Background Information
Greater than 80% of children diagnosed with cancer will survive for 5 or more years.1 With cure rates rising, emphasis in pediatric oncology is being placed not only on cure, but also on improving the quality of life of pediatric cancer survivors. Cancer treatment for acute lymphoblastic leukemia (ALL) involves chemotherapy that eliminates cancerous cells in the body. However, these treatments also damage the healthy cells of the body resulting in multi-system late effects. Physical performance impairments and physical activity limitations are among the documented late effects of childhood cancer.2,3 Decreased motor skill level, muscle weakness, balance impairments, and deficits in ankle dorsiflexion range of motion (ROM) occur in survivors of pediatric ALL.4-6 These impairments begin early in treatment and can contribute to physical performance limitations long into adulthood. Emerging research is demonstrating the relationship of these deficits to chemotherapy-induced peripheral neuropathy, a known side effect of treatment in ALL.7,9 These neuromuscular deficits lead to decreased walking efficiency, which in turn, can contribute to cardiopulmonary health concerns as an adult.10 Research demonstrates that these deficits occur during treatment and continue past treatment, and may be improved by physical therapy or exercise intervention.12 Due to this evidence and observed clinical trends in our patients, the Developmental and Rehabilitation Services Department, together with the Cancer and Blood Disorders Center of Children’s Hospitals and Clinics of Minnesota, began a proactive physical therapy program for children and adolescents with ALL: The Stoplight Program.

The Stoplight Program History
In 2004, Children’s began offering physical therapy services to all children diagnosed with ALL. We observed that families often allowed more sedentary behavior following diagnosis due to fear of what their child could or should do during cancer treatment. We also found that parents would overestimate their child’s abilities as related to those of their peer, unaware of the weakness or difficulty that occurred during regular child’s play. Many families accepted deficits as “normal” during cancer treatment, and did not know they could do something to help their child lead an active lifestyle with their peers. Since starting The Stoplight Program, we are now able to identify deficits, educate families, and advance our children and adolescents along the developmental continuum of safe and successful physical activity that will follow them into a long and healthy future.

The Stoplight Program Basics
The Stoplight Program is based on the levels of a traffic light with red representing moderate to severe deficits, yellow representing mild deficits, and green representing no deficits. Education is given to the family on activities they can do when their child is in a specific level, and tailored exercises are prescribed as the child continues through the program depending on their individual deficits. A child may move from one level to another and receive a changed level of physical therapy intervention depending on current chemotherapy cycle and functional level. Please refer to Table 1 for a synopsis of the outcome measurements we use and interventions we provide. Physical therapy visit frequency typically ranges from 1 visit per month with emphasis on home programming, to 1 visit per week with emphasis on neuromuscular training. Timing of physical therapy visits is shown in Table 2.

Lessons learned
Our program has evolved over the past 9 years secondary to information learned from our families and from our research program as it has developed. We started by educating both our physical therapy staff and our oncology staff on the common deficits that occur in survivors of ALL. Next, physical therapists began assessing patients at set time points that were thought to be critical to the onset of known deficits and recommending physical therapy intervention based on this information. Over the years, we have adjusted the timing of our assessments to better meet the child and family’s needs and priorities during treatment. We have become more aggressive in our treatment of ankle flexibility, strength, and gait abnormalities because of the long-term patterns we have seen with our interventions and emerging research findings. In addition, we have embedded physical therapists into the Cancer and Blood Disorders Clinic to allow coordination of physical therapy and oncology visits. Physical therapists provide therapy during oncology clinic visits, often during infusions. Our patients have improved access to physical therapy services, and better collaboration between the patient, family, oncology, and physical therapy team. Families report greater satisfaction and ability to follow through on recommended therapies because they don’t have to schedule a separate visit at a separate location. Physical therapy services provided through The Stoplight Program have been reimbursed well through insurance as need for medical intervention is documented through reliable and valid outcome measurements.

Program evaluation
Individual patients are evaluated prior to the end of physical therapy intervention to determine their functional outcome. As a whole, the program is currently completing research studies so that we may summarize and publish the effectiveness by determining short and long-term outcomes of this proactive physical therapy intervention. Research outcomes will be presented over the next few years.

Table 1

<table>
<thead>
<tr>
<th>Outcome measurement</th>
<th>Red</th>
<th>Yellow</th>
<th>Green/Discharge Criteria</th>
<th>Green Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity level</td>
<td>≤60</td>
<td>70-90</td>
<td>100</td>
<td>60 min/day</td>
</tr>
<tr>
<td>Active ankle ROM</td>
<td>≤3°</td>
<td>0-9°</td>
<td>2°</td>
<td>Stretching through treatment</td>
</tr>
<tr>
<td>Ankle strength</td>
<td>≤3+</td>
<td>4</td>
<td>5</td>
<td>See above</td>
</tr>
<tr>
<td>Floor to stand</td>
<td>≤½</td>
<td>Needs upper extremity support</td>
<td>Independent</td>
<td></td>
</tr>
<tr>
<td>Gait</td>
<td>GAIT test</td>
<td>Balance training</td>
<td>Balance incorporated in physical activity</td>
<td></td>
</tr>
<tr>
<td>Balance</td>
<td>PDMS II or BOT-2** balance scale</td>
<td>Balance training</td>
<td>Balance training</td>
<td></td>
</tr>
<tr>
<td>Gross motor skills</td>
<td>≤1.5-2.5 S.D</td>
<td>Motor skill training</td>
<td>Motor skill training</td>
<td></td>
</tr>
</tbody>
</table>

**BOT-2 – Bruininks-Oseretsky Test of Motor Proficiency, Second Edition

Table 2

<table>
<thead>
<tr>
<th>PT visit type</th>
<th>Inpatient evaluation</th>
<th>Outpatient evaluation</th>
<th>Initial discharge</th>
<th>Follow up outpatient evaluations</th>
</tr>
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<tbody>
<tr>
<td>Day post diagnosis</td>
<td>Day 2-4</td>
<td>Weeks 6-8</td>
<td>Green criteria met</td>
<td>Every 6 months until 2 evaluations with no deficits</td>
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<tr>
<td>Chemotherapy Cycle</td>
<td>Induction</td>
<td>Consolidation</td>
<td>Typically Maintenance</td>
<td>Maintenance/Post treatment</td>
</tr>
</tbody>
</table>