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[Dong-min Seo](#) , Inhae Heo , Jonghwan Moon , [Junsik Kwon](#) , Yo Huh , Byung Hee Kang , Seoyoung Song , Sora Kim , [Kyoungwon Jung](#) *

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Article

Impact of a Rounding Checklist Implementation in the Trauma Intensive Care Unit on Clinical Outcomes

Dong-min Seo ^{1,2}, Inhae Heo ¹, Jonghwan Moon ^{1,2}, Junsik Kwon ^{1,2}, Yo Huh ^{1,2}, Byung Hee Kang ^{1,2}, Seoyoung Song ², Sora Kim ² and Kyoungwon Jung ^{1,2,*}

¹ Division of Trauma Surgery, Department of Surgery, Ajou University School of Medicine, Suwon, Republic of Korea

² Ajou University Hospital Gyeonggi South Regional Trauma Center, Suwon, Republic of Korea

* Correspondence: jake98@ajou.ac.kr or jake98@daum.net; Tel.: +82-31-219-7491 or +82-10-3857-2968

Abstract: This study aimed to evaluate the effectiveness of an intensive care unit (ICU) round checklist, FAST HUGS BID (Feeding, Analgesia, Sedation, Thromboembolic prophylaxis, Head-of-bed elevation, Ulcer prophylaxis, Glycemic control, Spontaneous breathing trial, Bowel regimen, Indwelling catheter removal, and De-escalation of antibiotics) in improving clinical outcomes for patients with severe trauma. Patients admitted to our trauma ICU between 2016 and 2020 were retrospectively analyzed. We divided the participants into two groups: before (before-FD, 2016-2017) and after (after-FD, 2019-2020) the checklist's implementation. We compared patient characteristics and clinical outcomes, including ICU and hospital length of stay (LOS) and in-hospital mortality. Survival analysis was performed using Kaplan–Meier curves and multivariable logistic regression models, and multiple linear regression analysis was used to identify independent factors associated with ICU and hospital LOS. Compared with the before-FD group, the after-FD group had significantly lower in-hospital mortality and complication rates, shorter ICU and hospital LOS, and reduced duration of mechanical ventilation. revealed that the checklist's implementation was a significant independent factor in reducing ICU and hospital LOS and in-hospital mortality. In this before/after study, we observed that the FAST HUGS BID checklist implementation was associated with decreased ICU and hospital LOS and in-hospital mortality.

Keywords: severe trauma; outcomes; checklist; mortality; implementation; quality improvement

1. Introduction

Patients with severe trauma require intensive care unit (ICU) treatment for various complex injuries. However, the intricate nature of the treatment process in trauma care creates an environment prone to medical errors, often referred to as a "perfect storm." Such errors can arise from various factors, including unstable vital signs, incomplete patient histories, and insufficient information. In addition, trauma surgeons face the challenge of making time-critical decisions while simultaneously managing complex teams and collaborating with many disciplines [1]. When managing severely injured patients, trauma surgeons usually play a dual role as both surgical specialists and critical care providers, taking charge of all treatment processes. Therefore, trauma surgeons need to possess the necessary qualifications and capabilities in surgical critical care to manage their patients in the ICU. Moreover, ensuring a seamless continuity of management within the same quality of surgical service contributes to improved outcomes [2]. Furthermore, it is crucial for trauma surgeons to minimize medical errors and provide high-quality critical care, in addition to performing resuscitation in the trauma bay and conducting surgical procedures in the operating room.

Many studies have underscored the significance of appropriate physician staffing and the use of protocols, clinical practice guidelines, and checklists to improve clinical outcomes in modern ICUs [3–5]. In particular, some studies showed that the implementation of checklists for organized critical care in ICUs led to improved patients' outcomes [6,7]. In our trauma ICU (TICU), we recently adopted the Feeding, Analgesia, Sedation, Thromboembolic prophylaxis, Head-of-bed Elevation, Ulcer Prophylaxis, Glycemic Control, Spontaneous Breathing Trial, Bowel Regimen, Indwelling Catheter Removal, and De-escalation of antibiotics (FAST HUGS BID) checklist, which is easily remembered by simple mnemonics. This checklist was initially introduced as "FAST HUG" by Vincent in 2005 and later updated to "FAST HUGS BID" by Vincent III and Hatton in 2009 [8,9]. The FAST HUGS BID is a multidisciplinary protocol and checklist that includes essential and evolving components of evidence-based critical care.

In this study, we hypothesized that the implementation of the FAST HUGS BID checklist in the TICU could reduce in-hospital mortality and length of stay (LOS) in the ICU and hospital. Accordingly, we compared clinical outcomes before and after the implementation of the FAST HUGS BID checklist in our TICU. Furthermore, we performed a detailed analysis to assess the effectiveness of each checklist component before and after its implementation.

2. Materials and Methods

2.1. Study Procedure

This retrospective observational study was conducted for the patients admitted to the TICU at Ajou University Hospital from March 2016 to December 2020. Patients who were under 18 years of age, transferred from other hospitals, admitted to the general ward, or classified as immediate non-survivors upon arrival were not eligible for this study. After the exclusion, the patients included in final sample were then divided into two groups based on different time phases: before the implementation of the FAST HUGS BID checklist (before-FD) from March 2016 to December 2017 and after implementation (after-FD) from January 2019 to December 2020. The FAST HUGS BID checklist was implemented at our trauma center in mid-2018. We excluded patients admitted in 2018 because the FAST HUGS BID checklist was being refined through trial and error during that period. It is worth noting that the TICU at Ajou University Hospital operates as a semi-closed ICU, with dedicated trauma surgeons conducting bedside rounds more than twice daily. Furthermore, the FAST HUGS BID checklist was prominently displayed at each patient's bedside and applied to all ICU patients by the trauma staff, nurses, and other team members.

2.2. Definition and Study Outcomes

The FAST HUGS BID is a checklist that highlights the key factors in the general care of critically ill patients. This approach includes the following clinical practices: feeding, analgesia, sedation, thromboembolic prophylaxis, head-of-bed elevation, ulcer prophylaxis, glycemic control, spontaneous breathing trials, bowel regimens, indwelling catheters, and drug de-escalation.

The primary outcomes were the in-hospital mortality, overall complication rate, ICU LOS, hospital LOS, and duration of invasive mechanical ventilation. Secondary outcomes were the incidence of each complication, such as acute kidney injury, acute respiratory distress syndrome, pneumonia, venous thromboembolism, pressure ulcer, surgical site infection, urinary tract infection, catheter-related bloodstream infections, or sepsis. Additionally, we conducted a detailed analysis by comparing the impact of each component of the checklist before and after the intervention.

2.3. Statistical Analysis

Categorical variables were reported as proportions and compared before and after FD using the chi-squared test. Continuous variables were presented as means with standard deviations or medians with interquartile ranges. Continuous variables were compared between the two groups using Student's t-test for those with a normal distribution and the Mann-Whitney U test for those with a non-normal distribution. Kaplan-Meier curves and logistic regression models were employed to

perform survival analysis. Multiple linear regression analysis was conducted to identify factors independently associated with ICU and hospital LOS. All variables with a p-value <0.1 in the univariable analysis were included in the multivariable model. The threshold for statistical significance was set at $p < 0.05$. Statistical analysis was carried out using SPSS 25.0 for Windows (SPSS, Inc., Chicago, IL, USA).

3. Results

3.1. Characteristics of Patients

We reviewed 13,278 patients admitted to the TICU during the study period and excluded 10,862 patients according to the criteria. Of the 2,416 patients included in the final sample, 696 and 1,720 were included in the before-FD and after-FD groups, respectively (Figure 1). Patient characteristics are summarized in Table 1. It was observed that patients in the after-FD group exhibited a higher prevalence of underlying diseases and a greater Injury Severity Score (ISS) than those in the before-FD group ($P < 0.05$).

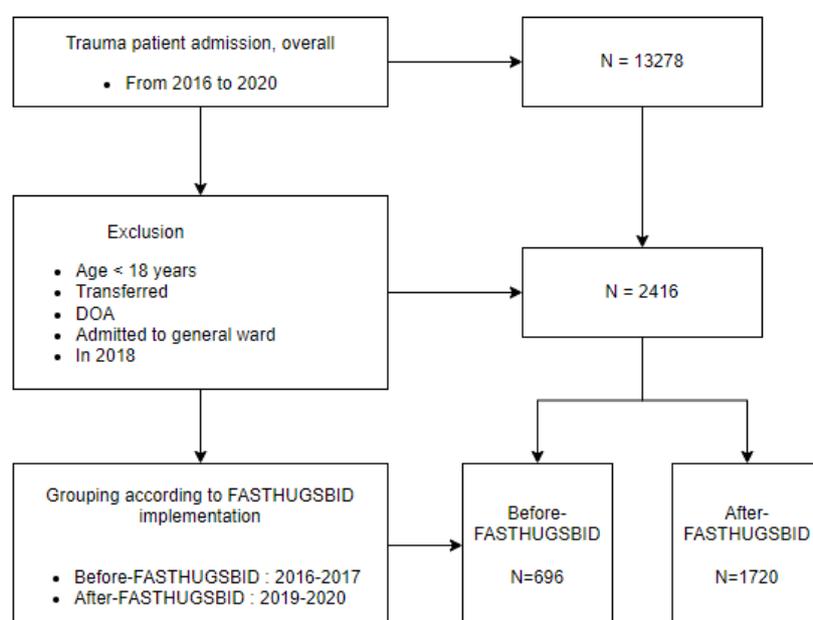


Figure 1. Flow chart of patient selection.

Table 1. Patient characteristics in the before- and after-FD groups.

Variables	Before-FD ¹ (n=696)	After-FD ² (n=1720)	P values
Age (year), mean \pm SD ³	48.7 \pm 17.5	48.7 \pm 16.8	0.97
Sex, n (%)			0.09
Female	171 (24.6)	368 (21.4)	
Male	525 (75.4)	1352 (78.6)	
Mechanism of injury			0.539
Blunt, n (%)	618 (89.3)	1545 (90.1)	
Penetrating, n (%)	74 (10.7)	169 (9.9)	
Underlying disease, yes (%)	263 (38.3)	734 (42.9)	<0.05

Injury Severity Score, median (IQR ⁴)	13 (5-22)	17 (10-24)	<0.05
Initial physiologic parameters			
Systolic blood pressure (mm Hg), mean \pm SD	131.2 \pm 26.9	136.0 \pm 26.7	<0.05
Diastolic blood pressure (mm Hg), mean \pm SD	82.2 \pm 20.9	89.2 \pm 21.1	<0.05
Mean arterial pressure (mm Hg), mean \pm SD	98.5 \pm 21.4	104.8 \pm 21.2	<0.05
Pulse rate (per min), mean \pm SD	90.7 \pm 19.9	89.2 \pm 20.4	0.09
Respiratory rate (per min), mean \pm SD	20.4 \pm 5.8	21.1 \pm 5.9	<0.05
Body temperature ($^{\circ}$ C), mean \pm SD	36.4 \pm 0.7	36.5 \pm 0.7	0.25
Glasgow Coma Scale, median (IQR)	15 (13-15)	15 (14-15)	0.07

¹ Before-FD, before implementation of the FAST HUGS BID checklist; ² After-FD, after the implementation of the FAST HUGS BID checklist; ³ SD, standard deviation; ⁴ IQR, interquartile range.

3.2. Primary Outcomes

Compared with the before-FD group, the after-FD group had lower in-hospital mortality (8.3% vs. 4.8%; $P < 0.05$) and complication rates (23.0% vs. 16.5%; $P < 0.05$). In addition, the after-FD group exhibited shorter ICU LOS (7.8 days vs. 5.1 days; $P < 0.05$), hospital LOS (24.3 days vs. 17.6 days; $P < 0.05$), and duration of invasive mechanical ventilation (9.2 days vs. 5.0 days; $P < 0.05$) (Table 2).

Table 2. Comparisons of primary outcomes between the before- and after-FD groups.

Primary outcomes	Before-FD ¹ (n=696)	After-FD ² (n=1720)	<i>P</i> values
In-hospital mortality, n (%)	58 (8.3)	83 (4.8)	<0.05
Complications, n (%)	160 (23.0)	283 (16.5)	<0.05
ICU ³ length of stay (days), mean \pm SD	7.8 \pm 13.3	5.1 \pm 10.4	<0.05
Hospital length of stay (days), mean \pm SD	24.3 \pm 24.6	17.6 \pm 16.0	<0.05
Duration of mechanical ventilation (days), mean \pm SD	9.2 \pm 13.3 (n=315)	5.0 \pm 8.4 (n=682)	<0.05

¹ Before-FD, before implementation of the FAST HUGS BID checklist; ² After-FD, after the implementation of the FAST HUGS BID checklist; ³ ICU, intensive care unit; ⁴ SD, standard deviation.

3.3. Secondary Outcomes

The after-FD group had lower complication rates for pressure ulcers (10.9% vs. 5.7%; $P < 0.05$), pneumonia (9.1% vs. 3.4%; $P < 0.05$), and surgical site infections (4.3% vs. 1.3%; $P < 0.05$) than the before-FD group. However, a higher incidence of sepsis was observed in the after-FD group than in the before-FD group (0.4% vs. 1.5%; $P < 0.05$) (Table 3).

Table 3. Comparisons of secondary outcomes between the before- and after-FD groups.

Complications	Before-FD ¹ (n=696)	After-FD ² (n=1720)	<i>P</i> values	OR ³ (95% CI ⁴)
Total, n (%)	160 (23)	283 (16.5)	<0.05	0.66 (0.53-0.82)
Acute kidney injury, n (%)	9 (1.3)	26 (1.5)	0.68	1.17 (0.54-2.51)
Acute respiratory distress syndrome, n (%)	4 (0.6)	9 (0.5)	1.00	0.91 (0.28-2.97)
Pressure ulcer, n (%)	76 (10.9)	98 (5.7)	<0.05	0.49 (0.36-0.67)
Venous thromboembolism, n (%)	8 (1.1)	24 (1.4)	0.63	1.21 (0.54-2.72)

Pneumonia, n (%)	63 (9.1)	59 (3.4)	<0.05	0.38 (0.25-0.52)
Surgical site infection, n (%)	30 (4.3)	23 (1.3)	<0.05	0.30 (0.17-0.52)
Urinary tract infection, n (%)	8 (1.1)	18 (1.0)	0.82	0.91 (0.39-2.10)
Catheter related blood stream infection, n (%)	2 (0.3)	9 (0.5)	0.74	1.83 (0.39-8.47)
Sepsis, n (%)	3 (0.4)	25 (1.5)	<0.05	3.40 (1.02-11.32)

¹ Before-FD, before implementation of the FAST HUGS BID checklist; ² After-FD, after the implementation of the FAST HUGS BID checklist; ³ OR, odds ratio; ⁴ CI, confidence interval.

3.4. Comparisons of Each Component of the FAST HUGS BID Checklist

Each component of the checklist was compared between the before-FD and after-FD groups (Table 4). For Feeding, the after-FD group exhibited a faster time to the first start of enteral nutrition and greater body weight gain than the before-FD group ($P<0.05$). For Analgesia, the after-FD group had a shorter duration of intravenous (IV) fentanyl use, higher usage of IV nefopam, and increased use of per oral (PO) painkillers compared with the before-FD group ($P<0.05$). For Sedation, the after-FD group showed a lower rate of IV midazolam, IV propofol, and IV vecuronium use and a higher rate of IV dexmedetomidine use than the before-FD group ($P <0.05$). For Thromboembolic prophylaxis, the after-FD group had a higher rate of SC enoxaparin use and a shorter time to the first use of enoxaparin than the before-FD group ($P<0.05$). For Head-of-bed elevation, the after-FD group had a shorter time to the first start of head-of-bed elevation than the before-FD group ($P<0.05$). For Ulcer prophylaxis, the after-FD group exhibited a lower rate of ulcer medication and pantoprazole use than the before-FD group ($P<0.05$). For Spontaneous breathing trial, the after-FD group showed a shorter time to extubation and a higher rate of unplanned intubation events than the before-FD group ($P<0.05$). For Bowel regimen, the after-FD group demonstrated a lower rate of diarrhea than the before-FD group ($P<0.05$). For Indwelling catheter removal, the after-FD group showed a shorter time to central venous catheter removal and urinary catheter removal than the before-FD group ($P<0.05$). For Drug de-escalation, the after-FD group had a lower rate of restricted antimicrobial use and a shorter duration of antimicrobial use ($P<0.05$).

Table 4. Comparisons of each component of the FAST HUGS BID checklist before and after implementation.

Component of FAST HUGS BID checklist	Before-FD¹ (n=696)	After-FD² (n=1720)
Feeding		
Time to enteral nutrition (days), mean \pm SD	2.7 \pm 3.7	1.5 \pm 1.9
Time to parenteral nutrition (days), mean \pm SD	7.9 \pm 8.9 (n=161)	9.2 \pm 9.5 (n=209)
Body weight difference (kg), mean \pm SD	0.46 \pm 6.3	0.52 \pm 3.9
Analgesia		
IV ³ Fentanyl use, n (%)	508 (73.0)	1225 (71.2)
Duration of IV Fentanyl use (days), mean \pm SD	5.8 \pm 7.6 (n=508)	2.5 \pm 2.9 (n=1225)
IV Nefopam use, n (%)	421 (60.5)	1407 (81.8)
PO ⁴ painkillers use, n (%)	456 (65.5)	1382 (80.3)
PO opioids use, n (%)	72 (10.3)	654 (38.0)
TD ⁵ Fentanyl patch use, n (%)	196 (28.2)	550 (32.0)
Pain scale, median (IQR)	1 (0.1-2.0)	1.2 (0.5-2.1)
Sedation		
IV Midazolam use, n (%)	201 (28.9)	113 (6.6)
IV Propofol use, n (%)	205 (29.5)	434 (25.2)
IV Dexmedetomidine use, n (%)	138 (19.8)	452 (26.3)
IV Vecuronium use, n (%)	69 (9.9)	83 (4.8)
RASS ⁶ score, median (IQR)	-0.4 (-1.5-0.0)	-0.3 (-1.0-0.0)
Thromboembolic prophylaxis		
SC ⁷ LMWH use, n (%)	165 (23.7)	690 (40.1)
Time to the first use of LMWH ⁸ (days), mean \pm SD	4.8 \pm 4.8 (n=165)	2.8 \pm 2.8 (n=690)
Head of bed elevation		
Time to first head of bed elevation (days), mean \pm SD	8.8 \pm 16.8	4.8 \pm 12.0
Ulcer prophylaxis		

H2-blocker use, n (%)	640 (92.0)	1476 (85.8)
Proton pump inhibitor use, n (%)	64 (9.2)	86 (5.0)
Glycemic control		
Average level of blood sugar (mg/dL), mean \pm SD	137.1 \pm 32.6	134.5 \pm 31.3
Hypoglycemic event, n (%)	29 (4.2)	67 (3.9)
Spontaneous breathing trial		
Time to extubation (days), mean \pm SD	6.4 \pm 7.2 (n=308)	4.8 \pm 5.5 (n=594)
Unplanned intubation, n (%)	6 (0.9)	37 (2.2)
Bowel movement		
Diarrhea event, n (%)	142 (20.4)	277 (16.1)
Vomiting event, n (%)	108 (15.5)	242 (14.1)
Indwelling catheter		
Time to removal of CVC ⁹ (days), mean \pm SD	11.9 \pm 16.5	7.6 \pm 11.0
Time to removal of urinary catheter (days), mean \pm SD	8.5 \pm 16.3	5.8 \pm 12.5
Drug de-escalation		
Restricted antimicrobials use, n (%)	175 (25.1)	333 (19.4)
Duration of antimicrobials use (days), mean \pm SD	18.0 \pm 22.1	8.2 \pm 13.6

¹ Before-FD, before implementation of the FAST HUGS BID checklist; ² After-FD, after the implementation of the FAST HUGS BID checklist; ³ Transdermal, transdermal; ⁴ RASS, Richmond Agitation & Sedation Scale; ⁵ SC, subcutaneous; ⁶ LMWH, low-molecular-weight heparin; ⁷ CVC, central venous catheter; ⁸ CVC, central venous catheter; ⁹ CVC, central venous catheter

3.5. Factors Associated with In-hospital Mortality and LOS in the ICU and Hospital

Multivariable logistic regression analysis showed that the implementation of the FAST HUGS BID checklist was an independent contributing factor for in-hospital mortality (adjusted OR=0.434; P=0.008). Other factors associated with in-hospital mortality included the initial Glasgow Coma Scale (GCS), ISS, and complications (Table 5). The Kaplan-Meier curve for the comparison of the 90-days in-hospital mortality indicated that the after-FD group had a significantly higher survival rate than the before-FD group (P =0.002) (Figure 2).

Table 5. Factors associated with in-hospital mortality identified by logistic regression analysis.

Variables	Univariable analysis		Multivariable analysis	
	Adjusted OR	P values	Adjusted OR	P values
Age	1.018	<0.001	1.040	<0.001
Sex	0.864	0.499		
Mechanism of injury	0.601	0.148		
Underlying disease	0.933	0.713		
Initial systolic blood pressure	0.985	<0.001	0.898	0.538
Initial diastolic blood pressure	0.976	<0.001	0.764	0.441
Initial mean arterial pressure	0.977	<0.001	1.445	0.482
Initial pulse rate	1.025	<0.001	1.010	0.103
Initial respiratory rate	1.019	0.244		
Initial body temperature	0.458	<0.001	1.048	0.789
Initial Glasgow Coma Scale	0.673	<0.001	0.748	<0.001
Injury Severity Score	1.088	<0.001	1.066	<0.001
FAST HUGS BID	0.551	0.001	0.434	0.008
Complications	4.215	<0.001	2.080	0.016

Nagelkerke $R^2=0.450$
Hosmer-Lemeshow Chi-square test = 9.753, $df= 8$, P value =0.283

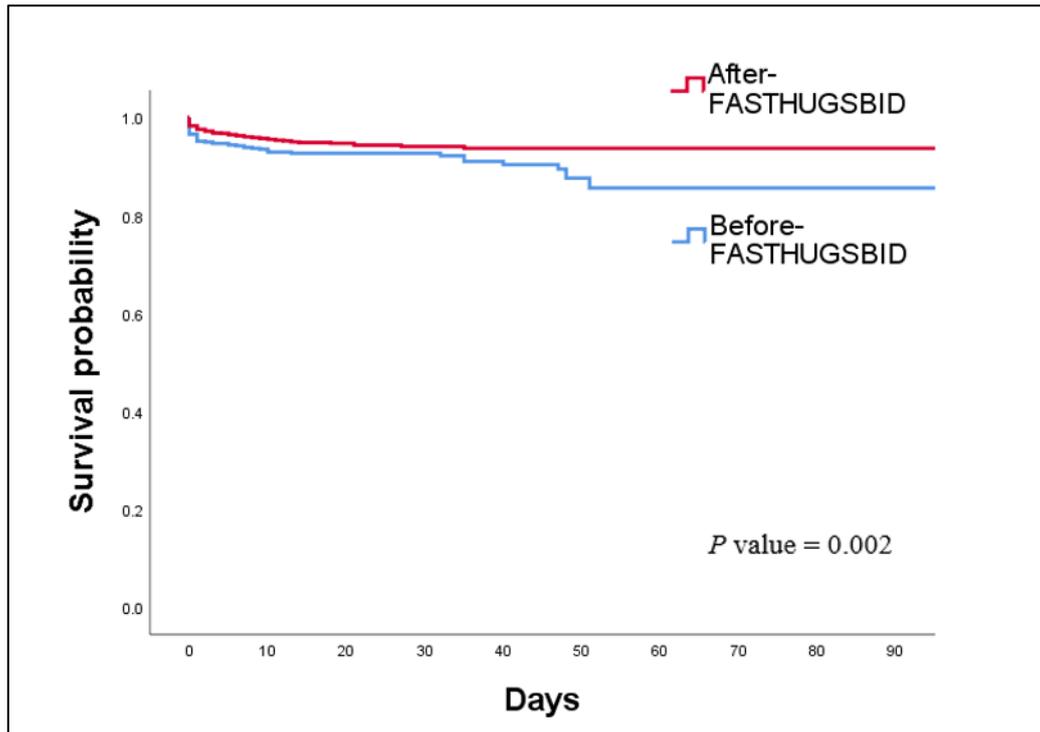


Figure 2. Kaplan-Meier curve for comparison of 90 days in-hospital mortality before and after implementation of the FAST HUGS BID program.

In addition, multivariate linear regression analysis revealed that the implementation of the FAST HUGS BID checklist was an independent contributing factor for LOS in the ICU ($B=-0.118$; $P < 0.001$) and hospital ($B=-0.063$; $P = 0.002$). The initial GCS score, ISS, and complications were also found to be associated with ICU and hospital LOS (Tables 6 and 7).

Table 6. Multiple linear regression for factors associated with ICU length of stay.

Variables	β^1	95% CI ²	Beta ³	P value
Mechanism of injury	0.502	-0.840~1.843	0.014	0.464
Underlying disease	0.897	0.102~1.691	0.042	0.027
Initial systolic blood pressure	-0.409	-0.887~0.069	-1.018	0.094
Initial diastolic blood pressure	-0.791	-1.747~0.164	-1.566	0.104
Initial mean arterial pressure	1.203	-0.229~2.636	2.385	0.100
Initial pulse rate	0.015	-0.008~0.037	0.027	0.202
Initial respiratory rate	0.003	-0.069~0.076	0.002	0.934
Initial body temperature	-0.335	-0.923~0.254	-0.022	0.265
Initial Glasgow Coma Scale	-0.682	-0.841~-0.522	-0.171	<0.001
Injury Severity Score	0.194	0.150~0.238	0.196	<0.001
FAST HUGS BID	-2.742	-3.645~-1.839	-0.118	<0.001
Complications	8.212	7.049~9.374	0.285	<0.001

$R = 0.500$, $R^2 = 0.25$, $adj.R^2 = 0.246$

¹ B, unstandardized coefficients; ² CI, confidence interval; ³ Beta, standardized coefficients.

Table 7. Multiple linear regression for factors associated with hospital length of stay.

Variables	β	95%CI	β eta	P value
Initial systolic blood pressure	-40.431	-124.612~43.749	-0.597	0.346
Initial diastolic blood pressure	-97.933	-266.144~70.278	-1.144	0.254
Initial mean arterial pressure	135.708	-116.528~387.944	1.597	0.292
Initial pulse rate	-0.534	-4.176~3.108	-0.006	0.774
Initial body temperature	58.948	-42.239~160.135	0.023	0.253
Initial Glasgow Coma Scale	-189.064	-214.394~-163.734	-0.309	<0.001
Injury Severity Score	28.164	20.962~35.367	0.175	<0.001
FASTHUGSBID	-251.928	-409.369~-94.487	-0.063	0.002
Complications	398.987	200.615~597.359	0.083	<0.001

$R=0.430$, $R^2=0.185$, $adj.R^2=0.182$

¹ B, unstandardized coefficients; ² CI, confidence interval; ³ Beta, standardized coefficients.

4. Discussion

In this study, we observed that the implementation of the FAST HUGS BID checklist improved the clinical outcomes of trauma patients in the ICU. Although patients with after-FD were characterized by higher severity of injuries, as indicated by a greater ISS, they exhibited lower rates of in-hospital mortality and complications, shorter ICU and hospital LOS, and reduced duration of invasive mechanical ventilation. Furthermore, multivariate logistic and linear regression analyses revealed that the implementation of the FAST HUGS BID checklist was an independent factor associated with shorter LOS in the TICU and hospital and lower in-hospital mortality.

The assertion that the implementation of the FAST HUGS BID checklist substantially affects the TICU population is well-supported by the following evidence. First, the implementation of the checklist resulted in a decrease in medical errors due to its concise and easily memorable format, which included the fundamental components of care involving all members of the trauma team. Second, the trauma team was able to make a care plan for each day and assess its completion using the checklist during daily ICU rounds. Several studies have endorsed our approach. For example, Stahl et al. showed that a structured checklist could reduce medical errors in the management of trauma patients [6], Barcellos et al. reported a reduction in the duration of mechanical ventilation and ICU stay with the implementation of a checklist [10], and Pronovost et al. revealed a decrease in the rate of catheter-related bloodstream infections through checklist utilization [11]. Additionally, some studies demonstrated a reduction in the rate of ventilator-associated pneumonia (VAP) following the use of a checklist [12,13], and Haynes et al. documented a decrease in mortality and complications following the implementation of a checklist during surgery [14,15].

Our literature review indicates a scarcity of comparative studies evaluating the impact of the FAST HUG or its updated version since its initial proposal by Vincent [8,9]. Those studies have primarily focused on comparing outcomes of specific diseases or individual components, such as VAP reduction. In contrast, in this study, we selected indicators that could assess the effect of each element within the FAST HUGS BID, collected data, and compared their applications. In addition, we specifically compared LOS in the ICU and hospital and in-hospital mortality using the Kaplan-Meier curve, which are considered quality indicators for critical care treatment. Furthermore, we employed multivariate logistic regression analysis to demonstrate the association between the application of the FAST HUGS BID and other relevant factors. Our findings indicate that the application of the FAST HUGS BID, along with other factors, has a significant impact on clinical outcomes.

F for Feeding. Many studies have reported that malnutrition or weight loss increases complications and worsens outcomes in severely ill patients [16]. Li et al. found that early enteral feeding in patients with trauma in the ICU was associated with lower mortality and shorter hospital

LOS [10]. Additionally, Ortiz-Reyes et al. suggested that compared to delayed enteral nutrition, early enteral nutrition improved clinical outcomes in mechanically ventilated patients [17]. Moreover, many studies have demonstrated that early enteral nutrition is associated with lower mortality, shorter LOS, and improved clinical outcomes in mechanically ventilated patients, especially in trauma patients [18]. These findings align with the results observed in our study, where the after-FD group exhibited a shorter time to initiate enteral nutrition. It is worth noting that feeding represents one of the most important advantages of the FAST HUGS BID, considering that patients with sepsis or trauma may require nearly double the amount of energy during the acute phase [19].

A for Analgesia. Pain can affect a patient's psychological and physiological recovery, and adequate pain relief is an integral part of effective intensive care management. Critically ill patients commonly experience pain because of not only their underlying illness but also routine procedures, such as turning, suctioning, and dressing changes [20]. After applying the FAST HUGS BID checklist at our center, we observed a decrease in the use of narcotic analgesics and an increase in the utilization of nefopam. Despite maintaining a pain scale of three points in both groups, pain was effectively managed without excessive use of narcotic analgesics, which has been considered a positive effect [21–23]. In light of such emerging evidence, it can be argued that the elimination of disadvantages associated with the misuse and abuse of narcotic analgesics should be prioritized over the concerns about the potential side effects arising from the increased use of nefopam.

S for Sedation. Although the after-FD period exhibited a higher rate of dexmedetomidine and propofol usage and a lower rate of benzodiazepine usage, there were similar sedation levels in both periods; this was evidenced by Richmond Agitation-Sedation Scale scores consistently falling within the target range throughout this study. Previous studies have shown that dexmedetomidine or propofol offers advantages (e.g., reduced ventilation days and LOS in the ICU) over benzodiazepines in sedating critically ill patients [24,25]. It may be difficult and controversial to conclude that the use of dexmedetomidine or propofol instead of benzodiazepines directly affects survival in critically ill patients [24]. However, based on the findings of our study, it can be inferred that reducing benzodiazepine usage while increasing the utilization of dexmedetomidine or propofol contributed to a decrease in ventilation days and LOS in the ICU, as well as overall mortality. It is worth noting that a recent meta-analysis by Ng et al. reported the effectiveness of dexmedetomidine in reducing the incidence of delirium or agitation in the ICU [26]. However, because of the retrospective nature, there was a limitation in comparing the occurrence of delirium between the before and after periods in this study.

T for Thromboembolic Prophylaxis. According to the recently published American Association for the Surgery of Trauma and the American College of Surgeons Committee on Trauma clinical guidelines, patients with severe trauma face a high risk of venous thromboembolism, and prioritizing prophylaxis is crucial in preventing potentially lethal complications [27]. Indeed, appropriate thromboembolic prophylaxis for critically ill patients with severe trauma who are unable to move or walk is an important factor in achieving favorable outcomes [27]. In this study, we confirmed that thromboembolic prophylaxis was more actively administered after the implementation of the FAST HUGS BID approach, and there were a higher utilization rate of low molecular weight heparin and enoxaparin and a shorter time to the initial administration of enoxaparin in the after-FD period. It can be inferred that these factors contribute to improved clinical outcomes.

H for Head-of-Bed Elevation. Since the 1990s, head-of-bed elevation has been reported to reduce the incidence of gastroesophageal reflux and VAP in ventilated patients [28]. A recent systematic review indicated that head-of-bed elevation to 30°–60° resulted in a reduced occurrence of VAP (with an absolute risk reduction of 25.7%) compared with supine (0°–10°) positioning. However, the analysis did not reveal any improvement in other outcomes, including microbiologically proven VAP, length of ICU and hospital stay, or duration of mechanical ventilation [29]. There are various opinions regarding the optimal degree of head-of-bed elevation (30°–60°), but it is unclear which degree is most effective in reducing VAP [30]. After the implementation of the FAST HUGS BID checklist, we uniformly applied an elevation of 30° in all patients, except for those with cerebrospinal fluid leakage due to unstable spinal cord injury or skull base fracture before fixation. We kept the

angle for head-of-bed elevation at 30° in the TICU because we observed an increase in incidents of unplanned tube removal (e.g., endotracheal tube, central venous catheter, and chest tube) when the elevation exceeded 30°. Furthermore, we witnessed an increase in pressure sores resulting from back maceration, primarily caused by the patient sliding down the bed. Moreover, we verified that after-FD patients had a shorter time to initiate head-of-bed elevation, and the incidence of pneumonia was significantly reduced. While other elements were also affected, it can be inferred that the uniform and systematic implementation of head-of-bed elevation contributed to the reduction in the incidence of VAP.

U for Ulcer Prevention. Before 2020, routine prophylaxis against stress ulcers in the ICU was not well justified, and the advantages and disadvantages of stress ulcer prevention were not clearly verified [31,32]. However, a recent review paper published in 2022 concluded that prophylaxis should be considered for critically ill patients with risk factors for stress ulcers. Nonetheless, frequent reassessment and de-escalation of therapy are required when patients have a lower risk of bleeding [33]. In our study, we observed a lower rate of utilization of ulcer medication, including proton pump inhibitors, among after-FD patients. This phenomenon can be attributed to the selective use of medications and the de-escalation of stress ulcer prevention therapy through regular re-evaluation in the TICU following the implementation of the FAST HUGS BID checklist.

G for Glucose Control. A recent systematic review highlighted that intensive glucose control is related to an increased risk of severe hypoglycemic events, but it also leads to reduced ICU LOS, sepsis, and mortality [34]. In this study, blood glucose levels were within the optimal range in both the before-FD and after-FD groups. However, the average blood sugar level was lower in the after-FD group than in the before-FD group, suggesting that blood sugar was controlled more efficiently in the after-FD group. Although this study had limitations in directly confirming whether better-controlled blood glucose levels were associated with reduced ICU and hospital LOS, sepsis incidence, or mortality, it can be inferred that these factors might have indirectly influenced clinical outcomes.

S for Spontaneous Breathing Trial. A randomized controlled trial published in 2008 demonstrated a significant reduction in ventilation days, ICU and hospital LOS, and mortality when spontaneous awakening and breathing trials were implemented daily [35]. Additionally, Robertson et al. showed that the implementation of a daily spontaneous breathing trial protocol resulted in improved extubation rates [36]. In this study, we observed that the after-FD group had a shorter time to extubation but a higher rate of unplanned intubation. Herein, we need to interpret with caution that the before-FD group exhibited an unusually lower rate (0.9%) of unplanned intubation. Since the rate was exceptionally low compared to the optimal range for failed extubation (5%–10%) [37], these findings suggest paradoxically that the absence of daily spontaneous awakening or breathing trials before the implementation of the checklist might have contributed to prolonged ventilator care.

B for Bowel Regimen. Diarrhea is common in ICU and has been found to be associated with increased mortality rates and prolonged ICU and hospital LOS [38]. In this study, we observed a decrease in the incidence of diarrhea events in the after-FD group. It can be inferred that the ICU staff checked for the presence and frequency of diarrhea daily, changed the feeding solution and diet, or prescribed symptom-relieving medications more aggressively following the checklist's implementation. These efforts, either directly or indirectly, might have contributed to the decrease in ICU and hospital LOS, as well as the mortality rate, among patients in the after-FD group.

I for In Indwelling Catheter Removal. Central venous and urinary catheters are necessary for massive transfusion, drug administration, total parenteral nutrition, and close monitoring of critically ill patients in the ICU. However, the risk of infection associated with these catheters is a critical concern. Therefore, many studies, including recent systematic reviews, have underscored the importance of promptly removing unnecessary central venous and urinary catheters to prevent catheter-associated infections [39–42]. In our study, we found that the indwelling periods of the central and urinary catheters significantly decreased after-FD. This observation indicates that the condition of the catheter was checked more closely, and unnecessary catheters were removed earlier in each round after the implementation of the checklist. Consequently, these efforts might have reduced the LOS in the ICU and hospital and improved mortality.

D for Drug De-escalation of Antibiotics. Empirical antibiotic therapy is widely employed in the ICU due to the high prevalence of infections, and appropriate antimicrobial therapy is crucial for critically ill patients. However, caution must be exercised as it may cause the development of drug-resistant organisms. Consequently, Masterton emphasized the importance of antibiotic de-escalation and discontinuation at the earliest possible time [43]. A recent systematic review demonstrated that antibiotic de-escalation therapy can be both safe and effective for most infections [44]. Consistently, our study also showed a significant decrease in the number of antibiotics used, particularly restricted antimicrobials typically reserved for drug-resistant organisms, and a shorter duration of antibiotic use after-FD. These results suggest that antibiotic utilization was managed more closely and effectively after the checklist's implementation.

To the best of our knowledge, this study is the first to evaluate the effectiveness of the implementation of the ICU round checklist, FAST HUGS BID, in severe trauma patients. Notably, our study differs from previous studies in that we analyzed each component of the checklist separately to identify potential improvements following its implementation. In addition, this study has several strengths, including the quantitative assessment of how much the checklist contributed to reducing ICU and hospital LOS and improving in-hospital mortality through the construction of a multivariable logistic regression model with adjustment for various confounding factors. However, this study has limitations owing to its retrospective observational nature. Regarding the evaluation of performance and outcome improvement, various factors other than the checklist's introduction might have influenced the results. Additionally, the presence of a time gap between the before- and after-FD periods might have introduced a limitation in terms of conducting a fair comparison. The difference in group sizes might have increased the possibility of selection bias. Moreover, because the study was conducted at a single center exclusively for patients with trauma, the generalizability of our results to other ICU settings may be limited.

5. Conclusions

The implementation of the ICU round checklist, FAST HUGS BID, has proven to be a valuable tool in enhancing communication and minimizing the risk of vital information being overlooked during discussions regarding the care of patients with severe trauma. In this study, we confirmed improvements in each component of the checklist following its introduction in the TICU. Moreover, we observed that its implementation was associated with decreases in in-hospital mortality and ICU and hospital LOS. These findings highlight the potential of utilizing a round checklist in an intensive care setting for severely injured patients, as it effectively reduces risks and improves clinical outcomes.

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