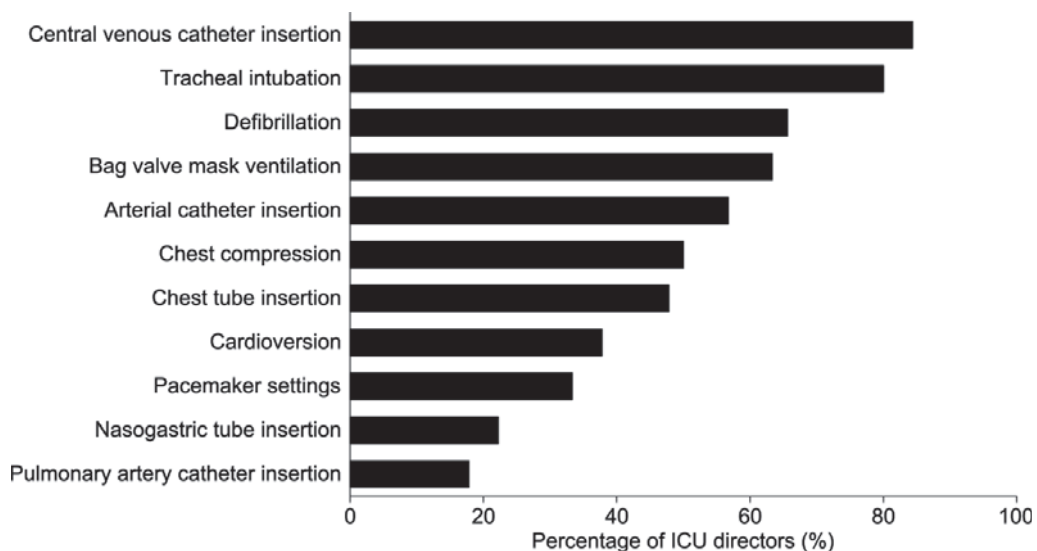


Fig. 3 The fundamental procedural skills that directors thought were important for residents/fellows to possess during intensive care unit (ICU) rotations.

This figure shows the percentage of ICU directors who selected each procedural skill that they thought was important for residents/fellows to possess during ICU rotation.

and “We have to obtain results such as patient outcomes, beyond novice satisfaction by training course.”

Discussion

This study showed that ICU directors felt that the baseline levels of the fundamental critical care procedural and management skills acquisition among residents/fellows were suboptimal. According to the ICU directors, the residents/fellows performed well in only six (54%)

simple procedural skills (i.e., chest compression, nasogastric tube insertion, bag valve mask ventilation, defibrillation, arterial catheter insertion, and tracheal intubation) out of the 11 procedural skills, and one (6%) simple management skill (i.e., oxygen mask placement) out of the 18 management skills.

To the best of our knowledge, this is the first study on the perceptions of ICU directors regarding the procedural and management skill acquisition level among resident

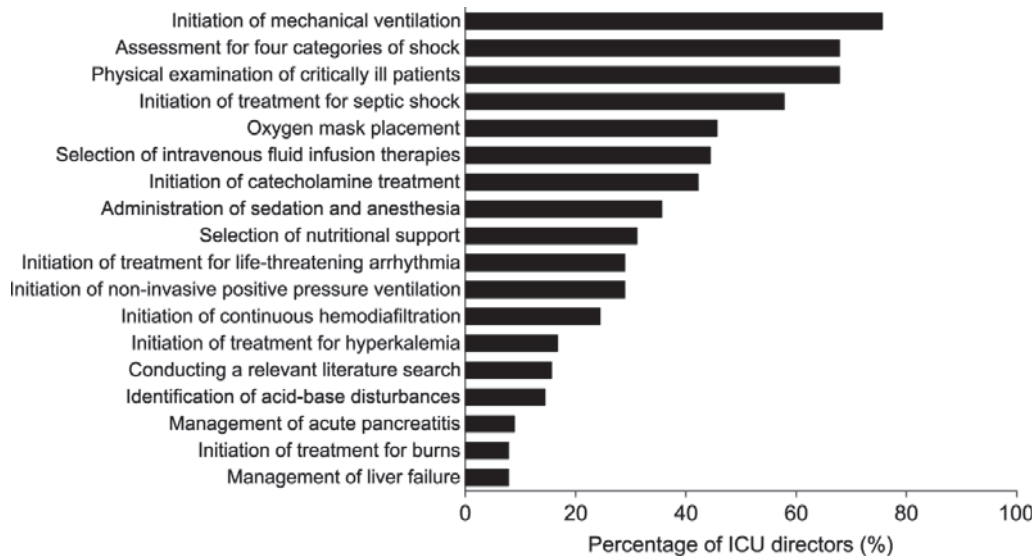


Fig. 4 The fundamental management skills that directors thought residents/fellows should possess during intensive care unit (ICU) rotation.

This figure shows the percentage of ICU directors who selected each management skill that they thought were important for residents/fellows to possess during ICU rotation.

and/or fellow at the beginning of ICU rotation. However, the perceptions of new graduate physicians regarding the procedural and management skill competencies have been reported²²⁻²⁴. Moercke et al.²³ reported that no post-graduate trainee thought that they met a minimum level for the 210 identified necessary skills. Among the 210 identified necessary skills, post-graduate trainees considered themselves to be maintaining a minimum level of skill in 74%²³. Lenchus et al.²⁴ reported that only 36% of residents achieved competency in central venous catheter insertion by the end of a 4-week ICU training experience.

The limited procedural and management skills of a novice can lead to an increase in medical errors. Factors that may influence the likelihood of medical errors include high workload, inadequate knowledge, little prior experience, poor interface design, inadequate supervision or instruction, stressful environments, mental state (e.g., fatigue, boredom, and task overload), and frequent changes in the immediate surroundings or current work plan during various training rotations²⁵. Residents/fellows starting an ICU rotation are at higher risk of experiencing these errors because the ICU is an inherently unfamiliar, high-risk, stressful, and complicated environment; and ICU patients are less likely to tolerate or recover from medical errors than other patient populations²⁶. Lee et al.²⁷ found longer duration of ICU stay and higher mortality rate among patients managed by junior surgical residents than those managed by senior surgical

residents. Learning from trial and error in patient care is no longer acceptable, and suitable induction and orientation courses for new ICU residents/fellows are needed.

To assist and prepare trainees for ICU rotations, simulation-based boot camp, which provides learners with timely feedback and an opportunity to practice repeatedly with a clear goal in mind until the desired skill is mastered, could be effective²⁸. A mechanical ventilation boot camp has been developed to educate first-year residents on troubleshooting and addressing ventilator alarms²⁹. Participants in the mechanical ventilation boot camp demonstrated post-course improvement in cognitive knowledge, critical actions performed in acute respiratory distress syndrome and mucus plugging simulation scenarios, and in self-reported confidence²⁹. Moazed et al.¹⁷ showed that ICU residents acquired critical care knowledge and skills, and retained these skills up to 12 months after a boot camp experience. Simulation-based learning is an effective method to master procedural and management skills in a critical care setting³⁰⁻³³. Furthermore, simulation-based training can improve both individual and/or team performance and has demonstrably decreased complications from invasive procedures³⁰⁻³². According to the current survey, ICU directors considered the residents/fellows' skills at the beginning of the ICU rotation to be inadequate, but most ICUs do not have a training curriculum. Furthermore, considering that most of the surveyed ICU directors expressed an interest in a simulation-based training course, an ICU boot camp

should be developed.

However, one of the major challenges that ICU directors need to overcome is the agreement on what should constitute the core skills and the competency levels⁶. Bobel et al.³⁴ reported that the expectations regarding junior surgery trainees' medical knowledge and skills were not consistent across ICUs, although, they have some common expectations such as knowledge of ventilators, being able to place a central and arterial line, and being able to communicate effectively. Furthermore, components of items measuring competencies and the approaches for the assessment of competencies (i.e., checklists and/or global rating scales) differed among the facilities^{35,36}. The set of skills required for residents/fellows prior to an ICU rotation and the competency assessment tool should be standardized by JSICM.

Our results from Japanese clinical teaching ICUs suggest that an ICU boot camp for one to four-year postgraduate learners should be conducted over a period of one day (3-5 hours) and should consist of simulation-based learning and lectures focused on central venous catheter insertion, initiation of mechanical ventilation, physical examination of critically ill patients, assessment of the four categories of shock, and initiation of treatment for septic shock. These skills were specified by the ICU directors for the residents/fellows to acquire based on what they thought the residents/fellows failed to perform well or very well in. The use of simulation for central venous catheterization is associated with success rate, fewer needle passes, and pneumothorax^{37,38}. Simulation-based mechanical ventilation boot camp was effective to educate first-year residents²⁹. Keller et al.³⁹ also recommended incorporating simulation with case-based scenarios to improve mechanical ventilation knowledge and technical skills. Similarly, using simulation with shock case-based scenario can improve students' understanding of the four different categories of shock and residents' knowledge and confidence⁴⁰⁻⁴³. Furthermore, Li et al.⁴⁴ recommended inclusion of didactic lectures followed by simulation to teach management of severe sepsis.

This study has some limitations. First, this survey was limited to the ICU directors' perception because residents/fellows undergoing ICU rotations were not registered with the JSICM. Ideally, conducting the survey based on the trainee and trainer's perspectives is required. Second, our results may not portray the actual level of fundamental skills acquired since there is no clear definition of competency in all the critical care skills. Although the ICU directors thought that residents/

fellows performed the chest compression well or very well in the current study, residents/fellows may have delivered chest compression at rates much lower than recommended⁴⁵. Future efforts should focus on developing global assessment tool for procedural and management skill competence^{35,36,46-48}. Third, the response rate was low overall. Although it is similar to the response rate of the survey regarding education among ICU directors^{49,50}, this low response rate may limit the interpretation of this survey results. Fourth, the fundamental critical care procedural and management skills were selected based on existing literature, guidelines, and expert opinion from a clinical trial conducted by JSICM and may not reflect the skills that resident/fellows focus on. Finally, there were no questions regarding communication and teamwork skills. Breakdowns in communication and teamwork are associated with medical errors and unfavorable patients' outcomes; therefore, they may be required as fundamental skills^{51,52}.

In conclusion, residents and fellows start ICU rotations without adequate procedural and management skills. A simulation-based pre-ICU training course is necessary to improve clinical practice, accelerate clinical learning and skill development, and decrease medical errors during trainees' clinical experiences. Our findings provide a roadmap for curriculum and content development for ICU boot camp. Future studies should aim at establishing boot camps that incorporate the recommended contents in the current study (i.e., central venous catheter insertion, initiation of mechanical ventilation, physical examination of critically ill patients, assessment of the four categories of shock, and the initiation of treatment for septic shock) and should assess the effectiveness on patient outcomes.

Acknowledgements: We thank all ICU directors who participated in the survey.

Conflict of Interest: The authors declare no conflict of interest.

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(Received, November 14, 2021)

(Accepted, March 23, 2022)

(J-STAGE Advance Publication, May 30, 2022)

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