

Evaluation of the impact of trained pediatric intensivists on patient management in intensive care unit: An uncontrolled before-after study

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Abstract

It is known that the presence of a pediatric intensivist in the pediatric intensive care unit (PICU) improves the quality of patient care and treatment. In this study, it was aimed to determine the differences in the quality of patient care between the period when a pediatric intensivist is actively working and the period when he/she is not actively working. This is a retrospective cohort observational study conducted in Batman Training and Research Hospital. Children aged 1 month to 18 years old admitted to the PICU between October 2020 and March 2021 were enrolled in the study. The 6-month period without an intensivist was compared with the period when the patients were treated by a pediatric intensivist. Demographic data and mortality of the group were recorded and compared between groups. There was no statistically significant difference between the groups in terms of number, gender, and age. The mean Pediatric Risk of Mortality (PRISM) score and Pediatric Death Rate (PDR) were higher in group 2, and these differentiations were statistically significant (0.39 ± 0.18 vs 4.57 ± 2.36 , $p < 0.001$; 1.08 ± 0.15 vs 2.05 ± 1.25 , $p < 0.001$). Although mortality was statistically higher in group 2, there were no invasive procedures like mechanical ventilatory support, dialysis, and central venous catheter applications in group 1. The ratio of patient acceptance from other hospitals was higher in group 2 ($p < 0.001$). In intensive care units under the management of intensivists, clinical follow-up of critical and risky patients can be performed on-site. This protects from transfer difficulties. Invasive interventions can be performed on patients with less risk, and yet mortality is below average. Pediatric intensive care units should be managed by pediatric intensivists and their numbers should be increased.

Keywords: Pediatrics, intensivist, intensive care unit, patient care

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Introduction

Research has shown that having a pediatric intensivist present in a pediatric intensive care unit (PICU) leads to better quality of care and treatment [1]. This approach has been implemented in developed countries for many years, with pediatric intensivists working around the clock in PICUs [2]. With pediatric intensivists working in hospitals, there has been a significant reduction in mortality rates, duration of mechanical ventilation, and length of stay in the PICU [3].

In this study, the objective was to compare patient care quality, PICU modalities, and patient outcomes during periods of active and inactive pediatric intensivist presence.

Materials and Methods

This study observed a retrospective cohort in a 16-bed pediatric intensive care unit (PICU) at the Batman Training and Research Hospital. Before March 2021, the patients were treated by pediatricians in the PICU. After a pediatric intensivist was hired, the pediatricians worked alongside the intensivist to manage patient care. The pediatricians worked exclusively during night shifts in the PICU.

The study included patients aged 1 month to 18 years who were admitted to the PICU between October 2020 and September 2021. The patients were divided into two groups based on whether they received care from a pediatric intensivist for 6 months. Group I did not receive care from a pediatric intensivist, while Group II did. The pediatric intensivist visited patients twice daily, made decisions regarding new patient admissions, was present during emergencies, and utilized telemedicine outside of working hours for patient care.

In this study, the researchers compared data between groups on several factors. This included age, gender, length of stay in the PICU, number of patients requiring mechanical ventilatory support or tracheostomy, Pediatric Risk of Mortality (PRISM) scores, Pediatric Death Rate (PDR), number of central venous catheter procedures, instances of thoracostomy tubes and gastrostomy applications, cases of nosocomial

infection, and number of patients requiring dialysis. The study received ethical approval from Batman Education and Training Hospital Non-Interventional Clinical Research Ethics Committee (approval no. 2022/312).

Statistical Analysis

The statistical analysis was carried out using the SPSS package program (IBM SPSS Statistics 27). Frequency tables and descriptive statistics were used to interpret the results. Non-parametric methods were used for measurement values that did not follow a normal distribution. The *Mann-Whitney U* test (Z-table value) was used to compare the measurement values of two independent groups by non-parametric methods. To examine the relationships between two qualitative variables, *Pearson- χ^2* cross-tabulations were used. A *p*-value below 0.05 was considered statistically significant.

Results

In the pre-intensivist period, Group I consisted of 260 patients, with 156 (60%) males and 104 (40%) females. Group II in the post-intensivist period had 264 patients, with 163 (61.7%) males and 101 (38.3%) females. The mean age for Group I was 67.01 ± 62.63 , and for Group II it was 60.69 ± 59.77 months. There was no significant difference between the two groups in terms of their number, gender, and age, as shown in Table 1.

While 27 patients (10.4%) in Group I were transferred to another hospital after PICU admission, this rate was lower in Group II, with only 17 patients (6.4%) being transferred ($p=0.104$). No patients were adopted from another hospital in Group I, but 12 patients (4.5%) in Group II were admitted to the PICU from other hospitals due to intensive care unit requirements ($p<0.001$).

In the study, Group I had a significantly lower Pediatric Risk of Mortality score (PRISM score) of 0.39 ± 0.18 compared to Group II, which had a score of 4.57 ± 2.36 ($p<0.001$). Additionally, group I had a lower mean Pediatric Death Rate (PDR) of 1.08 ± 0.15 compared to Group II with a rate of 2.05 ± 1.25 ($p<0.001$).

There were no reported infections in Group I, while 3 patients (1.1%) in Group 2 tested positive for blood culture ($p=0.085$). The mean length of stay in the intensive care unit was significantly shorter in Group I with 1.7 ± 1.58 days compared to Group II with 5.5 ± 4.76 days ($p<0.001$).

Central venous catheters were not inserted in any patients in Group I, but 47 patients (17.8%) in Group II received them ($p<0.001$). In Group II, 45 patients (17%) required invasive mechanical

ventilation, while none were used in Group I ($p<0.001$). Tracheostomy was performed on 7 patients (2.7%) and gastrostomy was performed on 3 patients (1.1%) in group II, but not in Group I ($p<0.001$).

Chest tubes were not inserted in Group I, but 4 patients in Group II received them ($p<0.001$). None of the patients in Group I required hemodialysis, but 3 patients received it in Group II ($p<0.001$).

Table 1. Descriptive data of patients.

| | Group I (n=260) Pre- intensivist | Group II (n=264) Post- intensivist | p value |
|--|---|---|------------------|
| Male gender, n (%) | 156 (60) | 163 (61) | 0,683 |
| Age, months, mean \pm SD | 67.01 \pm 62.63 | 60.69 \pm 59.77 | 0,198 |
| LOS-PICU ^a day, mean \pm SD | 1.7 \pm 1.58 | 5.5 \pm 4.76 | <0,001 |
| PRISM ^b score, mean | 0.39 \pm 0.18 | 4.57 \pm 2.36 | <0,001 |
| PDR ^c mean | 1.08 \pm 0.15 | 2.05 \pm 1.25 | <0,001 |
| Acceptance from another center, n (%) | 0 (0) | 12 (4) | <0,001 |
| Transfer to advanced center, n (%) | 27 (10) | 17 (6) | 0,104 |
| Infection, n (%) | 0 (0) | 3 (1.1) | 0,085 |
| Mortality rate, % | 0 | 0.7 | <0,001 |

^a Length of stay Pediatric intensive care unit, ^b Pediatric Risk of Mortality, ^c Predictive Death Rate

Table 2. PICU modalities.

| | Group I Pre-intensivist | Group II Post-intensivist | p value |
|----------------------------------|------------------------------------|--------------------------------------|------------------|
| Intubation, n | 0 | 42 | <0,001 |
| Invasive MV, n | 0 | 45 | <0,001 |
| Central venous catheter, n | 0 | 47 | <0,001 |
| Chest tube, n | 0 | 4 | <0,001 |
| Dialysis, n | 0 | 4 | <0,001 |
| Tracheostomy, n | 0 | 7 | <0,001 |
| Gastrostomy, n | 0 | 3 | <0,001 |
| Cardiopulmonary Resuscitation, n | 0 | 31 | <0,001 |

MV: Mechanical Ventilator

Cardio-pulmonary resuscitation (CPR) was not administered in Group I, and there were no reported deaths. However, in Group II, CPR was performed on 31 patients, and 15 of them (5.7%) died ($p < 0.001$).

The mortality rate was 0% in Group I and 0.7% in Group II ($p < 0.001$).

Discussion

The research conducted shows that the management of patients by pediatric intensivists has a positive impact in various ways. The number of children receiving mechanical ventilation in the PICU increased, and many were admitted from other hospitals. The two groups showed significant differences in terms of the procedures performed in the intensive care unit. Overall, the study highlights the positive effects of pediatric intensivists in patient management. During both periods, the patient's count, gender, and age were comparable. A previous study investigated the impact of a trained intensivist's leadership on the treatment of patients in a pediatric intensive care unit and discovered that the number of mechanically ventilated children increased twofold in the post-intensivist period [4]. In this current study, no patient required mechanical ventilation before the presence of a pediatric intensivist, whereas 45 patients required invasive mechanical ventilation after the intensivist's arrival. This difference indicates that patients with more severe respiratory failure were managed by the intensivist, which may have contributed to the higher mortality rate observed in the intensivist-treated group.

In cases where extubation fails, tracheostomy may be necessary, according to research [5]. The study found that during the pre-pediatric intensivist period, there were no children who required a tracheotomy due to mechanical ventilation, but during the post-pediatric intensivist period, 2.65% of children required this procedure. Pollack et al. also found an increase in invasive procedures during the post-intensivist period [6]. Before the arrival of the pediatric intensivist, none of the patients received any renal replacement therapy. However, after the intensivist's arrival, hemodialysis was performed on four patients. In addition, chest tube insertion and gastrostomy

were commonly used procedures during the pediatric intensivist's working period. None of the patients received chest tube insertion during the pre-pediatric intensivist period, but four patients needed this procedure during the post-intensivist period. Gastrostomy was performed on three patients during the post-intensivist period.

Inserting a central venous catheter is often necessary for extracorporeal treatments like therapeutic plasma exchange and continuous veno-venous hemodiafiltration [7]. It is believed that providing patient treatment using this approach is a safer option. In the post-intensivist era, 17.8% of patients received central venous catheters, while no catheterization was observed in the pre-intensivist era. This may be due to the difficulty of inserting peripheral vascular access in patients with poor circulation, which untrained physicians are unable to maintain for an extended period.

Studies have shown that antimicrobial stewardship and infection rates decrease when led by intensivists compared to the opposite scenario [8]. After the post-intensivist period, there was an increase in nosocomial infections from zero to three cases, which is not consistent with the literature. The infection rate correspondingly increased from zero percent to 1.1 percent. This increase could be due to the growing number of critically ill children who needed mechanical ventilation support, invasive procedures, and extracorporeal treatment methods.

During the post-intensivist period, patients with higher disease severity, as indicated by their PRISM scores, are more likely to receive treatment. This results in a higher occurrence of invasive procedures and complications. Kesici S. et al. conducted a study that revealed the mean PRISM score of patients admitted during the intensivist period was higher than those admitted during the non-intensivist period [4]. Despite the presence of critically ill patients, the mortality rate was lower during the intensivist period. Our research suggests that the high mortality rate after the intensivist period may be due to the admission of patients with higher PRISM

scores. Although the mortality rate was higher compared to Group I, only a small percentage of patients (5.7%) passed away. Other studies have reported mortality rates ranging from 7% to 19.6% [4, 9].

Studies have shown a decrease in length of stay (LOS) in ICU in the post-intensivist period [6]. Our study found that the average length of stay in the Pediatric Intensive Care Unit (PICU) was longer during the post-intensivist period. We believe this may be due to the fact that, in the pre-intensivist era, only low-risk patients were treated in the PICU and were quickly discharged or transferred to other medical facilities. Conversely, seriously ill patients were transferred to specialized facilities. However, during the post-intensivist era, patients were primarily referred from other medical centers, resulting in a significant increase in admissions. Kesici et al.'s research on this subject also resulted in similar findings [4].

Conclusion

Under the leadership of pediatric intensivists, patients are referred to other centers less frequently. By doing so, it becomes possible to handle a greater number of seriously ill patients in the same location. This approach allows for the transfer of critically ill patients from facilities that do not have intensive care capabilities. Intensivists ensure the safe and effective use of intensive care modalities and invasive procedures. It is crucial to have more pediatric intensivists available to save the lives of children.

Limitations

Retrospective access to data from previous patients was not available in the pre-intensivist period of the study, which had a negative impact on the number of patients during the post-intensivist period.

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Conflict of interest

There is no conflict of interest between the authors.

References

1. Manthous CA, Amoateng-Adjepong Y, Al-Kharrat T, Jacob B, Alnuaimat HM, Chatila W, et al. Effects of a medical intensivist on patient care in a community teaching hospital. in Mayo Clinic Proceedings. Elsevier. 1997;72(5):391-9. doi: [10.4065/72.5.391](https://doi.org/10.4065/72.5.391).
2. Wallace DJ, Angus DC, Barnato AE, Kramer AA, and Kahn JM, Nighttime intensivist staffing and mortality among critically ill patients. NEJM. 2012;366(22):2093-101. doi: [10.1056/NEJMsa1201918](https://doi.org/10.1056/NEJMsa1201918).
3. Nishisaki A, Pines JM, Lin R, Helfaer MA, Berg RA, TenHave T, et al., The impact of 24-hr, in-hospital pediatric critical care attending physician presence on process of care and patient outcomes. Crit Care Med. 2012;40(7):2190-5. doi: [10.1097/CCM.0b013e31824e1cda](https://doi.org/10.1097/CCM.0b013e31824e1cda).
4. Kesici S and Bayrakci B, Impact of leadership of trained intensivist in pediatric intensive care unit in a middle income country: an uncontrolled before-after study. Indian J Pediatr. 2020;87(4):262-7. doi: [10.1007/s12098-019-03154-5](https://doi.org/10.1007/s12098-019-03154-5).
5. Kesici S, Bayrakci B, Unal OF, Ertuğrul İ. Tracheostomy in pediatric intensive care unit: When and where? Iran J Pediatr. 2016;26(1):2283. doi: [10.5812/ijp.2283](https://doi.org/10.5812/ijp.2283).
6. Pollack MM, Katz RW, Ruttimann U, and Getson PR, Improving the outcome and efficiency of intensive care: the impact of an intensivist. Crit. Care Med. 1988;16(1):11-7. doi: [10.1097/00003246-198801000-00003](https://doi.org/10.1097/00003246-198801000-00003).
7. Celegen M and Celegen K, Determination of central venous catheter complications: Internal jugular vein versus femoral vein catheterization. Ann. Med. Res. 2023;30(1):98-101. doi: [10.5455/annalsmedres.2022.08.268](https://doi.org/10.5455/annalsmedres.2022.08.268).
8. Steinmann KE, Lehnick D, Buettcher M, Schwendener-Scholl K, Daetwyler K, Fontana M, et al., Impact of empowering leadership on antimicrobial stewardship: a single center study in a neonatal and pediatric intensive care unit and a literature review. Front Pediatr. 2018;6:294. doi: [10.3389/fped.2018.00294](https://doi.org/10.3389/fped.2018.00294).
9. Bayrakci B, Kesici S, Kendirli T, Kalkan G, Sari A, Tokmak N, et al., Evaluation report of pediatric intensive care units in Turkey. Turkish J Med Sci. 2014;44(6):1073-86. doi: [10.3906/sag-1307-102](https://doi.org/10.3906/sag-1307-102).