Evaluation of In Utero Erythropoiesis in Very Low Birth Weight Preterm Infants
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Purpose
Anemia of prematurity occurs in very low birth weight (VLBW) premature infants and is exacerbated by blood loss due to laboratory sampling. The determination of red blood cell (RBC) lifespan is important to evaluate the pharmacodynamics of erythropoietin in the stimulation of in RBC production in these infants. The current investigation is aimed at developing a mathematical model to describe the in utero RBC production under non steady state conditions in VLBW infants.

Methods
Neonatal and adult donor RBCs were labeled at two discrete biotin densities. The two biotin labeled RBC (BioRBC) populations were transfused into seven premature infants (mean±SD: birth weight: 784±164 g). A hemoglobin (Hb) mass balance model was used to account for phlebotomies, RBC transfusions and growth. A linear change in in utero RBC production rate was considered. The in utero RBC lifespan was assumed to vary linearly with time. All modeling and simulation were conducted using WINFUNFIT, using ordinary least squares fit to individual subject’s Hb amount-time data.

Results
The in vivo lifespan of neonatal and adult RBCs were 63±12 and 75±19 days (mean±SD). The model considering a linear change in both RBC lifespan and in utero RBC production rate was able to describe the survival of in utero produced RBCs under non-steady state conditions.

Conclusion
This study demonstrates the utility of multi-density BioRBC method in determining in vivo RBC lifespan. Contrary to previous published studies, in vivo RBC lifespan of neonatal and adult RBC were not statistically different. In addition, the model developed can be used to estimate the rate of in utero production under non-steady state conditions.