Supplementary Materials

The specific definitions of NEC, ROP, and IVH

Necrotizing enterocolitis (NEC) can be staged into three groups on the work of Bell *et al*. NEC in this study refers to stage 2 and above. According to the Bell's classification, the specific classification was as follows:

Stage I

Stage Ia

- Clinical signs: temperature instability, apnea, bradycardia, emesis, abdominal distension, positive fecal occult blood test.
- Radiographic findings: normal or mild intestinal dilation.

Stage Ib

- Clinical signs: as in stage Ia, hematochezia.
- Radiographic findings: as in stage Ia.

Stage II

IIa: mildly ill

- Clinical signs: as in stage I, absent bowel sounds, abdominal tenderness.
- Radiographic findings: intestinal dilation, pneumatosis intestinal, intestinal obstruction.

IIb: moderately ill

- Clinical signs: as in stage IIa, metabolic acidosis, thrombocytopenia, cellulitis of abdominal wall or mass of right lower abdomen.
- Radiographic findings: as in stage IIa, portal venous gas, ascites.

Stage III

Stage IIIa:

- Clinical signs: as in stage IIb, shock, hypotension, frequent apnea, mixed acidosis, DIC,

24   neutropenia, anuria.

25   •   Radiographic findings: as in stage IIb, diffuse peritonitis, abdominal obvious tenderness,

26   abdominal wall redness, and swelling.

27 Stage IIIb: perforation

28   •   Clinical signs: any, sudden aggravation of clinical signs.

29   •   Radiographic findings: pneumoperitoneum.

30 Retinopathy of prematurity (ROP) can develop when the immature retinal blood vessels have not reached

31 the edge of the retina. It was graded by the International Classification of ROP (ICROP).

32   •   Stage 1: Demarcation line. A whitish line is visible between the normally vascularized retina and

33   the peripheral retina in which there are no blood vessels.

34   •   Stage 2: Visible ridge. The demarcation line develops into a ridge, with height and width,

35   between the vascular retina and peripheral retina.

36   •   Stage 3: Blood vessels in the ridge. Blood vessels grow and multiply (proliferate) and are visible in

37   the ridge.

38   •   Stage 4: Partial retinal detachment. Vitreoretinal surgery may be indicated.

39   •   Stage 5: Complete retinal detachment. No treatment is usually possible.

40 Intraventricular hemorrhage (IVH) was graded as follows according to the Papile classification:

41   •   Grade I: subependymal, germinal matrix hemorrhage.

42   •   Grade II: IVH without ventricular dilatation.

43   •   Grade III: IVH with ventricular dilatation.

44   •   Grade IV: IVH with intraparenchymal hemorrhage.

45 ***Specific measures of quality control circle***

46 We carried out the sampling management in accordance with the steps of the Quality Control Circle (QCC).

47 A total of 284 infants with a GA of <32 weeks who were hospitalized from July 2018 to June 2019 were

48 enrolled as the control group (before QCC). A total of 276 infants with a GA of <32 weeks who were

49 hospitalized from July 2019 to June 2020 were enrolled as the observation group (after QCC).

50 Through the current situation investigation, the causes of large sampling blood loss before QCC were

51 analyzed from the aspects of patients, doctors, nurses, management, and the environment by

52 brainstorming. According to the 80/20 rule (Pareto Principle), "Insufficient execution of placental blood

53 sampling," "Puncture failure due to technical problems," "Not sufficiently aware of the risks of frequent

54 sampling in sampling personnel," and "Failure to establish bedside blood sampling form in time" were the

55 main reasons affecting sampling blood loss of preterm infants, with a cumulative percentage of 79.7%.

56 According to the main problems and comprehensive evaluation, the final improvement plan to be

57 implemented was formulated: (1) educational intervention for the medical staff, such as requiring

58 attending physicians to master the indications of each sampling test and sampling technology training for

59 nursing personnel, which using the standard operation video of blood sampling and conducting regular

60 assessment; (2) communicating the minimum blood volume required for each examination with the

61 laboratory department, starting a bedside standardized sampling form, and strictly controlling each

62 sampling volume defined by the minimum volume for each test; (3) sampling from the umbilical cord at

63 birth for partial examinations, such as blood culture and hepatitis markers; (4) using micro-blood sampling

64 technology and bedside biochemical tests; and (5) using one sample for multiple tests, such as liver

65 function, renal function, and electrolytes. The QCC team summarized and evaluated the various measures,

66 then analyzed and modified the measures through quality management methods.

67 ***Sample size calculation***

68 This test mainly took the change of RBCTs volume as the main analysis index and adopted the hypothesis

69 test of two groups of their overall mean. According to our previous research, the RBCTs mainly occurs in

70 very low birth weight infants (66.9%), so we selected the data of April 2019 and October 2019 as the

71 pretest results, and the number of very low birth weight infants in the two groups was similar. In April

72 2019 and October 2019, the average RBCTs volume was 61 ± 57ml/kg and 44 ± 34 ml/kg, respectively.

73 With level of significance, α=0.05 (two-sided test), type II error (β) set to 0.2, power of the test is

74   maintained at 80%, the ratio of subjects is set to 1:1. Using the following formula:

75    $$n_1 = n_2 = 2\left[\frac{(t_\alpha + t_\beta)^2 s}{\delta}\right]^2$$

76   By using the menu "Two Sample T-Tests Allowing Unequal Variance" of PASS 2021 software, 147 cases

77   were required for each group according to the blood transfusion volume. Considering that the abscission

78   rate is 10%, 164 cases were required before and after the management. A total of 328 subjects were

79   included, which can ensure the scientific nature of the research design.

80   **Supplementary Table 1: Basic clinical features.**

Stratification	Basic clinical features	Before management (mean ± SD)	After management (mean ± SD)	P-value
28 ≤ GA < 32 weeks	GA, weeks	30.2 ± 1.2	30.3 ± 1.1	0.494
	BW, g	1394 ± 260	1397 ± 281	0.902
	Hospitalization days, days	37 ± 15	39 ± 15	0.199
	Hgb at birth, g/L	168 ± 24	169 ± 25	0.604
	HCT at birth, %	49.1 ± 6.8	49.2 ± 6.8	0.907
	No. male (%)	133 (54.1)	11.5(48.7)	0.241
	No. cases	246	236	
<28 weeks	GA, weeks	26.9 ± 0.7	26.7 ± 1.1	0.142
	BW, g	961 ± 147	943 ± 156	0.613
	Hospitalization days, days	71 ± 18	83 ± 35	0.238
	Hgb at birth, g/L	162 ± 26	161 ± 21	0.926
	HCT at birth, %	47.5 ± 7.5	46.7 ± 5.3	0.578
	No. male (%)	23 (60.5)	24 (60.0)	0.962
	No. cases	38	40	

81   BW: Birth weight; GA: Gestational age; Hgb: Hemoglobin; HCT: Hematocrit; No.: Number of; SD: Standard

82   deviation.

83   **Supplementary Table 2: RBCT rates stratified by sample blood loss.**

| Sampling volume	RBCT	No RBCT	Sum	χ^2	P value
<10 mL/kg	3 (1.7%)	169 (98.3%)	172		
10–20 mL/kg	56 (40.0%)	84 (60.0%)	140		
20–30 mL/kg	97 (89.9%)	11 (10.2%)	108	365.920	<0.001
>30 mL/kg	138 (98.6%)	2 (1.4%)	140		

84   RBCT: Red blood cell transfusion.

85   **Supplementary Table 3: The incidence of preterm complications during hospital stays.**

Stratification	Complications	Before management n (%)	After management n (%)	P-value
28 ≤ GA < 32 weeks	ROP	59 (24.0)	27 (11.4)	**<0.001**
	Stage 1–2 ROP	57 (23.2)	27 (11.4)	**0.001**
	Stage 3–5 ROP	2 (0.8)	0 (0)	0.499
	Grade 1–2 IVH	52 (21.1)	50 (21.2)	0.990
	Grade 3–4 IVH	8 (3.3)	4 (1.7)	0.273
	NEC	9 (3.7)	11 (4.7)	0.581
GA < 28 weeks	ROP	30 (78.9)	25 (62.5)	0.111
	Stage 1–2 ROP	27 (71.1)	21 (52.5)	0.092
	Stage 3–5 ROP	3 (7.9)	4 (10.0)	0.745
	Grade 1–2 IVH	19 (50.0)	12 (30.0)	0.071
	Grade 3–4 IVH	6 (15.8)	5 (12.5)	0.677
	NEC	2 (5.3)	0 (0)	0.234

86   Bold text indicates a statistical difference. GA: Gestational age; IVH: Intraventricular hemorrhage; *n*:

87   Number of cases; NEC: Necrotizing enterocolitis; ROP: Retinopathy of prematurity.

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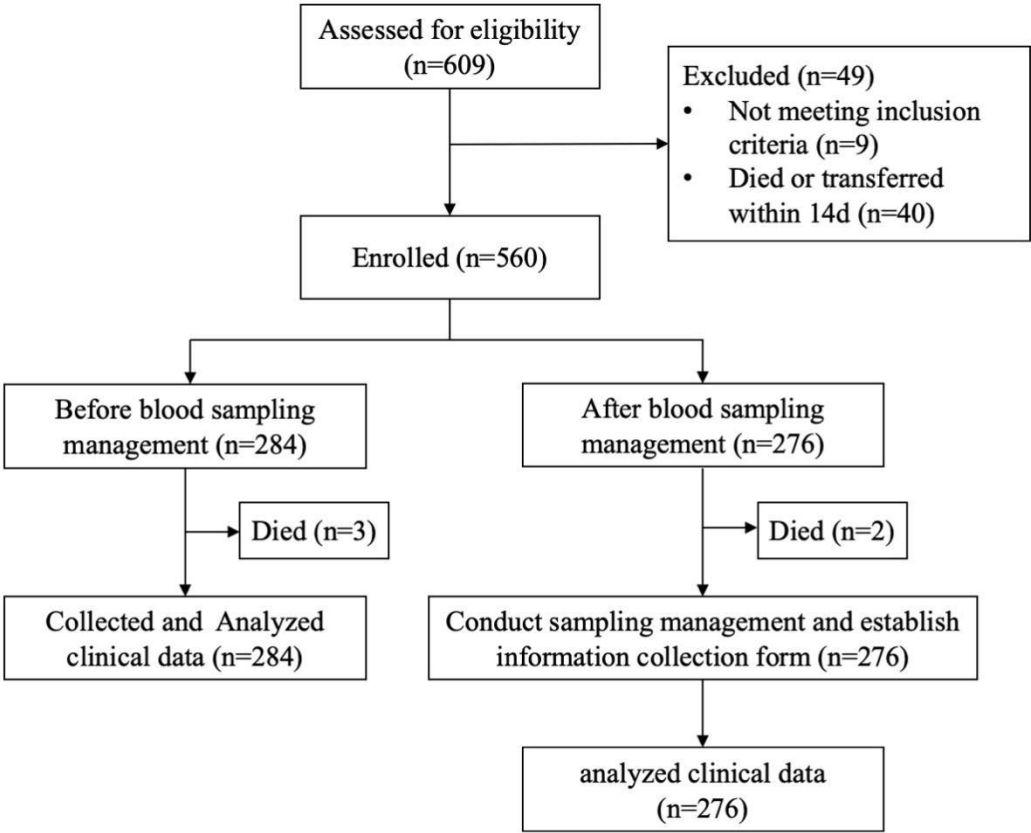
90 **Supplementary Figure 1:** Schematic flowchart. Schematic flowchart showing the numbers of infants

91 assessed for eligibility before and after blood sampling management.

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