

# Red Cell Transfusions in Children with Thalassemia; Outcomes of a 10mL/kg/hr Infusion Rate

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June 14, 2023

## Abstract

Children with transfusion dependent thalassemia have an impaired ability to synthesize alpha or beta globin which results in anemia. Packed red blood cell (PRBC) transfusions are required to increase hemoglobin which supports appropriate growth and development. PRBC transfusions must be completed with 4 hours however infusion rates vary across institutions. Our institution infuses PRBC's up to 10mL/kg/hr. A descriptive study of 21 children who received a total of 276 transfusions during 2021 demonstrated that this rate is safe and well tolerated. Shorter transfusion times support patients' and families' time, resources, and quality of life and aptly utilize institutional resources.

## Introduction

Thalassemia is a disorder of hemoglobin production, one of the most common monogenic disorder in the world. Thalassemia is caused by mutations in the alpha or beta globin genes which lead to decreased synthesis of respective alpha and beta globin chains ultimately causing anemia.<sup>1</sup> Children and adolescents with severe mutations require regular packed red blood cell (PRBC) transfusions every 3-5 weeks to maintain a hemoglobin that allows for appropriate growth and development. Indications for transfusion include inability to maintain a hemoglobin baseline of  $>7\text{g/dL}$  or those who have complications of ineffective erythropoiesis, such as splenomegaly and frontal bossing.<sup>2</sup>

Care for a child with chronic illness such as thalassemia places a burden on both the child and family. Monthly appointments for PRBC transfusion therapy and clinical visits create a financial burden with co-payments, time constraints, missed work, childcare for siblings, parking and food etc. The culmination of these stressors impact the parents' employment and quality of life of both the patient and their family.<sup>3</sup> As children reach young adulthood this burden carries over to their own employment and family life. Within the health care system, a longer length of stay for transfusion therapy incurs more health care resources and costs.

For the child with transfusion dependent thalassemia, PRBC transfusions administered in an infusion center by the medical team are part of their health maintenance treatment; children receiving them are healthy and without acute symptoms. The clinical procedure for a red cell transfusion is based on guidelines from national and international professional hematologic organizations. The American Association of Blood Banks (AABB) states that patients should be closely monitored for transfusion reaction during the first 15 minutes of each unit of a PRBC transfusion.<sup>4</sup> The rate of transfusion can be as fast as the patient can tolerate but each unit of PRBCs must be completed within 4 hours.<sup>4</sup> Lal and colleagues<sup>2</sup> report that the traditional transfusion rate used in children with thalassemia is 5mL/kg/hr transfusion rate for children with adults receiving a unit of PRBCs in one hour. At our institution, PRBC transfusions for children with thalassemia who are otherwise healthy, are administered at a rate of up to 10mL/kg/hr of red cells.

When pediatric patients reach young adulthood and are transitioned to an adult hematology clinic, or patients are transfused at facilities closer to home, they have reported that each PRBC transfusions take longer. For young children, many institutions will titrate up to a maximum rate of 5mL/kg/hr, resulting in infusions taking more than 3 hours. For adolescent and young adults, each unit of PRBCs may be transfused at rates between 2 to 4 hours. Thus for an adult patient receiving 3 units of PRBCs, overall transfusion time can increase up to 6 to 12 hours. These prolonged infusions negatively impact the quality of life of the patient and family.

To our knowledge, there are no publications that summarize patient outcomes when red cells are infused at a faster rate in an outpatient setting. The purpose of this study is to examine the safety of the 10mL/kg/hr transfusion rate through summarizing the outcomes of children with thalassemia undergoing PRBC transfusions.

## Results

In this retrospective cohort study, data was abstracted from the electronic medical record of patients who are between ages 1 and 18, diagnosed with thalassemia, and received PRBC red transfusions at Children's Minnesota during 2021 as part of their health maintenance. The study was approved by the Institutional Review Board at Children's Minnesota and a waiver of consent was provided. Demographic and clinical characteristics including organ function were collected. For each transfusion day, total volume infused per kilogram, and total time for transfusion were calculated. Vital signs at 15 minutes and at end of transfusion (temperature, heart rate, blood pressure, and respiratory rate) were reviewed for all transfusions; frequency of vital sign measurements was determined by institutional policy. The number of times vital signs were outside normal limits for age were identified according to the American Heart Association's Pediatric Advanced Life Support course manual.<sup>5</sup> Additionally the percentage that the vital sign was over the norm for age was also calculated.

Twenty-one patients met the study criteria and are summarized in Table 1. All patients had a diagnosis of either alpha or beta transfusion dependent thalassemia requiring at least 8 transfusions per year. Transfusions were given every 3-5 weeks as part of their chronic transfusion program when they were at their baseline health status in our infusion center, not in an acute care setting. Institutional thalassemia care guidelines used in the ongoing care and monitoring of patients with thalassemia at Children's Minnesota are based on guidelines from both the Northern California Comprehensive Thalassemia Center<sup>6</sup> and the Thalassaemia International Federation<sup>7</sup>. Results of organ function monitoring are summarized in Table 1.

As seen in Table 2, there was a mean of 13.1 transfusions per patient during 2021. Transfusion time each transfusion day averaged just over 2 hours with a mean transfusion volume of 18.7 mL/kg. Among the 21 patients included in this cohort, there was a total of 276 transfusions that were reviewed. The number of times that heart rate, blood pressure, or respiratory rate were outside of the parameters for age, as defined by the American Heart Association,<sup>6</sup> were low (Table 2). When vital signs were elevated, the average percentage over the norm for age was also low at approximately 4% (Table 2). One patient experienced hives as a reaction during one PRBC transfusion. All patients were stable throughout their outpatient transfusions and were discharged to home.

The AABB mandates that PRBC transfusions be completed with a 4 hour time period and the rate of infusion can be as rapid as the patient can tolerate.<sup>4</sup> To our knowledge, we are the first to report that children or adolescents with thalassemia, who is otherwise medically well, can safely tolerate infusion rates of 10 mL/kg/hr. Implementation of this clinical practice promotes the effective utilization of the patients', families', and institution's time and resources. Clinical sites implementing this changes as a quality improvement project, may consider measuring the patient and/or family's quality of life and resource utilization pre and post clinical change. While this recommendation should not be applied broadly to children who are acutely ill, have unclear etiology for their anemia, or have underlying cardiac or pulmonary conditions, when used in appropriate patient population this change can decrease the burden of living with a chronic illness for patients and their families.

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