Combining Automated Vision Screening With On-site Examinations in 23 Schools: ReFocus on Children Program 2012 to 2013

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ABSTRACT

Purpose: The Association for the Blind and Visually Impaired (ABVI) began the ReFocus on Children Program to assist school nurses in providing vision screening for at-risk children in the Charleston County School District in South Carolina.

Methods: In 2012 to 2013, 2,750 low-income school children ages 3 to 5 years were screened using the Plusoptix Vision screener (Atlanta, GA). Further examinations were performed on 419 (56%) children referred and glasses prescribed and provided for 192 children (positive predictive value 46%). In 2013, teacher feedback questionnaires were sent to the 23 schools.

Results: Teacher feedback questionnaires had a 49% response rate. Of teachers responding to the questionnaire, 70% reported the children liked wearing their glasses. Teachers provided observations of positive impact, including improved academic performance.

Conclusions: Nurses appreciated that the entire process was efficient and completed in school, simplifying care and follow-up. The authors encourage partnerships between schools, nonprofit agencies, and healthcare providers to improve screening and access to comprehensive vision care for young children.

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INTRODUCTION

Undiagnosed vision issues pose a barrier to literacy, social development, and education.[1] As in other states, South Carolina does not require vision testing prior to school enrollment and school nurses are often responsible for providing the first assessment of vision in a child's life. In 2010, The Association for the Blind and Visually Impaired (ABVI) in Charleston, South Carolina, began the ReFocus on Children Program. The program was developed to help school nurses screen young children for risk factors that may lead to vision loss or vision impairment.

Automated vision screening offers new technology, allowing quick assessment of risk factors for visual disability. Instrument-based vision screening has been recently recommended for young children by the American Academy of Pediatrics. Photoscreening with the Gateway DV-S20 digital

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camera (Gateway Companies, Inc., North Sioux City, SD) has been shown to be more sensitive and cost-effective in screening young children than acuity testing.[2] School nurses using the SureSight vision screener (Welch Allyn, Skaneateles Falls, NY) were able to screen 98.6% of the students, including all special education students.[3] The ReFocus on Children program uses the Plusoptix screener (Plusoptix, Inc., Atlanta, GA), which has been recommended for widespread school screenings.[4]

Increasingly, medical services are being brought to students at their schools.[5] The ReFocus on Children program began as a seed outreach program to provide in-school eye screenings, examinations, and prescription glasses to an at-risk population. We describe the logistics and results of this program for the 2012 to 2013 school year. The program's ultimate goal is to help school nurses provide access to comprehensive vision care and reduce unnecessary vision loss or impairment.

PATIENTS AND METHODS

Participant Screening and Examinations

ABVI, with assistance from the Medical University of South Carolina's Storm Eye Institute, designed the program to reach children in the Head Start, Child Development, and kindergarten classrooms in 23 low-income, Charleston County Title I schools in South Carolina. The Plusoptix screener was used to screen eligible students. The parents of children who were referred for examination were given an educational permission form, which was returned prior to an examination (**Appendix A**, available in the online version of this article). With guidance from the school nurse, parents completed and returned the permission slips. Children with returned permission slips received a full eye examination by a licensed optometrist or ophthalmologist at their school. Those needing prescription glasses were provided glasses delivered to their school by an optician at no charge to the child's family. No personnel involved in the ABVI ReFocus program has any financial or proprietary interest in Plusoptix, Inc.

Screening Process

Scheduling was arranged with the school administration and ABVI staff. The screening was organized with the teachers by the school nurse. A team approach using the coordination of teachers, teacher assistants, and the school nurse was most beneficial in identifying the children and addressing any specific concerns. The screening process was made more comfortable and effective for the children by the presence of the school nurse. The screening room was kept close to the nurse's office so that the nurse was readily available to the student population as needed. Approximately 60 children were screened per hour using the screener.

The Plusoptix screener is an infrared video camera that performs automated photorefraction (estimate of glasses prescription) of both eyes. The handheld camera portion provides a moving light fixation target (smiling face) and is attached to a computer screen that displays the child's "picture" and the screener findings. The Plusoptix has been shown to be sensitive in detection of amblyopia risk factors in young children.[4,6-8] The Plusoptix SO8 was used initially, followed by the model upgrade SO9. Modifications to the referral criteria were made according to screener-specific recommendations to maximize sensitivity and specificity in detection of refractive errors according to American Association for Pediatric Ophthalmology and Strabismus guidelines: Arthur modification 1 (anisometropia $\geq$ 1.5 D, hyperopia $\geq$ 3.5 D, myopia $\geq$ 3.0 D, astigmatism $\geq$ 2.0, anisocoria $\geq$ 1 mm).[9] Although the ReFocus program was designed to have an optometrist "onsite," screening was usually conducted by a nurse or trained layperson. Most school populations were screened with a rate of 100% and completed within a morning.

Examination and Spectacle Fitting Process

Using a team approach, referred children with permission slips were positioned for their examinations. The room that was used for the screening process was also used for the examinations. Children were then taken to the nearby library or returned to the classroom to await pupil dilation and, if needed, fitting of glasses. The school nurse was available to assist the examiners and facilitate referrals. Portable equipment, including fixation targets, slit lamp, diagnostic loose lens set, indirect ophthalmoscope, and lenses, were placed in the designated darkened room. Referred children with permission slips were given eye examinations by a licensed optometrist or ophthalmologist. Assessment of ocular alignment and motility was performed. Visual acuity assessment attempts were performed on selected children, according to physician request. Eye drops (proparacaine hydrochloride ophthalmic solution USP 0.5% [Akorn, Inc., Lake Forest, IL], tropicamide

TABLE 1

ReFocus Guidelines for Spectacle Prescription in Children Ages 4 to 6 Years[a,b]

Diagnosis	Guidelines
Myopia	Preschool: ≥ -2 D
	Kindergarten or first grade: If vision worse than 20/30 (if possible), then ≥ -1.5 D
Astigmatism	≥ +1.75 if regular
	≥ +1.25 if oblique
Anisometropia	≥ +1.25 spherical anisometropia
	≥ +1.75 of cylindrical hypermetropia
Hyperopia > 3.5 D	Give less by 1.0 D
	Exception if developmental delay—consider giving less by 0.50 D
	Exception if strabismus—give full correction and refer to pediatric ophthalmology

D = diopters

[a]Data from Donahue S. Prescribing spectacles in children: a pediatric ophthalmologist's approach. *Optometry and Vision Science.* 2001;87:110-114. Braverman R. Diagnosis and treatment of refractive errors in the pediatric population. *Curr Opin Ophthalmol.* 2007;18:379-383. Cotter SA. Management of childhood hyperopia: a pediatric optometrist's perspective. *Optom Vis Sci.* 2007;84:103-109.

[b]The child's school performance and opinion of caretakers and teachers should be sought out and considered. If there are concerns about visual performance, the child should be referred for a full examination even if he/she passed the vision screening. These are guidelines and only guidelines—the physician has full discretion to best meet the needs of each child.

ophthalmic solution USP 1% [Akorn, Inc.], and cyclopentolate hydrochloride 1% [Alcon Laboratories, Inc., Jena, Germany] one or two drops) were placed in both eyes of all of the children. The children waited for at least 30 minutes to allow pupil dilation and cycloplegia. Subsequently, cycloplegic retinoscopy was performed to determine if glasses would be prescribed. Guidelines for glasses prescriptions were based on the previously researched recommendations, with each physician having discretion based on the individual child and teacher and parent input (**Table 1**). If further pathology was detected, the children were referred for local pediatric optometric or ophthalmologic care. For those children prescribed glasses, fitting and frame selection were performed by the children and the team in an adjacent room on the same day. The examining physician and optician were not affiliated. Glasses were distributed to the students in a few weeks when available and, most recently, an informative letter sent home with the glasses. The school nurse and teachers were able to follow and support the group of students who had received glasses.

Data Analysis

The number and percentage of children successfully screened, examined, and fitted for glasses at each school was determined. The number of screening referrals was compared with the number of glasses prescribed to calculate the positive predictive value (PPV) of the screener.

Teacher Feedback

In April 2013, letters were sent to each teacher in the 23 schools where screenings took place. Teachers were asked to distinguish whether children in their classroom had different responses to their new glasses, but not to identify any child by name. Questions posed included: (1) Did the child/children wear the glasses?; (2) Did the child/children like the glasses or not? Was it difficult to have the child/children wear the glasses?; and (3) What effect did the glasses wear seem to have, if any, on the child/children's behavior or academic accomplishments? In addition, the option was given to include any overall positive and negative effects. Packets were sent to the principal of each school with feedback letters for each classroom where children received glasses. Teachers were given stamped return envelopes to mail their responses to ABVI.

RESULTS

Screening and Examinations

During the 2012 to 2013 academic year, a total of 2,750 children were successfully screened. Seven hundred forty-one of the children screened were referred (27% referral rate). Of these children, 152 were from Head Start programs, 212 from Child Development classrooms, and 377 from kindergarten classrooms. Examinations were performed on 419 children (those for whom consents were returned) and glasses prescribed for 192 children according to specified refractive criteria guidelines (**Table 1**).

The PPV of the Plusoptix screener in this setting was 46%. Referral rates varied for each school from 12% to 43% of children screened (**Table 2**).

TABLE 2
Referral Rates by School

School	No. Referred / Total No. of Children Screened	% of Total Screened Referred
West Ashley	14/114	12%
Frierson	9/68	13%
Murray Lasaine	16/122	13%
Goodwin	47/213	22%
C.C. Blaney	25/111	23%
Thomas Myers	26/113	23%
A.C. Corcoran	56/229	24%
C.C. Human Services	3/12	25%
Mary Ford	31/123	25%
Mt. Zion	26/106	25%
St. James Santee	26/102	25%
Ladson	68/238	27%
Minnie Hughes	18/67	27%
Burns	11/39	28%
Mitchell	16/58	28%
Dunston	49/171	29%
Chicora	39/125	31%
Memminger and James Simmons	58/184	32%
Chas Progressive/ North Charleston School of the Arts	47/144	33%
Midland Park	122/311	39%
Sanders-Clyde	38/89	43%

Teacher Feedback

Response to the teacher feedback letters was overall positive. Letters were sent to 110 classrooms and 54 teachers sent back responses (49% response rate). It was found that most children who received glasses wore them regularly. Thirty-seven (68.5%) teachers responded that the children continue to wear the glasses they were given. Nine teachers (16.8%) reported that some of the children wore the glasses half of the time and 8 teachers (14.8%) stated that the children did not wear them at all. In respect to the children who were reported as not wearing their glasses, the most frequent comments were that the children did not bring them to school, broke the glasses, or wore them at first but do not wear them anymore.

Overall, teachers responded positively that most children liked their glasses. It was found that 38 teachers (70%) reported the children liking their glasses, whereas only 10 teachers (18.5%) reported that children disliked their glasses and 6 teachers (11.1%) saw mixed responses from the children. The mixed responses of children included those who loved their glasses but then lost them and children who did not like them but would still wear them. Of the children who did not like wearing their glasses, the most frequent comment was it was difficult to get the children to wear them.

Because the third question on the teacher feedback letter was an open-ended question, the responses were categorized into positive and negative impacts and recurring comments were grouped by topic. Overwhelmingly, teachers reported that the impact on the children receiving the glasses was positive. Of the positive comments, the largest impact was a reduction in squinting and overall better vision. Teachers noted an improvement in the children's academic progress, an increase in the children's focus during lessons, and an increase in participation and classroom interaction. Some teachers described improvement in the student's confidence and behavior. The negative impact responses included teacher reports of children being embarrassed to wear glasses, taking poor care of their glasses, and some children using the glasses as a toy. It was noted by teachers that, because these children are very young, lessons on how to care for their glasses would be helpful.

DISCUSSION

With the help of school nurses and the Charleston County School District, ABVI was able to screen more than 2,500 children in the 2012 to 2013 school year, with 192 receiving glasses through an in-school portable clinic. Based on the teacher questionnaire, the children who received glasses overwhelmingly had positive responses to wearing the glasses, including less squinting and more class participation. Informally, school nurses reported the program was efficient and accurate, allowing better use of time.

Automated vision screening is now recommended for children of preschool age by the American Academy of Pediatrics.[10] Although obtaining a visual acuity is ideal in this age group, it is often time-consuming, unreliable, or both. Yet, this age group is most in need of screening for refractive error and amblyopia risk factors because these children are starting to build the foundation of their future education. This report demonstrates that automated screening is an effective part of vision care for preschool- and kindergarten-aged students in South Carolina Title I schools.

School nursing input is important in obtaining follow-up from a screening referral. We were able to examine 56% of children referred by providing in-school examinations with direct involvement of the school nurse, which is an improvement on other reported follow-up rates.[3,11] This rate has increased to 75% for the 2013 to 2014 school year by sending the information brochure/consent home early in the school year with follow-up by the nurse. In addition, because the entire process was completed at school, the students received the enthusiastic encouragement of the entire team. Students were supported and made comfortable as they began wearing their glasses as a group.

We found that almost half of those children who were referred needed glasses. Although our PPV is lower than has been reported in other studies,[4,6] these studies were performed in a population with a higher disease prevalence, which artificially raises the PPV from that of the general population. Our referral rate (27%) is both greater and less than that found in other reported programs.[3,11,12] Because automated screeners detect risk factors for amblyopia even prior to the development of pathology, this rate of referral is not unexpected.[13] Adjustments in the referral criteria in this age group have been recommended in an effort to lower referral rates and improve the PPV.[14,15] The newest model screener, Plusoptix S12 Mobile Vision Screener (marketed to school nurses [School Nurse Supply]), allows selection of referral criteria from a pre-set list.

We found the automated screenings to be quickly and successfully accomplished in the school setting. The addition of on-site examinations provided an opportunity to expand care. Nurses and teachers provided positive feedback. The school nurse was able to participate in all stages of the process while allowing time for other student needs. The ReFocus on Children program facilitated vision screening and access to vision care for at-risk children.

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Dear Parents and Guardians,

The Association for the Blind and Visually Impaired - Charleston is promoting eye health and proper eye care in local schools. If you have signed the school's screening permission slip, we will be preforming vision screening for your child with our PlusOptix machine. If your child is referred by the screener, or if the test is inconclusive, we will return to the school to do a free eye exam. Following the exam, if needed, your child is eligible to receive free prescription eye glasses at no charge to you. The exam will be held during school hours. He/she will receive the glasses within three weeks of the exam.

ALL YOU NEED TO DO IS SIGN & RETURN THE ATTACHED CONSENT FORM.

This is a fantastic opportunity to provide your child with free eye exams and eyeglasses!!

Please fill out the attached medical form and permission slip. Without the form, we cannot provide this service!!!

Thank You,

The Association for the Blind and Visually Impaired - Charleston
ReFocus on Children Program Team
843.723.6915

ReFocus on Children – Medical History Form

(Please Print Clearly)

Student Information

Name	
Male or Female	
Student's Birth Date	
Race	
Phone	
Parent / Guardian Name	
Parent/Guardian's Work Phone	
Complete Home Address	

Medical Information

Student's Eye Doctor (if any):		Date of Last Visit:	
Student's Medical Doctor:		Doctor's Phone #	
Is your child allergic to (please circle): Latex Other:			
Please list any medications your child is taking and why:			

Does your child have any of the following?

	Yes	No		Yes	No
Abnormal Blood Pressure			Family history of retina problems		
Allergies			Family history of glaucoma		
Asthma			Family history of cataract		
Diabetes			Family history of crossed eyes		
Eye Disease			Family history of strong eyeglasses prescription		
Heart Condition					

Does your child have any disease, condition, or problem not listed above? If yes, please list:

Child's Medicaid number: *Be sure to fill out all 10 numbers*										

Child's Full Name on Card:	

Permission Slip for Vision Exam at School

Child: _____
(*Print name)*

Parent/legal guardian: _____
(*Print name)*

I, the parent/legal guardian of the above named child, understand that the Association for the Blind and Visually Impaired - Charleston, in conjunction with the Medical University of South Carolina, Storm Eye Institute and others have developed a program with the goal of locating children who may need corrective lenses for vision and supplying or assisting their families in obtaining such corrective lenses.

I have agreed for my child to receive vision screening services at his or her school utilizing a PlusOptix Screener under the direct supervision of a South Carolina licensed optometrist during school hours of the 2013-2014 school year. If my child does not pass the vision screening, I authorize the licensed optometrist or ophthalmologist who will be at the school to perform an eye exam using standard ophthalmic procedures, which will include the use of dilation drops. I understand there will be no charge for vision screenings or eye exams performed at my child's school. Children who pass the vision screening will not receive an eye exam. If the optometrist or ophthalmologist examines my child and determines it appropriate, information shall be sent home recommending further pediatric ophthalmological care. I understand a vision screening does not replace a complete eye exam performed by a licensed optometrist or ophthalmologist. I also understand vision screenings should be conducted regularly, as eyes may change over time.

I understand the Association for the Blind and Visually Impaired – Charleston or others, through grants, government assistance programs with which I and/or my child may qualify or otherwise, may but are not required to seek to provide or assist me with obtaining corrective lenses for my child through a South Carolina licensed optometrist or optician. If my child does not pass the vision screening, the results shall be provided to my child to bring home. I authorize individuals associated with my child's vision screening to contact me regarding the results and possible coordination of obtaining corrective lenses for my child.

I understand any information derived from the eye exam is confidential and shall be used only for the purposes authorized by me in this permission slip.

Signature of parent/guardian

Date: _____