INFANTS ≤23 WEEKS MANAGED WITH FIRST-INTENTION HIGH-FREQUENCY JET VENTILATION

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Approaches to respiratory support and the availability of ventilator technologies in national markets vary around the world. We sought to better understand the use of first-intention high-frequency jet ventilation (HFJV) using 2.0-mm and 2.5-mm internal diameter endotracheal tubes (ETTs) for infants ≤23 weeks' gestation in the Tiny Baby Collaborative: which infants received this intervention; what are their ventilator settings, blood gases, and blood pressures; and what is the impact of ETT size?

As background, more than 50 hospitals in the United States, Canada, Australia, Spain, Germany, Sweden, and Japan submit data to the Collaborative. For this study, U.S. hospitals using first-intention HFJV for infants ≤23 weeks' gestation admitted during 2024-2025 contributed twice-daily details (nearest values to 0600 and 1800) on ventilator settings, blood gas, and vital signs during the first two postnatal weeks, linked with routinely collected characteristics and outcomes. Data were analyzed using Python and R.

RESULTS

In this dataset of 70 infants managed with first-intention HFJV during 2024–2025 across 9 U.S. hospitals, there were 8 infants born at 21 weeks' gestation, 32 at 22 weeks, and 30 at 23 weeks. The median birthweight was 515 g (IQR 450–570 g). Additional characteristics are in Table 1.

TABLE 1. INFANT CHARACTERISTICS	2.0-mm (n=42)	2.5-mm (n=28)
Birth year – n (%)		
2024	20 (48%)	12 (43%)
2025	22 (52%)	16 (57%)
GA week – n (%)		
21w	7 (17%)	1 (4%)
22w	25 (60%)	7 (25%)
23w	10 (24%)	20 (71%)
Birth weight (g) – Median (IQR)	465 (410–537.5)	566 (515–625)
Maternal race – n (%)		
White	24 (57%)	17 (61%)
Black	10 (24%)	6 (21%)
Asian	0 (0%)	0 (0%)
Other	8 (19%)	5 (18%)
Maternal Hispanic ethnicity – n (%)	12 (29%)	4 (14%)
Singleton – n (%)	38 (90%)	24 (86%)
Male – n (%)	24 (57%)	16 (57%)
Female – n (%)	18 (43%)	12 (43%)
Clinical chorioamnionitis – n (%)	9 (21%)	4 (14%)

C-section – n (%)	19 (45%)	16 (57%)
Antenatal corticosteroids (any) – n (%)	39 (93%)	24 (86%)
5-min Apgar ≤3 – n (%)	14 (33%)	5 (18%)
Admission pH <7.0 – n (%)	5 (12%)	2 (7%)

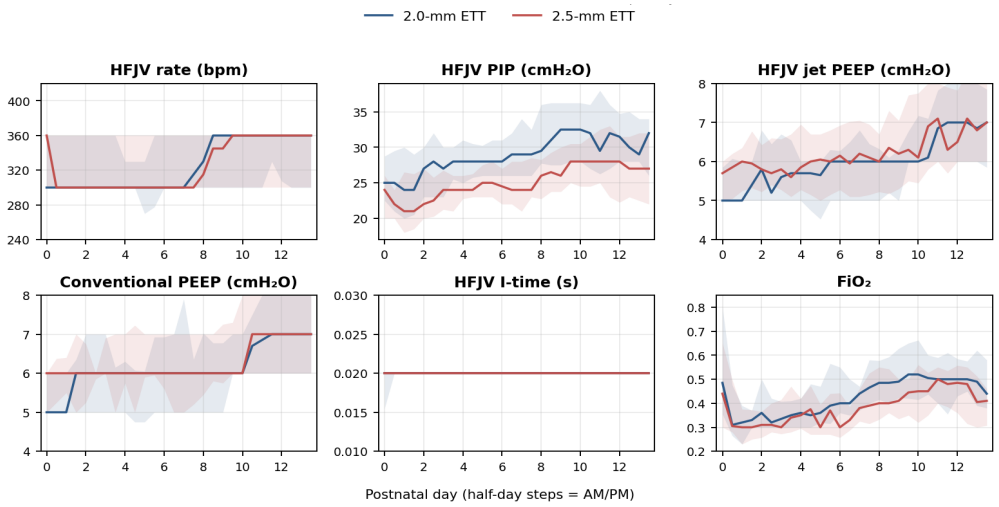
Among the 70 infants, 24 (34%) were diagnosed with grade III–IV intraventricular hemorrhage and 31 (44%) died prior to NICU discharge. Management and outcomes are shown in Table 2.

TABLE 2. INFANT MANAGEMENT AND OUTCOMES	2.0-mm (n=42)	2.5-mm (n=28)
Any postnatal corticosteroids – n (%)	30 (71%)	22 (79%)
Any hydrocortisone – n (%)	30 (71%)	14 (50%)
Postnatal age at first hydrocortisone (d) – Median (IQR)	1 (1–2.75)	5 (1–17.5)
Any dexamethasone – n (%)	10 (24%)	14 (50%)
Postnatal age at first dexamethasone (d) – Median (IQR)	49.5 (39.5–55.5)	35 (25.5–40.75)
Any diuretic – n (%)	21 (50%)	21 (75%)
Inhaled β2-agonist – n (%)	6 (14%)	6 (21%)
Pulmonary interstitial emphysema – n (%)	3 (7%)	1 (4%)
Chest tube – n (%)	4 (10%)	2 (7%)
Pulmonary hemorrhage – n (%)	2 (5%)	3 (11%)
Postnatal age at first endotracheal extubation age (d) – Median (IQR)	14.5 (3–35.5)	35 (22–42)
Postnatal age at final endotracheal extubation age (d) – Median (IQR)	41 (3.5–82.75)	63 (36–141)
Days of mechanical ventilation – Median (IQR)	38 (3.5–62.75)	43 (28–63)
Mortality – n (%)	23 (55%)	8 (29%)
Timing of death (d) – Median (IQR)	4 (2–7.5)	10.5 (3.25–38.5)
IVH grade III–IV – n (%)	11 (26%)	13 (46%)

Ventilator management

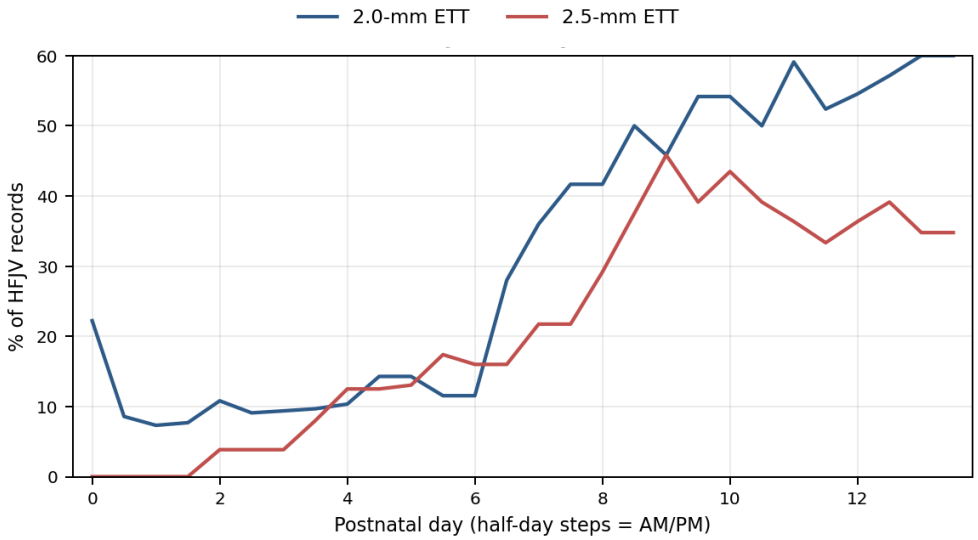
All 70 infants were started on first-intention high-frequency jet ventilation on NICU admission. Of these, 7 (10%) transitioned to another ventilator during the first 2 postnatal weeks: 1 was extubated to non-invasive respiratory support; 4 transitioned to high-frequency oscillatory ventilation and 2 to conventional ventilation. Of the 7, 3 returned to high-frequency jet ventilation during the first 2 postnatal weeks. Median (IQR) HFJV settings over time are shown in Figure 1.

FIGURE 1. MEDIAN (IQR) HIGH-FREQUENCY JET VENTILATOR SETTINGS



During the first 2 weeks, 32 of 70 infants received back-up ventilation while on HFJV; back-up use rose over the 2 weeks (Figure 2). Among 70 infants, 4 (6%) were started with a back-up rate on first ventilator recording; at the end of two weeks, 21 in 44 infants (48%) were on back-up ventilation. The back-up rate had a median (IQR) of 4 (2–5) bpm, PIP of 15 (14–18) cmH_2O, and back-up iT of 0.40 (0.40–0.40) s.

FIGURE 2. PROPORTION OF INFANTS ON BACK-UP VENTILATION



Blood gases

Of 1368 blood gases recorded during the first 2 weeks, 1096 (80%) were arterial, 179 (13%) capillary, 67 (5%) venous, and 26 (2%) had an unknown source. Arterial sampling decreased over the first 2 weeks (Figure 3). Values differed by blood gas source as expected (Table 3).

FIGURE 3. PROPORTION OF BLOOD GASES DRAWN FROM ARTERIAL SOURCE

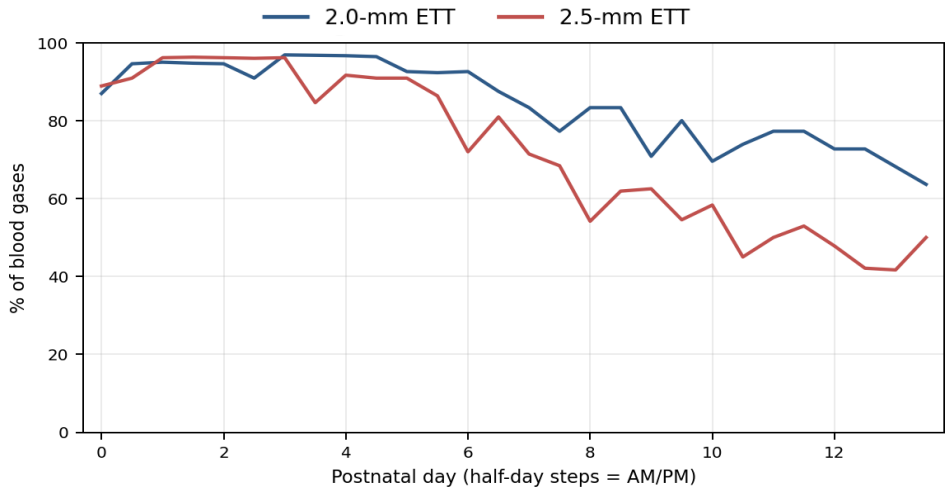
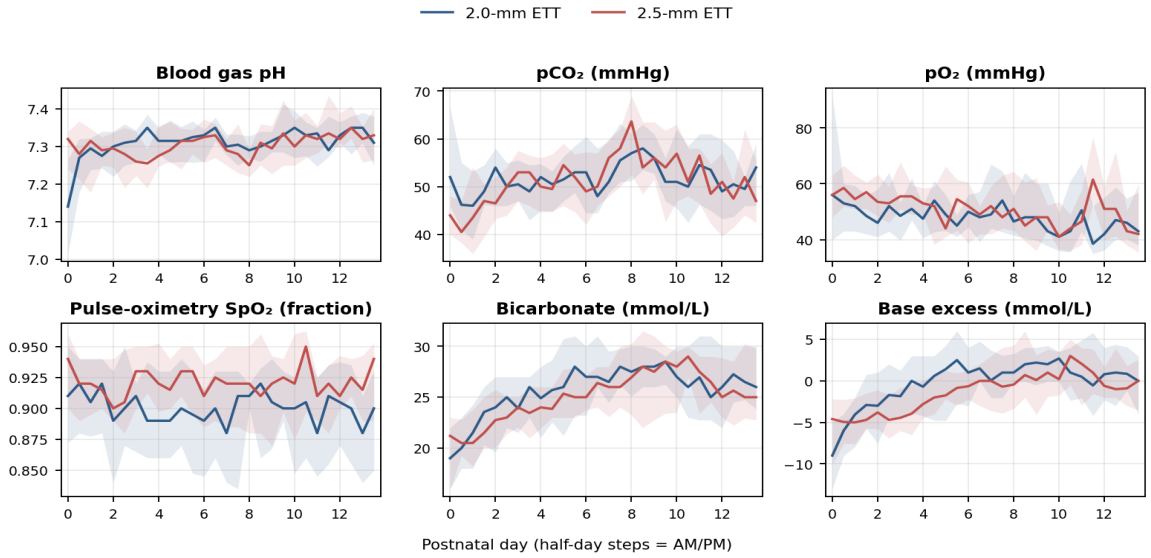


TABLE 3. BLOOD GAS VALUES BY ORIGIN

Source	pH – median (IQR)	pCO_2 – median (IQR)	pO_2 – median (IQR)
Arterial	7.31 [7.25–7.36]	51 [45–58]	52 [44–62]
Capillary	7.30 [7.245–7.35]	51 [43–58]	39 [32.75–45.25]
Venous	7.28 [7.24–7.35]	57 [49–64.5]	37 [32–43]

Due to the small number of non-arterial blood gases, values from all sources were analyzed together. Trends during the first 2 weeks on HFJV are shown in Figure 4.

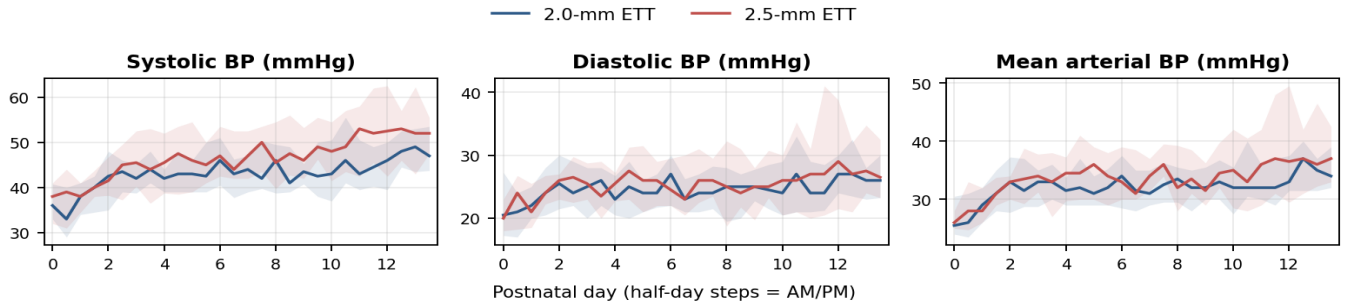
FIGURE 4. BLOOD GAS AND OXYGEN SATURATION OVER TIME ON HFJV



Blood pressures

Of the 70 infants, 65 (93%) had an umbilical arterial catheter; 1091/1404 (78%) of recorded blood pressure readings were from an arterial line, and the remainder from a blood pressure cuff (locations not included). Measures of blood pressure, regardless of source, are shown in Figure 5.

FIGURE 5. BLOOD PRESSURES OVER TIME ON HFJV



DISCUSSION

In this detailed description of 70 infants born at ≤23 weeks' gestation managed on first-intention high-frequency jet ventilation at 9 U.S. hospitals, we observed that the majority of infants started on high-frequency jet ventilation were managed for at least 2 consecutive weeks on this ventilation modality. During the study period of 14 days, infants achieved expected blood gas pH and pCO_2 measures and blood pressures.

We did not perform formal statistical testing to compare 2.0-mm and 2.5-mm ETTs, infants by gestational age at birth, or test for trends in ventilator settings, blood gas or pulse oximetry values, or blood pressures over time. Notably, infants started with 2.0-mm ETTs had several characteristics associated with higher risk of adverse outcomes. They were born at earlier gestational ages and had birthweights, on average, 20% less than infants intubated with a 2.5-mm ETT.

In the Collaborative minimum dataset, among all infants ≤23 weeks' gestation with NICU admission and mechanical ventilation within 1 hour of birth in the dataset, 24/32 (75%) of infants born at 21 weeks, 384/823 (47%) of infants

born at 22 weeks, and 373/1440 (26%) of infants born at 23 weeks were intubated with a 2.0-mm ETT. All other infants were intubated with a 2.5-mm ETT. These data suggest that use of 2.0-mm ETTs is inversely proportional to gestational age at birth among infants <24 weeks and that clinicians may prefer to use 2.5-mm ETTs when possible. In cases where a 2.5-mm ETT does not fit the patient's trachea, a 2.0-mm ETT may be the only method to provide life-sustaining ventilation. In our cohort, 45% of infants intubated with a 2.0-mm ETT survived to discharge.

Strengths of this report include the broad representation of sites including large- and small-volume hospitals encompassing both academic and community practice. Limitations of this report include that larger numbers of patients are required for detailed statistical analysis or comparison with other ventilation modalities. Future research to describe and evaluate real-world ventilation practices for infants <24 weeks is needed.