

## **Adaptive Mobility Devices with Daily Living Functions**

**Kathleen M. Huebner**

Professor and Associate Dean  
Graduate Studies in Vision Impairment  
Pennsylvania College of Optometry  
8360 Old York Road  
Elkins Park, PA. 19027,

**USA**

215-780-1360

[kathyh@pco.edu](mailto:kathyh@pco.edu)

[http://www.pco.edu/acad\\_progs/grad/grad\\_prgs.htm](http://www.pco.edu/acad_progs/grad/grad_prgs.htm)

A wide variety of Adaptive Mobility Devices (AMDs) will be described and shown through photographs, many being used by children or adults with visual impairments. For more than a decade, students from the Pennsylvania College of Optometry O&M Certificate and Masters Degree programs have created, as part of their coursework, AMDs for specific functional uses beyond safe walking such as running and transporting materials. All the AMDs must serve to detect obstacles and drop-offs as does a long cane. Students based their designs on actual cases and student/client needs. Case studies, rationale, materials used, approximate cost, strengths and limitations of each AMD will be shared with the audience and questions from the audience will be welcome along with open discussion.

The AMD's have specific purposes that make using a traditional cane plus managing another device difficult. Students based their designs on actual cases and student/client needs. Some of the AMDs that will be shared were designed and are used for running, carrying laundry, hay, yard clippings, etc., while others are designed to be used with baby strollers or wheelchairs. Many are for short-term purposes such as transitioning from push toys for toddlers to long canes. Some of the AMDs are designed for individual use, while other are designed for partners such as parent and child, or teacher and student, or two students will also be shown and described.

PVC is the primary material used. PVC is polyvinyl chloride which is an inexpensive and versatile plastic used for many purposes such as plumbing and furniture. Additional materials such as hula hoops, a variety of wheels, grips, baskets, battery operated lights and other attachments will be highlighted. These AMDs are not meant to replace the traditional cane or the AMDs often used as pre-canes or those designed for additional support. Toddlers, children, adolescents, adults and elderly persons in a variety of

indoor and outdoor familiar areas can use the AMDs that will be shown and described. It is hoped that the audience will learn from the ideas presented as well as share their ideas and experiences during discussion. At a minimum the following types of canes will be presented: Running Canes; Functional Carrying Canes (Oxygen, Laundry City and Laundry + Rural; Stroller Attachments; Wheelchair Attachments; Dual Canes; and Preschool Children Toy-Transition Canes.

Students based their designs on actual cases and student/client needs.

### **OXYGEN CARRYING CANE**

The first AMD to be shown and discussed is the **OXYGEN CARRYING CANE**. This was developed by *Donna Hinrichsen, Indiana USA*. She called it the Tank-Cart-Cane.

The cane was made so he could pull the cart and tank while detecting obstacles and identifying drop-offs. Without the AMD he tired easily and bumped into walls, corners, etc. while using his long cane with the opposite hand. He tires easily and the team feels that the effort required energy that takes away from his learning.

The OXYGEN CARRYING AMD is made with Hoola Hoop with Wheels and Clamps which easily joins the oxygen tank, oxygen tank carrier and the AMD together into one unit that is pushed in front of the user.

#### **►AMD Materials and Dimensions:**

- ▶ Top – 10” PVC pipe + 2 ¾ inch elbows
- ▶ Sides – 42 inches each made from hula hoop
- ▶ Bottom – 26 “ PVC pipe + 2 ¾ inch elbows
- ▶ other materials used:
  - 5/8 inch casters, red reflective tape, PVC cleaner, PVC cement, 2 – 21/2 inch clamps
- ▶ **Cost of Materials: \$40.00**

#### **►Benefits:**

- ▶ AMD detects drop offs, obstacles, and terrain changes
- ▶ Is less frustrating for student
- ▶ He easily negotiates corners and narrow passages,
- ▶ Space between handles of clamps helps to hold the oxygen cord, eliminating concerns about tripping or stepping on the cord.
- ▶ AMD is also flexible and will not jar into the cart or student if an obstacle is contacted.

The second AMD to be shown and discussed is the **CARRYING CANE FOR JOB**. This was developed by *Karen Frank, Maryland, and USA*. This AMD was designed for a

student who is 19 year old, with retinopathy of prematurely, autism and severe mental retardation. The student follows simple one-step familiar directions and makes his needs known using one word and occasionally two-word phrases. He is approximately 5' 10" tall. His shoulders measured approximately 20 inches across. His program emphasizes completion of simple household tasks, such as taking the laundry out of the dryer and carrying it back to his dorm room. He is learning jobs such as picking up the mail and delivering packages in familiar buildings, all with adult assistance. He is able to locate many offices and departments within the school. He trails the wall along familiar routes and has an adapted rectangle roller cane. He is not able to use this AMD during his jobs either in the day or evening as his job required carrying large amounts of mail and packages and sometimes laundry. This cane was created to assist him in completing his tasks during both day and evening programming. A modified design of the "Wheeler" as described in the *TAPS: an Orientation & Mobility Curriculum for Students with Visual Impairments*. The modifications include:

- ▶ Larger wheel size for increased ease of movement
- ▶ Caster wheels allowing for lateral movement as well as forward/reverse
- ▶ Front foam bumper to allow for stopping cushion
- ▶ Platform base (with optional basket) to allow for carrying objects
- ▶ Optional basket for hand held items
- ▶ "Wall finders" to help shoreline areas and can also assist in detecting drop-offs on either side.
- ▶ Foam handle for ease of grip
- ▶ Materials List, including options described above
- ▶ ½ inch PVC pipe
- ▶ Length of base determined by the student's shoulder width ( 21 inches wide), cut 2 pieces
- ▶ 2 12" sections for front bumper and lower cross bar
- ▶ 9" section for handle
- ▶ (4 5 " section for base sides between connectors
- ▶ 2 3" section for base sides for between connectors and elbow
- ▶ 2 3 ½" section for front cross bar
- ▶ ½ inch PVC joints
- ▶ 90° elbows (slip x slip)
- ▶ T joints (slip x slip x slip)
- ▶ 45° elbows
- ▶ 2 bushings
- ▶ 4 slip caps
- ▶ 3/8 " Foam pipe threaded couplings insulation – for ¾" pipes
- ▶ 11" for front bumper
- ▶ ½" for handle
- ▶ 3/8" Foam pipe insulation – for ½" pipes

- ▶ 20" section for back bumper of platform
- ▶ 2 2" caster wheels
- ▶ 2 "slide glides" for end caps of "wall finders"
- ▶ 6 #6 x 5/8" screws (sheet metal or wood)
- ▶ 2 #4 x 3/8" screws (sheet metal)
- ▶ Clear acrylic sheet, cut to fit base, 22" x 15"
- ▶ Red Scotchlite tape
- ▶ Black electrical tape
- ▶ Velcro
- ▶ PVC glue
- ▶ PVC Pipe cleaner, clear (to clean up all of your glue drips!)
- ▶ 17" wire or plastic basket
- ▶ 12" wire or plastic basket
- ▶ 1 Velstrap – a Velcro strap
- ▶ 2 Velcro One-Wrap straps

Other carrying canes will also be shown and described for use on farms, apartment living, and other types of communities.

**The third AMD to be shown and discussed is the WHEELCHAIR ATTACHMENT CANE.** This AMD was designed and made by *Carol Seckington, Maryland, USA*. It is for an 18 year old confined to wheelchair due to her cerebral palsy. She is congenitally blind and has received direct O&M skills training for one year. She wants to learn and has use of her left hand and arm to propel a one arm drive wheel chair. She can extend the right arm to "check in" or trail the wall as she travels. She has about using a cane. Physically she can not hold a cane, propel her wheelchair and also trail. There are some routes within our school and within her travels that are dangerous because of drop-offs or stairs. She has excellent hearing skills and uses auditory clues. The AMD would attaches to her wheelchair and gives an auditory "signal" as it detects the drop offs/stairs. She has worked with this cane a few times and loves it. She picks up on the auditory output when the front tube detects the drop off...and she backs herself up so she does not fall.

The measurement used for length was the "detection unit" was a step and  $\frac{3}{4}$  out in front of her front wheels as those are what would go tumbling off a drop off or stairs first.

The overall AMD is made from various lengths of  $\frac{3}{4}$  inch PVC pipe. The front "detection" unit is made from 4" PVC pipe. The list of materials needed for construction is:

<u>#</u>	<u>Material</u>		<u>Cost Per Unit USA</u>	<u>Total</u>
(2)	10 foot length of ¾ inch PVC	@	\$2.13 each	\$4.26
(8)	"T" connections ¾ inch	@	.57 each	\$4.56
(4)	45 degree angle connections ¾ inch	@	.45 each	\$1.80
(4)	1 and 5/8 inch bearing casters	@	\$4.97 pkg	\$4.97
(1)	4 inch PVC pipe	@	\$7.00	\$7.00
(2)	4 inch end caps	@	\$2.10 each	\$4.20
(2)	male ¾ inch connectors	@	.97 each	\$1.94
(2)	female threaded connecting caps	@	.68 each	\$1.36
(1)	role of reinforced hose (1 inch)	@	\$12.00	\$12.00
(1)	box of rice	@	\$2.19	\$2.19
			TOTAL	\$44.38

Photos will be shown of the student's regular wheelchair before adapted attachment, pre-assembly parts, assembled parts and the student using the attachment. Other Wheelchair Attachments for object and drop off detection will be shown and discussed.

**The fourth AMD to be shown and discussed is THE TRASH AND YARD BUDDY.**

This AMD was designed and made by *Mary Hobbs, Indiana, USA*. This AMD was made. The student is a middle school boy with severe low vision due to retinal dystrophy. His parents want him to help with trash and yard work. The trash can on wheels that the family owns is awkward to navigate without tipping over and does not detect surface changes due to the uneven distribution of the weight of the load he is pushing or pulling. The Trash and Yard Buddy AMD was devised to allow him to equalize the weight of the trash or load and put some distance between him and the street as he approached the end of the driveway. He can feel the downward slope of the driveway, the flat surface of the sidewalk, and the upward slope of the camber of the street, if he goes a little too far. The AMD will hold a variety of baskets, trash can, or the recycling bin, depending on the job.

▶ **Other possible adaptations for consideration and development:**

- ▶ A large, stadium-type umbrella could be attached to the frame to accommodate for rainy days,
- ▶ A wide angle light in the front could be mounted to the front of the frame for night use.
- ▶ A clamp for holding his cane will be added to the side bar-- may be useful if he leaves the frame on the street and uses the cane for the trip back up the driveway. Otherwise, the AMD would be used instead of the cane in the yard and driveway area.

## **MATERIALS for The Trash and Yard Buddy**

PVC pipe – ¾ inch and 1 inch  
4 large, heavy-duty swivel wheels from Tractor Supply Store (screw-type)  
4 washers and nuts for adhering wheels  
PVC “ELL” joints  
PVC “T” joints  
PVC joints with 3-way adapter (screw in type) for ¾ pipe and 1 inch pipe  
Screw eyes with nuts (2 inch)  
Bungee cord  
PVC Cleaner  
PVC adhesive

**The fifth AMD to be shown and discussed is the PRESTO-CHANGE-O.** This AMD was developed by *Donna Hinrichsen, Indiana USA*. The teacher wanted a versatile cane that with minor and easy adjustments could be used for many short term uses with children transitioning from one device to another. It can be shortened or lengthened using a simple screw and wing nut, and can have various preschool toys added to it for motivational reasons through the use of clamps and can have various tips put on it. The “extra” handle can be used by the client if needed, or used to provide extra guidance by a mobility specialist. The “extra” handle can be changed to be located on the right or left sides, or even removed if it is not needed at all. The “extra handle is attached with a screw and wing nut set.

## **Materials for Presto-Change-O as Running Cane**

Presto-Change-O with Toy for Preschooler

- ▶ 4' of 1/2" PVC pipe (interior shaft)
- ▶ 5' of 3/4" PVC pipe (exterior shaft and front)
- ▶ 2 T joints (1- 1/2", 1- 3/4")
- ▶ 2 - 3/4" elbows
- ▶ 8" of 1" PVC pipe (extra handle)
- ▶ 1 set of 5/8" casters
- ▶ 2 wing nut and screw sets
- ▶ Reflective tape, PVC cleaner and cement
- ▶ Total cost.....\$25.00

**The sixth AMD to be shown and discussed is SKATE MATE.** This AMD was conceived and made by *Student Char Maternowski, Indiana, USA*. The Skate Mate was designed for a middle school student with Batten Disease. She was diagnosed while in first grade. She participates in the general education curriculum with her same age peers for most of the school day. She uses a long white cane with a roller tip for travel. An adult remains in close proximity as she travels. She has difficulty with problem

solving and becomes easily confused on previously mastered routes. Her physical abilities have changed over the course of the years. Her stamina has declined. She has difficulty with motor planning and coordination. She walks independently although she can be unsteady and her gait often is very hesitant. She enjoys physical activities and participates in the general education Physical Education class with modifications. Her physical abilities are assessed on an on going basis by both Occupational and Physical Therapists.

**Rationale:**

The Physical Education (PE) curriculum includes a 1 ½ to 2-week unit on roller-skating. All of the secondary school PE classes skate during this time. Last year, she was very motivated to participate in her first opportunity to roller skate. However, she was unable to maintain her balance when wearing skates. Additionally, she was unable to detect obstacles or walls in the gym. She was fearful of falling. Several modifications were attempted to assist her while skating. Adults using the modified sighted guide technique commonly used for unstable clients supported her on each side. This was not successful. An adult walked in front of her with an adult spotting from behind; however, this was cumbersome and abandoned. Finally, a skating aid provided by the rink was obtained. This device was too big for her. Additionally, it offered no obstacle detection nor did it offer any protection for her hands as she held on. She tended to hold onto the front of the device rather than the side, which appeared increase her balance difficulties. We needed a way for her to skate more independently. The Skate Mate was designed for her to use during the skating unit this spring. It addresses the difficulties observed last year.

Prior to design, the OT and PT were consulted to discuss ideas and obtain advice regarding construction considerations. The design was finalized and the prototype was built. The OT, PT, and educational consultant for students with orthopedic impairments evaluated the prototype. Modifications were made and then the final design was assembled. The Skate Mate was delivered for the student to test. During the test a flaw was discovered resulting in a modification to the front bumper to increase stability. The student tested it again after the modification was completed. She stated, “I can’t wait for skating. I’ll be fast. Can my friends use it too?”

**Skate Mate Special Features:**

The height of the Skate Mate is adjustable so the student can use it over the course of her secondary school career. It is designed to be weight bearing. The Skate Mate can be adjusted by removing the cinch pins, raising the legs to the desired height, and reinserting the pins. The wheels pivot as well as roll to provide the most maneuverability possible. The bumpers may be expanded with minor changes in the length of the PVC pieces.

***Skate Mate Supplies and Cost List:***

<u># NEEDED</u>	<u>DESCRIPTION</u>	<u>COST</u>
1 inch PVC	90° elbows	\$2.64
2	90° street elbows	\$2.88
6	Tees	\$2.40
2	10-foot PVC pipe	\$5.60
1 ¼ inch PVC		
3	Tees	\$2.22
2	Cross Tees	3.98
2	90° elbows	\$ .78
1	10-foot PVC pipe	\$4.20
1	5-foot PVC pipe	\$2.39
Miscellaneous		
4	Cinch pins	\$4.92
1	Can of Clear PVC Cement	\$1.99
1	Can of Clear PVC Cleaner	\$ .94
5	Casters	\$9.97
4	4-in. piece wooden rod (1¼ in.)	\$1.20
1	3-in. piece wooden rod (1¼ in.)	\$ .60
	<b>TOTAL:</b>	<b>\$47.71</b>

The Skate Mate costs would be close to \$50.00 if you had to purchase all the materials.. One could easily eliminate the adjustability feature and save some of the expense.

Skate Mate Construction Guide:  
Photos follow each set of instructions.

***Initial Preparation***

1. Cut all pieces of PVC to length;
2. Cut wooden pieces to length;
3. Drill end of wooden pieces with a drill bit sized to match instructions on casters;
4. Insert caster holders (metal pieces) into holes and pound into place;
5. Insert casters into holder;

6. Lay out all pieces of PVC and connectors;
7. Clean all ends of PVC pipe and insides of connectors with PVC cleaner

### **Closing**

A variety of transitional AMDs will be shown and discussed along with those made for recreational purposes, use by more than one individual called partner AMDs, running canes, rough terrain canes and other as time allows.