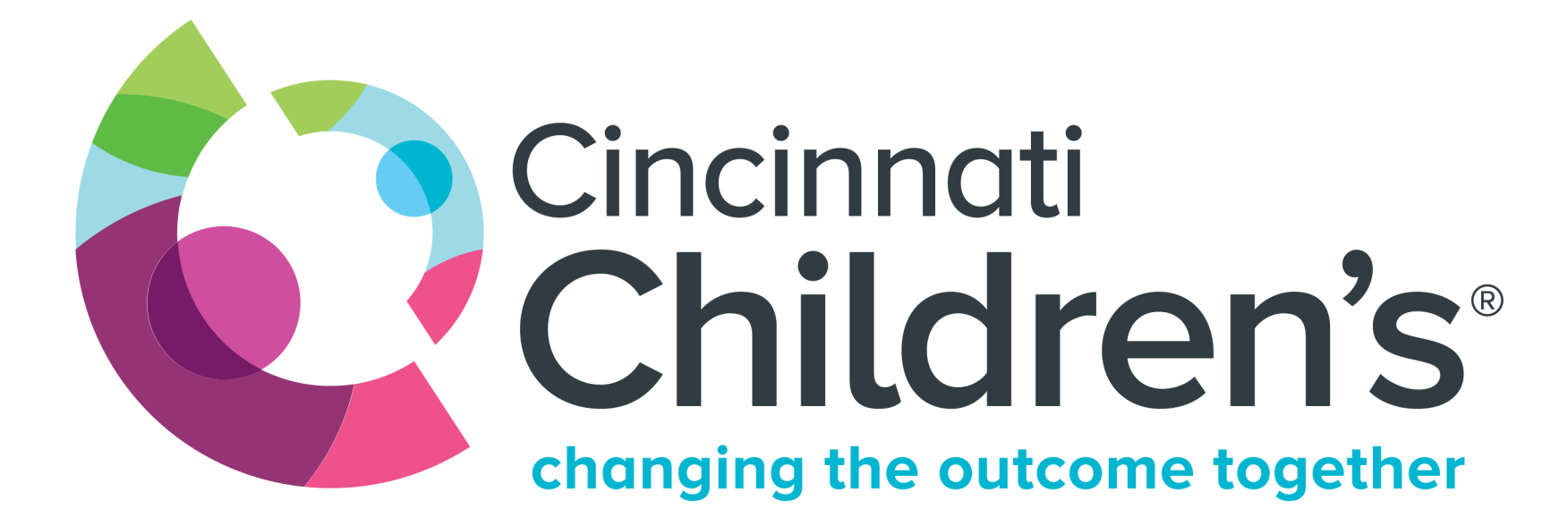


Flexible bronchoscopy in critically ill children and impact of a High-Risk Bronchoscopy Team in a high-volume center

Daniela Bullard Elias MD¹, David R. Spielberg MD MHSc², Dan T. Bencotter DO¹, John J. Brewington MD MS¹

¹Cincinnati Children's Hospital Medical Center, Division of Pulmonary Medicine; ²Lurie Children's Hospital, Division of Pulmonary Medicine



Introduction

- Flexible bronchoscopy is a frequent and generally safe procedure in critically ill children with numerous therapeutic and diagnostic indications. (1-3)
- There is wide practice variability in bronchoscopy utilization and limited evidence for guidance.
 - No standardized guidelines exist
 - Available literature is primarily small case series (most <200 patients)
 - There is wide variance in indications, findings and complications between reports (1,2)
- In this study, we capitalize on high volume of cases at Cincinnati Children's Hospital to evaluate indications, findings and complications.
 - Over 2600 procedures are performed per year
 - Around 20% of them in the Intensive Care setting (ICU)
- At the midpoint of this longitudinal cohort, a High-Risk Bronchoscopy Team (HRBT) was implemented.
 - It consists of 4-6 individuals performing high volumes of procedures
 - It provides a formal system for procedural backup with 24-hour call support
 - Aims to concentrate experience with high-risk or complicated procedures
- We aimed to evaluate the impact the implementation of the HRBT team had on
 - Characteristics of patients scoped
 - Safety outcomes

Methods

- We performed an IRB approved, single-center, retrospective review of all flexible bronchoscopies performed on children admitted to an intensive care unit over an 8-year period.
- Data was pulled from a central database completed from a standardized form done at the time of the procedure. This includes:
 - Patient demographics
 - Bronchoscopy Indications
 - Bronchoscopy findings
 - Complications
- All procedures performed on patients while admitted to an Intensive care (ICU) were filtered; Neonatal (NICU), Pediatric (PICU), Cardiac (CICU) were included.
- EMR was reviewed if further information was required to complete the database.
- Analysis included simple descriptive statistics, confidence scores were compared by standard paired t-test or Fisher's exact test with significance value of p<0.05.

Results

Table 1: Characteristics of critically ill children undergoing flexible bronchoscopy. 2608 procedures were recorded on 1304 patients admitted to a critical care setting. Age and weight were unchanged when comparing single or multiple bronchoscopies. The range of procedures per patient was 1-31. However, there was a significant rate of all-cause mortality in patients undergoing single procedure (OR 2.03, 1.6-2.56 p<0.0001). All-cause mortality is expected due to high acuity of patient presentations in critical care setting.

	Total	Single procedure	Multiple procedures	P
Number of procedures	2608	819	1789	
Number of patients	1304	819	485	
Age	5.45 ± 7.30	4.89 ± 7.15	5.7 ± 7.30	0.082
Weight	18.0 ± 22.30	17.0 ± 21.80	18.0 ± 21.80	0.277
All-cause mortality	427 (16.3%)	220 (26.9%)	207 (11.6%)	<0.0001

Figure 1: Most common findings by indications. The five most common findings were grouped by indication. Bronchitis was the most common finding when the indication was respiratory failure or infection/aspiration. In the case of atelectasis the most common finding was mucus plugging. As expected, when the indication was known hemorrhage or airway compression, those were the most common findings.

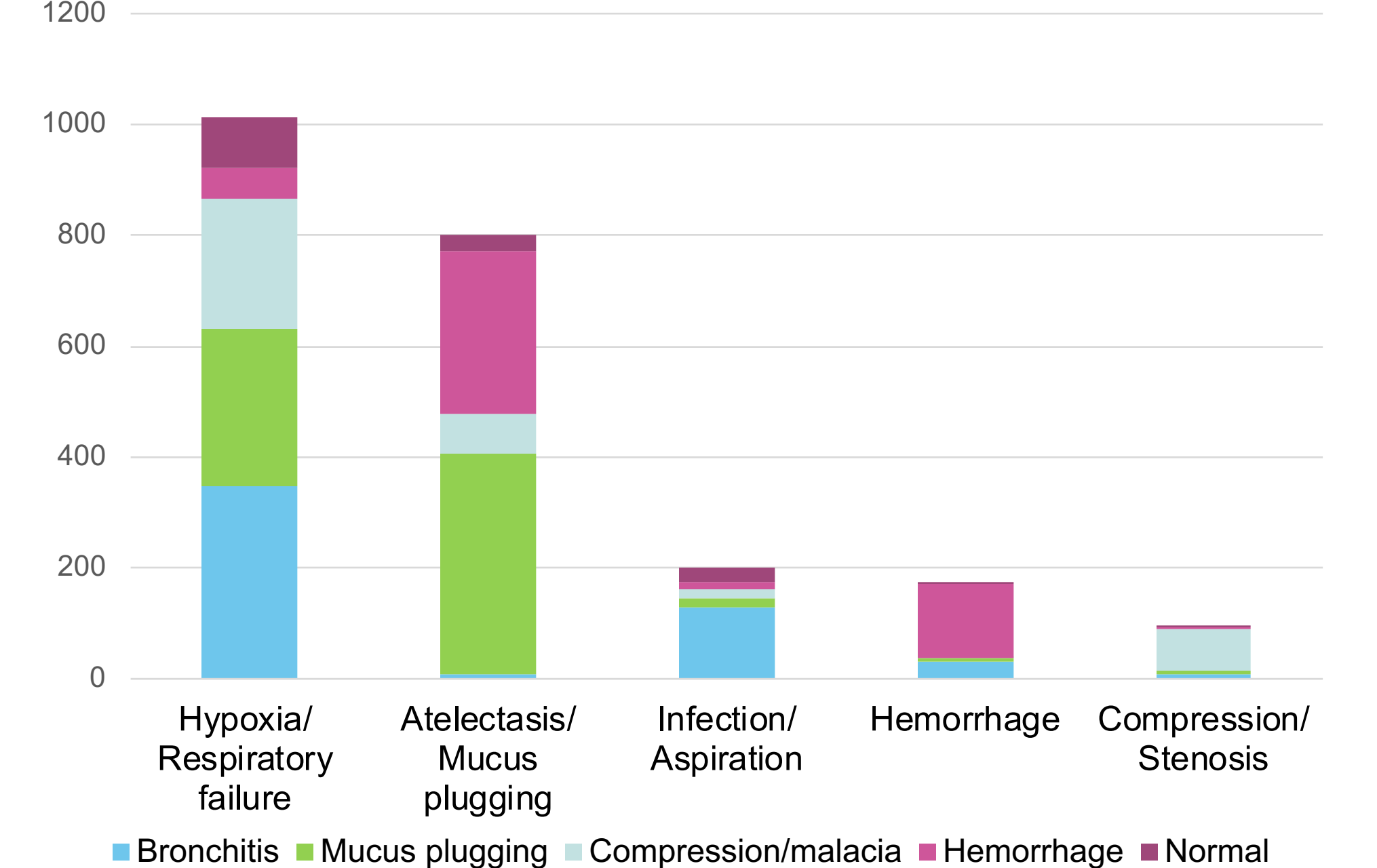


Figure 2: Cases by location. 2053 procedures (78.7%) were performed at the patient's bedside. The remainder (555, 21.3%) were performed in the operating room, cardiac catheterization lab or interventional radiology suite. All cases regardless of procedure location received care in the ICU setting before and after the procedure.

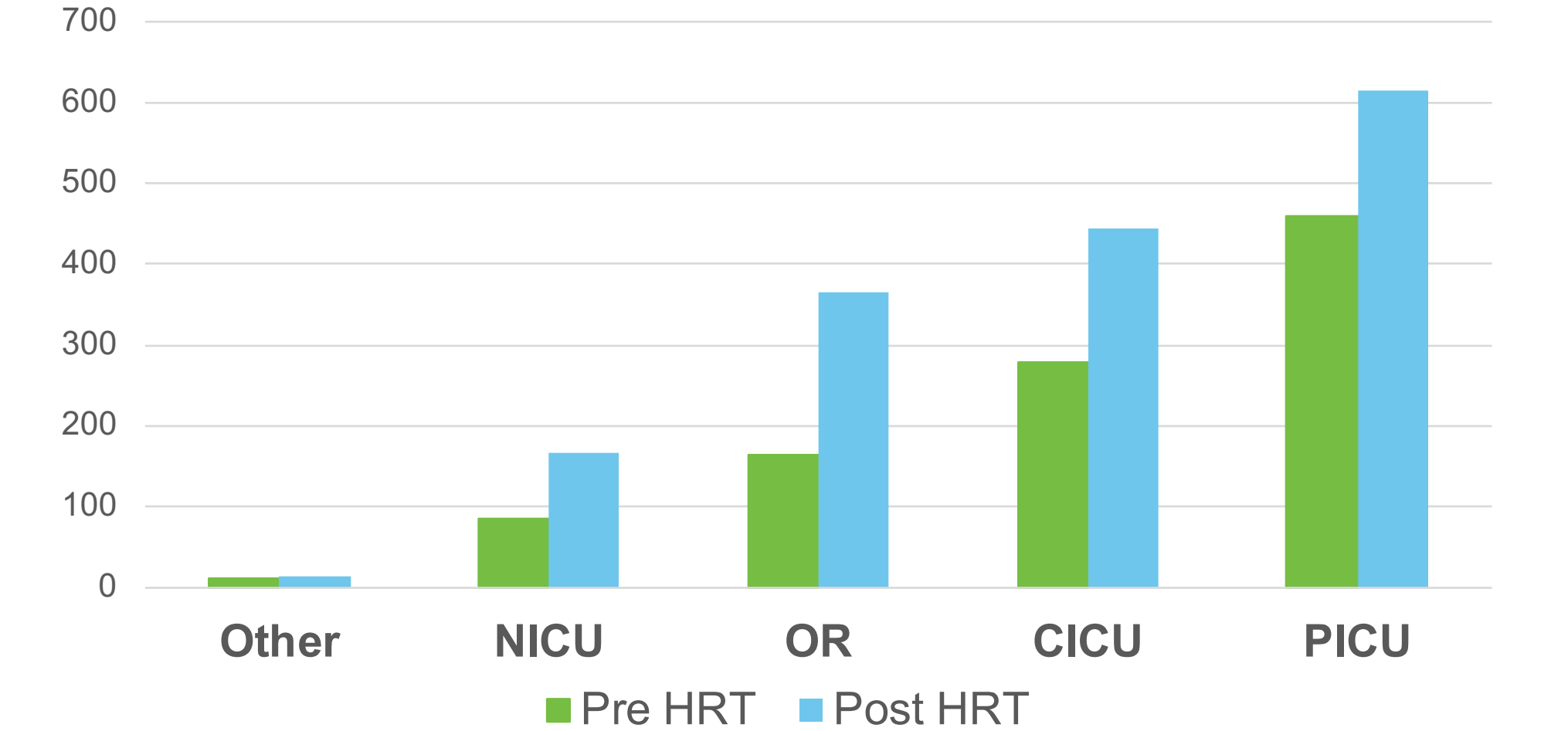


Table 2: Characteristics before and after HRBT implementation. Following implementation critical care procedures performed by HRBT members increased from 27.3% to 53.0%. There was a 6 month decrease in average patient age (p=0.04) and a 2.7kg decrease in weight (p=0.002). There was an increase of procedures done on patients on ECMO (OR 1.44, 1.04-2.02, p=0.035). Despite these changes, there was a decrease in rate of complications (OR 0.16, 0.07-0.37, p<0.0001) and all-cause mortality (OR 0.73, 0.59-0.9, p=0.003)

	Total	Pre-HRBT	Post HRBT	p
Number of procedures	2608	999	1609	
Single procedures	819 (31.4%)	365 (36.6%)	454 (28.2%)	<0.0001
Multiple procedures	1789 (68.6%)	634 (63.4%)	1155 (71.8%)	<0.0001
Age (years)	5.45 ± 7.3	5.8 ± 7.5	5.2 ± 7.2	0.042
Weight (Kg)	18.0 ± 22.3	19.7 ± 19.7	17.0 ± 22.30	0.002
Average number of procedures	2.0 ± 2.1	1.8 ± 1.9	2.1 ± 2.4	0.0008
Procedures by HRBT attending	1126 (43.2%)	273 (27.3%)	853 (53%)	<0.0001
Complications	29 (1.1%)	23 (2.3%)	6 (0.4%)	<0.0001
All-cause mortality	427 (16.4%)	191 (19.1%)	236 (14.7%)	<0.0001
ECMO	173 (0.07%)	53 (0.05%)	120 (0.07%)	0.035

Table 3: Characteristics of patients scoped by HRBT members. Patients scoped by HRBT over the 8-year period were on average 1.5 years younger and 4.7 kg lighter. A significant higher percentage of patients scoped by HRBT were on ECMO (1.54, 1.13-2.08, p=0.007). This shows increased comfort with expected higher complexity of procedure with a significant impact on rate of complications (0.21, 0.08-0.58, p=0.001)

	HRBT member	Non-HRBT member	p
Number of patients	1126	1482	
Age	4.6 ± 6.8	6.1 ± 7.55	<0.0001
Weight	15.4 ± 20.7	20.1 ± 23.3	<0.0001
Complications	4 (0.4%)	25 (1.7%)	0.001
Patients on ECMO	92 (8.1%)	81 (5.5%)	0.007

Results

Table 4: Complications before and after HRBT implementation. Each specific complication was counted as a separate event even if they occurred during the same procedure. Complications were noted in 1.2% of all procedures. No patient deaths were reported as a direct result of bronchoscopy.

Complications	Total	Pre-HRBT	Post-HRBT
Procedure without complications	2579 (98.8%)	976 (97.7%)	1603 (99.6%)
Prolonged desaturation	11 (0.4%)	11 (1.1%)	0
Pneumothorax	2 (0.08)	2 (0.2%)	0
Early termination of the procedure	7 (0.3%)	4 (0.4%)	3 (0.1%)
Unexpected intubation	3 (0.1%)	1 (0.1%)	2 (0.1%)
Hypotension	2 (0.08)	2 (0.1%)	0
Laryngospasm	1 (0.03%)	1 (0.1%)	0
Hemorrhage	6 (0.2%)	5 (0.5%)	1 (0.06%)
Cardiopulmonary arrest	2 (0.08)	2 (0.2%)	0

Conclusions

- Flexible bronchoscopy is a generally safe procedure in critically ill children with low rate of complications.
- Predictive value of finding bronchitis is high in patient with the indication of hypoxia or infection/aspiration. Finding hemorrhage also has a high predictive value for patients with this indication.
- Creation of a formal HRBT in a high-volume center
 - May help to increase comfort with complex or high-risk cases such as those patients on ECMO, younger children and/or lower weights
 - May impact the rate of complications associated with the procedure.

References

(1) Atag, Unal et al, 2021 (2) Field-Ridley, Sethi et al, 2015 (3) Terkavi, Altirkawi et al, 2015 (4) Wu, Lu et al, 2023

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