# The Stoplight Program

## For Children and Adolescents with Acute Lymphoblastic Leukemia

### 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.4-8 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,.9,10 These neuromuscular deficits lead to decreased walking efficiency, which in turn, can contribute to cardiopulmonary health concerns as an adult.11 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 peers, 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 severity of these deficits. 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.


1. Ries L MD, Krapcho M, et al. SEER Cancer Statistics Review, 1975-2004,. 2008. Accessed Jan 28, 2008.
2. Ness KK, Leisenring WM, Huang S, et al. Predictors of inactive lifestyle among adult survivors of childhood cancer. *Cancer.* 2009;115(9):1984-1994.
3. Ness KK, Gurney JG. Adverse Late Effects of Childhood Cancer and Its Treatment on Health and Performance. *Annu. Rev. Public Health.* 2007;28:279-302.
4. Van Brussel M, Takken T, Net Jvd, et al. Physical function and fitness in long-term survivors of childhood leukaemia. *Developmental Neurorehabilitation.* 2006;9(3):267-274.
5. Hartman A, Van den Bos C, Stijnen T, Pieters R. Decrease in Motor Perfomance in Children with Cancer is Independent of the Cumulative Dose of Vincristine. Cancer. 2006;106(6):1395-1401.
6. Wright M, Halton J, Martin R, Barr R. Long-term gross motor performance following treatment for Acute Lymphoblastic Leukemia. *Med Pediatr Oncol.* 1998;31(2):86-90.
7. Gocha Marchese V, Chiarello LA, Lange BJ. Strength and functional mobility in children with acute lymphoblastic leukemia. *Medical and Pediatric Oncology.* 2003;40(4):230-232.
8. Wright MJ, Galea V, Barr R. Proficiency of Balance in Children and Youth Who Have Had Acute Lymphoblastic Leukemia. *Physical Therapy.* 2005;85(8):782-790.
9. Gilchrist LS, Tanner L. The pediatric-modified total neuropathy score: a reliable and valid measure of chemotherapy-induced peripheral neuropathy in children with non-CNS cancers. *Support Care Cancer.* 2013;21(3):847-856.
10. Gilchrist L S WK, Tanner L, . Physical impairments and functional limitations during treatment for non-CNS tumors in children and adolescents. *Oncology Rehabilitation.* 2013;31(4):51.
11. Ness KK, Hudson MM, Pui CH, et al. Neuromuscular impairments in adult survivors of childhood acute lymphoblastic leukemia: associations with physical performance and chemotherapy doses. *Cancer.* 2012;118(3):828-838.


Children's® Hospitals and Clinics of Minnesota

childrensMN.org

## Table 1

| | Outcome measurement | Red | Red Intervention | Yellow | Yellow Intervention | Green/ Discharge Criteria | Green Intervention |
|---|---|---|---|---|---|---|---|
| **Activity level** | Lansky Play Performance Scale[1] / Karnofsky Performance scale[2] | ≤60 | • Strengthening<br>• Activity modification | 70-90 | • Strengthening<br>• Cycle training | 100 | • 60 min/day recommendation<br>• >15 min vigorous intensity 3x/week<br>• Jumping/running > 15 min, 3x/week |
| **Active ankle ROM** | Goniometry[3-5] | ≤0° | • Stretching<br>• Ankle/Foot Orthotics (AFO)<br>• Neuromuscular reeducation<br>• Gait training | 0-9° | • Stretching<br>• Orthotics<br>• Neuromuscular reeducation<br>• Gait training | ≥10° | • Stretching through treatment<br>• See above |
| **Ankle strength** | Manual muscle test[6] | ≤3+ | • Strengthening<br>• Gait<br>• AFOs<br>• Motor skill training<br>• Balance training | 4 | • Strengthening<br>• Gait with endurance<br>• Consider AFOs<br>• Motor skill training | 5 | • See above |
| **Floor to stand** | ½ kneel to stand[7] | Unable | • Strengthening<br>• Motor skill training | Needs upper extremity support | • Strengthening<br>• Motor skill training | Independent | • See above |
| **Gait** | GAIT rite[8]<br>6-minute Walk Test [9-12] (Endurance and gait characteristics with fatigue) | • Tripping<br>• Toe walking<br>• Moderate foot slap<br>• Drop foot | • AFOs<br>• Gait training<br>• See above | • Mild foot slap<br>• Short step length<br>• Endurance | • Consider AFOs<br>• Gait training<br>• See above | Normal | • See above |
| **Balance** | PDMS II* stationary scale or BOT-2** balance scale[13,14] | ≥1.5-2 S.D. | • Balance training | 1-1.5 S.D. | • Balance training | ≤1 S.D | • Balance incorporated in physical activity |
| **Gross motor skills** | PDMS II or BOT-2[13-14] | ≥1.5-2 S.D. below mean | • Motor skill training<br>• See above | 1-1.5 S.D. below mean | • Motor skill training<br>• See above | ≤1 S.D below mean | • See above |

*PDMS II – Peabody Developmental Motor Scales, Second Edition
**BOT-2 - Bruininks-Oseretsky Test of Motor Proficiency, Second Edition

## Table 2

| PT visit type | Inpatient evaluation | Outpatient evaluation | Initial discharge | Follow up outpatient evaluations |
|---|---|---|---|---|
| **Day post diagnosis** | Day 2-4 | Weeks 6-8 | Green criteria met | Every 6 months until 2 evaluations with no deficits |
| **Chemotherapy Cycle** | Induction | Consolidation | Typically Maintenance | Maintenance/ Post treatment |


1. Lansky SB, List MA, Lansky LL, Ritter-Sterr C, Miller DR (1987). The measurement of performance in childhood cancer patients. Cancer 60(7):1651-1656.
2. Schag CC, Heinrich RL, Ganz PA. Karnofsky performance status revisited: reliability, validity, and guidelines. J Clin Oncol. 1984 Mar;2(3):187-93.
3. Soucie JM, Wang C, Forsyth A, Funk S, Denney M, Roach KE, Boone D, and the Hemophilia Treatment Center Network. Range of motion measurements: reference values and a database for comparison studies. Haemophilia 2010
4. Grimston SK, Nigg BM, Hanley DA, Engsberg JR. Differences in ankle joint complex range of motion as a function of age. *Foot Ankle.* 1993;14(4):215-222.
5. Tiberio D. Evaluation of functional ankle dorsiflexion using subtalar neutral position. A clinical report. *Phys Ther.* 1987;67(6):955-957.
6. Medical Research Council of the United Kingdom. Aids to examination of the peripheral nervous system: Memorandum no. 45. Palo Alto, CA: Pendragon House; 1978
7. VanSant AF. Age differences in movement patterns used by children to rise from a supine position to erect stance. *Phys Ther.* 1988;68(9):1330-1339.
8. Thorpe DE, Dusing SC, Moore CG. Repeatability of temporospatial gait measures in children using the GAITRite electronic walkway. *Arch Phys Med Rehabil.* 2005;86(12):2342-2346.
9. American Thoracic Society. (2002). ATS statement: guidelines for the six-minute walk test. *American Journal of Respiratory and Critical Care Medicine,* 166(1), 111-117. doi: 10.1164/rccm.166/1/111
10. Geiger R, Strasak A, Treml B, et al. Six-minute walk test in children and adolescents. *J Pediatr.* 2007;150(4):395-399, 399 e391-392.
11. Li A, Yin Y, Au JT, et al. Standard reference for the 6-minute walk test in children who are healthy aged 7 to 16 years. Am J Respir Crit Care Med. 2007;176:174–180.
12. Nixon P, Joswiak ML, Fricker FJ. A six-minute walk test for assessing exercise tolerance in severely ill children. J Pediatr. 1996;129:362–366.
13. Folio MR, Fewell, Rebecca R. . *Peabody Developmental Motor Scales, 2nd edition.* Austin: Pro-ed; 2000.
14. Bruininks RH. Bot-2: *Bruininks-oseretsky Test of Motor Proficiency, Second Edition Manual.* Pearson Assessments; 2005