1. PROJECT PURPOSE

Milwaukee Public Schools (MPS) in partnership with Prevent Blindness Wisconsin (PBW) and the Center for Urban Population Health (CUPH) will demonstrate the impact of technology on the efficacy and efficiency of vision screening and follow-up eye care in providing service to approximately 5000 students annually in 30 urban elementary schools. *Project 20/20's* goals are:

- Ensure accurate and efficient vision screening, recording, and follow-up through introducing and implementing the use of appropriate technology.
- Increase the effectiveness, efficiency, and satisfaction of volunteers by enhancing the oversight of their efforts.
- Establish a systematic means of acquiring, managing and maintaining vision screening data through reengineering the vision screening process.
- Ensure that 5000 students annually in 30 MPS elementary schools are screened and receive appropriate eye care.
- Increase the attendance of students with vision problems through a systematic means to identify, screen, refer, and follow-up on eye care treatment.

MPS is the 26th largest school district in the country, serving 103,000 students in 160 locations. Current MPS student demographics reflect the following diversity: 59.5% African-American, 16.3% White, 15.9% Hispanic, 5.3% Asian, 1.0% Native American and 2.1% other non-white and 15% of the student population have disabilities. Over 77% of the elementary students receive free or reduced lunch, an indicator of the number of children living in poverty.

Children from low-income families are at greater risk for health problems that often predict poor academic performance, including vision problems, which can often be treated successfully when recognized early (WisKids Count, 2001). Vision problems affect 1 in 20 preschool children and 1 in 4 school age children (PBA, 1998). In the US today, fewer than 20% of children are adequately screened for vision problems (PBA, 1998). Among the 20% of school age children with a learning disability in reading, 70% of them have some sort of visual problem (Clear Vision, 2002). There is a strong connection between vision and learning (Simmons and Grisham, 1987). Left undetected and untreated, vision problems can lead to more serious problems. 80% of all learning during a child's first 12 years is obtained through vision (Clear Vision, 2002), and yet over 80% of pre-school and school age children never receive a vision screening (PBA, 1998). Without early detection and treatment, vision problems can lead to permanent vision loss, learning difficulties and delayed development that impact on achievement.

Over time, changes in resources and infrastructure have resulted in a marked decrease in direct health services available to children in schools. Volunteers and technology are some of the ways that schools and communities can partner together to reduce or eliminate barriers to learning and help children develop into healthy, resilient learners.

MPS has provided vision screening using volunteers, technology and partner agencies for the past two years. Volunteer groups worked with MPS, PBW and the American Red Cross (ARC) to perform vision screenings. In 2001, 16,000 children in 5 year old kindergarten (K5) and 5th grade were screened using traditional methods, and approximately 1000 more K5 children were screened using three different modalities: standard eye chart, photoscreening and auto refraction. Auto refraction was done using the Welch-Allyn SureSight Auto Refractor. (Appendix B). Complete analysis is still pending, but anecdotally, it appears that the SureSight was more efficient and effective than other methods in quickly and accurately identifying vision problems requiring further evaluation. Students who failed vision screenings were referred for appropriate care. Families of those students without health care resources

received vouchers for eye care exams and glasses if needed. Overall, the project was deemed successful and analysis and publication of results is pending. Although screening itself can be easily accomplished with volunteers, particularly with an instrument like the SureSight, it is the referral and data management piece that becomes unwieldy when working with large groups of children and volunteers in a decentralized system.

Through *Project 20/20* MPS will expand the MPS, PBW and ARC pilot into a 3-year program. *Project 20/20* will screen 5000 students per year in 30 MPS elementary schools. The elementary group is ideal for early intervention, because of the importance of early detection and treatment, which subsequently impacts learning. MPS, in partnership with the Center for Urban Population Health (CUPH) and Prevent Blindness Wisconsin (PBW), is using the volunteer program as the framework for a pilot to design, develop, and deploy a complete screening, referral, follow-up and data management solution for vision screening using network technologies. (Appendices C, D, E, F, G, H)

Problems, Goals, Solutions, and Outcomes:

Problem 1: Manual recording and tracking of vision screening and follow-up of 5,000 students annually is cumbersome and error prone.
Goal: Ensure accurate and efficient vision screening, recording, and follow-up through introducing and implementing the use of appropriate technology.
Solution: Creation of a comprehensive technology-based data management system for vision screening.
Outcome: Increased accuracy in transmittal of vision screening results and appropriate referrals with a reduction of labor traditionally required for the vision screening process.

Problem 2: Ability to manage decentralized volunteer efforts including training, communication, coordination, deployment, and oversight in the vision screening process.
Goal: Increase the effectiveness, efficiency, and satisfaction of volunteers by enhancing the oversight of their efforts.
Solution: Creation of a virtual support system for volunteers that provides anytime, anywhere support for training, resources and interactive peer communication.
Outcome: Increased volunteer effectiveness, efficiency and satisfaction.

Problem 3: Lack of systematic means to acquire, manage and analyze vision screening data.
Goal: Establish a systematic means of acquiring, managing and maintaining vision screening data through reengineering the vision screening process.
Solution: Design and implement a web-based information system for data management, analysis and tracking.
Outcome: Increased efficiency in monitoring the eye care follow-up of individual students.

Problem 4: Most MPS students do not receive vision screening and, if necessary, appropriate follow-up vision care.
Goal: Ensure that 5000 students annually in 30 MPS elementary schools are screened and receive appropriate eye care.
Solution: Through the integration of technology, increase the capacity of volunteers to screen and follow-up on treatment for students.
Outcome: 5000 MPS students annually will receive vision screening and if necessary, appropriate follow-up vision care. Those students in economic need will receive a voucher that covers an eye exam and glasses (if needed) at no cost to the family.

Problem 5: Health disparities of families living in poverty impact academic achievement. (WisKids Count 2001)

Goal: Increase the attendance of students with vision problems through a systematic means to identify, screen, refer and follow-up on eye care treatment. (Johnston, R. 2000) (Baker, D. & Jansen, J., 2000)
Solution: Children in economic need will be given vouchers for eye care and the parents will receive regular follow-up phone-calls/letters to ensure vision treatment is procured.
Outcome: Correction of vision problems will positively impact academic achievement and eliminate disparities related to vision.

2. INNOVATION

Project 20/20 utilizes emerging wireless and PDA (personal digital assistant) technology to reengineer the vision screening process. Currently, many school districts perform vision screenings, but do not have a comprehensive solution that provides data collection, data management and information dissemination. According to our research, *Project 20/20* will create the first collaborative vision screening information system to connect mobile volunteers to a project website and database via handheld computers. Innovations include:

- Using technology to reengineer the vision screening process.
- Managing volunteers at decentralized locations using the capability of handheld computers to communicate with the *Project 20/20* Manager and other volunteers.
- Empowering volunteers at decentralized locations to create and utilize information to improve their activities.
- Allowing effective and efficient data acquisition and management by delivering the data to a centralized repository from citywide schools.
- Enabling volunteers to transition from site to site while remaining connected to the project.
- Providing support to volunteers via access to a virtual interactive peer support system.
- Mobilizing community resources to use new technology to respond to an old problem.
- Utilizing a vision screening method that enables volunteers to overcome communication barriers.
- Using a completely objective means to acquire accurate data instead of subjective methodologies used previously.

Other attempts at using technology in vision screening have focused on recreating the screening tests, not on how the screenings are conducted, collected, and managed. Some examples of existing vision screening systems include VERA Vision Screening Software, Thomson Software CITY Vision Screener for Schools, and Eye-CEE System for Schools. However, these software programs concentrate on replicating vision screening tests on a computer display, not on coordinating the efforts of a vision screening program. As standalone installations, these programs do not provide the capability to centralize results from multiple locations in order to coordinate referral and follow-up efforts. Also, these applications are not relevant to all age groups, since each differs in the level of comprehension required to complete the on-screen tests. *Project 20/20* does not attempt to replicate tests, but concentrates on streamlining the vision screening process.

Other national efforts and projects in vision screenings have been varied. Some efforts have concentrated on creating mobile vision screening labs inside buses or vans. Some organizations that sponsor this type of intervention include LensCrafters, Vision is Priceless Council, Sacred Heart Health System, and chapters of the Lions Club. Also, the Fort Myers Lions Club has used SureSight technology to conduct vision screenings for migrant farm workers, but did not have a method to store and retain the results of the vision screenings. Instead, each worker received their results on a sheet of paper and the Lions Club is only able to state that the testers encountered "much worse problems than expected" in that population. *Project 20/20* will provide a framework for measuring the efficiency of vision screenings and provide a structure for furthering research on vision problems among underserved populations.

3. COMMUNITY INVOLVEMENT

Community partnerships have provided the stability and infrastructure to support a volunteer-based vision screening effort in MPS since 2001 (Appendices I, J, K). As public health resources dwindled, the community responded to this very basic children's health need by mobilizing the resources necessary to recruit, train and supervise a cadre of over 100 volunteers to provide screening to 16,000 K5 and 5th grade children in 135 buildings and followed up with exams and eyeglasses as needed. Volunteers included the students and staff of the University of Wisconsin-Milwaukee (UWM), Marquette University, Milwaukee Area Technical College and Alverno College; Wisconsin Federation of Nurses and Health Care Professionals –Retired; Black Nurses Association-Milwaukee Chapter; La Causa Children and Family Center; Clara Muhammad Mosque #3; Children's Hospital of Wisconsin, Aurora Health Care, Wal-Mart, American Red Cross-Greater Milwaukee Chapter, Prevent Blindness Wisconsin, Lenscrafters, Milwaukee Health Department (Appendix L) and school staff and parents.

The vision-screening program provided a steep learning curve during the first year as the process was evaluated throughout implementation. This feedback identified strengths and weaknesses of the program from the perspectives of volunteer, lead agency, school and student. The communication and flexibility established at the onset provided the structure to problem solve and seek a vision screening method that was highly accurate, easy to use with children of all ages, abilities and languages, and sensitive to volunteers' time and stamina. Volunteers of varying skill levels, cultures and languages all mastered traditional screening methods without difficulty, and will be able to easily learn the SureSight technique.

The partnership between MPS, ARC and PBW was successful because each entity was held accountable for a part of the process: recruitment (ARC), training and management (PBW), or implementation (MPS). Since the initial pilot, the resources of ARC have been diverted to the war effort and vision screening is beyond the scope of their mission. For this proposal, MPS remains the lead agency and is responsible for overseeing the entire project. PBW will provide volunteer recruitment (in place of ARC), technical vision screening expertise, evaluation of the program from an ophthalmologic perspective, and staff the Project Manager position. CUPH will join this partnership to provide network design and development and formative and summative evaluation.

4. EVALUATION AND DISSEMINATION

The primary goal of the evaluation process is to determine if the expected outcomes as stated in the Project Purpose have been achieved. MPS and PBW will perform 15,000 screening tests using the SureSight unit alone and in conjunction with wireless Palm network. Both methods will be used to screen 7,500 students each in order to form two groups for comparison.

Project Evaluators:

Center for Urban Population Health, Susan Partington, Ph.D. (Appendix M), and Timothy Halkowski, Ph.D. (Appendix N)

Outcome Evaluation Strategies:

A summative evaluation will address the following questions aligned to project outcomes:

1. Does the network augment the ability to screen a greater number of children with vision problems?

- To address this, the number of children screened per day using the network method will be compared to the number of children screened per day using the manual method. Once the numbers of students screened per day (date screened included on vision screening form), we will compare the mean number of students screened per day via both methods, stratified by grade level. *Evaluator: Susan Partington, Ph.D. [Outcomes Measured: 3, 4]*.

2. Does use of the network vision screening increase the capacity of schools to manage the care of students with vision problems?

- The role of a school district in managing the care of students with vision problems is to recommend that a child receive vision care and to verify the status of treatment after the initial recommendation. The time between screening/referral and referral/treatment, namely visual evaluation and correction, will be tracked for both methods. The key data here will be the recorded date of screening and date of referral letter. Date of treatment will be obtained through two methods: return of a redeemed voucher from the provider and/or a follow-up phone call to parent verifying treatment. The mean time will compare the mean time elapsed between screening and referral, referral and treatment, and total time for both methods. *Evaluator: Susan Partington, Ph.D. [Outcomes measured: 1, 4]*.

3. Do the referral and treatment rates *significantly differ* across racial/ethnic groups and income levels?

- To measure the impact of *Project 20/20* on traditionally underserved populations MPS will provide data from its Student Management System to identify the race/ethnicity of individual students and family income. The rates of positive screen and subsequent treatment will be compared across different socioeconomic groups. This data will be linked with vision screening and treatment data using a student ID number. *Evaluator: Susan Partington, Ph.D. [Outcome measured: 5]*.

4. Do children with abnormal vision screening test results *receive* appropriate vision care (visual evaluation and correction)?

- The frequency of compliance with referral recommendations and treatment results will be compared to students with abnormal screenings. The date and result of treatment from provider (voucher or screening form return) and follow-up phone call to the parent will be recorded. The rates of abnormal results and rates of treatment (visual evaluation and correction) will be compared. *Evaluator: Susan Partington, Ph.D. [Outcome Measured: 4]*.

5. Is appropriate vision correction *related* to improved school attendance?

- We will compare attendance records for 5th grade students who receive vision treatment to the attendance in the previous year. To do this we will obtain days absent for 5th grade students who receive vision treatment and number of days absent in the previous year from MPS. Then we will compare days absent for 5th grade students post-evaluation and correction to number of days absent during the same time period in the previous year. *Evaluator: Susan Partington, Ph.D. [Outcome Measured: 5]*.

Process Evaluation Strategies:

In addition to the evaluation outcomes measures discussed above, the project will also include two continuous process (or formative) evaluation components:

a) Semi-structured interviews with the volunteer vision screeners, (to gather data on their perceptions of the strengths, weaknesses, challenges, and solutions they encounter while implementing the screening program); and,

b) Ethnographic observation of the actual screening process at various school sites in the program (in order to cross check screeners' perceptions with third-party ethnographic observations).

The first purpose of these evaluation components is to provide data for any needed 'mid-course' improvements and revisions in screener training, or the actual vision screening work with the relevant technologies. The second purpose is to collect data on the transferability of this screening protocol and technology to other school districts nationwide.

As highlighted by the current research literature, interviews and ethnographic observations are crucial data sources for best understanding what problems must be solved when introducing a new technology

into a complex social setting, such as a workplace or a school (Brown & Duguid, 2000; Luff *et al.*, 2000; Suchman, 1987). [*Evaluator: Timothy Halkowski, Ph.D.*]

Human Subjects and Privacy Protection:
In the evaluation data collection and analysis for this project, the researchers will abide by the applicable FERPA and HIPAA regulations. The evaluators will submit this project to the local Institutional Review Board for approval before the start of data collection.

Dissemination:
Individuals and organizations interested in school based vision screening programs will be apprised of our process and results via posters or speaking presentations at the following conferences:

- Wisconsin Association of School Nurses-Spring 2005
- National Association of School Nurses-Summer 2005
- National Assembly of School Based Health Centers-Summer 2005
- Wisconsin Public Health Association-Spring 2006
- Prevent Blindness America-Summer 2006
- American Public Health Association- Fall 2006

In addition, we will seek publication in the following journals and periodicals:

- Journal of School Nursing
- e-Week
- Mobile Computing

The *Project 20/20* website and a comprehensive project video produced by MPS students will be used to disseminate results. All project developed software will be available for free download from our website subject to any state and federal regulations.

5. PROJECT FEASIBILITY
The vision screening process has largely depended on paper-based information systems. Our technical approach will remove paper from the process to achieve greater accuracy in recording and tracking of those children who are referred to vision care professionals. The revised process will eliminate the paper-based method of coordinating, managing, and recording vision screenings. This revised process will be phased in (Timelines – Appendices O, P) achieved through several technology components that work in synchronization to achieve efficiency. An ideal vision screening process requires several technologies to work seamlessly. A variety of technologies will be use to create the three major components: a Palm application, an extensible web-based desktop version of that application, and a collaboration web application. (Appendix R)

A day of vision screening: A general overview of the system being proposed can be illustrated by describing a typical day of vision screening. Ms. Doe has volunteered with PBW and checks the PDA that MPS has provided to see which school and homeroom to go to and who her partner is for the screenings. Upon arriving, she meets her partner and goes to the specified class. After explaining the process to the students, Ms. Doe clicks the student list and sees that Kenny is first on her list. Ms. Doe uses the SureSight instrument to conduct the screening and presses "Print" on the device. After the infrared ports on each device communicate, Ms. Doe sees on Kenny's student profile screen that the results for that screening have been captured on the Palm. She presses the "Next" button on the Palm and sees Tamika is next to be screened. At the end of the screenings, she uses the wireless Internet connection to transfer the screening results to the central project database using an encrypted connection by selecting the "Submit Class" button. The *Project 20/20* Manager is notified via an automatic email that the class is complete and uses the project website portal to create and print referral letters for the class and distribute vouchers to qualifying children.

***Project 20/20* Handheld Program and the SureSight Autorefactor:** Each pair of volunteers will be equipped with a Palm i705 and a SureSight unit. The SureSight unit conducts the screening and stores the results

temporarily. Fortunately, WelchAllyn (Appendix R) designed the unit with an IrDA infrared port. Since the Palm i705 and the SureSight infrared port use the same IrDA standard, CUPH will be able to create a program on the Palm to retrieve the results from the SureSight. WelchAllyn has developed a Software Development Kit (SDK) for the SureSight unit application and a rudimentary desktop application (which WelchAllyn does not plan to develop further), which will considerably reduce the amount of time needed to develop the infrared link.
The Palm program will consist of several distinct elements (Appendix S):

- A J2ME application (Java 2 Micro Edition)
- An Oracle 9iLite database
- A SureSight to Palm conduit
- A Palm to Oracle conduit
- Palm.net wireless Internet service

Each PDA will contain a J2ME program that provides the capability to create and utilize information at decentralized locations in a simple and direct manner to provide volunteers with the following benefits:

- Definition of the class, teacher, and room number to locate in a school.
- Ability to select a student for screening from an electronic class list.
- Elimination of recording screening results on paper.
- The ability to transition from site to site while remaining connected to the project.
- Functionality even when wireless capabilities are not available (as in a basement).
- Allow volunteers to access "web clippings" (scaled-down web pages) from the project web site that contain information such as Frequently Asked Questions (FAQ), SureSight training materials, troubleshooting tips, etc. to empower the volunteer to recover from a service failure without contacting the *Project 20/20* Manager.

***Project 20/20* Web-Based Desktop Application:** In year three, CUPH will develop a J2EE (Java 2 Enterprise Edition) web-based application to enhance the ability of other groups to deploy the *Project 20/20* application in their own environments. Initially the idea of a desktop application was promoted, but was found inadequate due to the mobile nature of the volunteers and the state of the network infrastructure at MPS. However, other school districts may have existing network infrastructure that makes this option feasible. By constructing this application in Year 3, the application will benefit from being constructed after formative and summative feedback has been provided for two years. CUPH will construct this web application using J2EE so that other groups can deploy the application on almost any existing web server using free or open source server and database software on a wide range of networks infrastructures. Since the handheld application will have component architecture, a large amount of source code will be reused from the handheld application to create the web application. Also, the source code will be provided to interested groups so that they can extend the capabilities of *Project 20/20* to include other types of vision screening tests.
***Project 20/20* Web Application:** On the same web application server that the Palm interacts with, CUPH will provide MPS with a collaborative web application. This application will be designed around the concept of portals. A portal is a section of a web site that customizes on specific content and applications according to the audience. Each portal can be protected with security policies so that only authorized users can access sensitive information. *Project 20/20* will have the following components on the web site:

- Public Portal
- Volunteer Portal
- *Project 20/20* Manager Portal
- MPS Administration/Staff Portal

Public Portal: Default web page that appears when accessing the site. This page presents content suitable for public consumption and project oversight by various stakeholders. Aggregate results and publications of the project would be posted here. Links for the other portals will be listed here.

Volunteer Portal: The volunteer portal will be the solution for the decentralized management of the volunteers, since the volunteers will be spread throughout the school district performing screenings. This portion of the web site will be available both online and through the Palm. This portal will provide an

online version of the training classes using audio and video, the SureSight manual, troubleshooting tips, and FAQ's. Also, each volunteer will be able to submit questions and problems to the *Project 20/20* Manager through their own "Project Mailbox". Also, the portal will have an interactive discussion board enabling volunteers to create an informal support group and share their experiences.
In addition, volunteers will have a personalized project status report. This report will list those schools that the volunteer has been paired with and provide information on whether those screenings have been completed or not. This web page will provide the volunteer with a task list that will help them stay focused on what screenings they need to complete. Access to personal health information (names, screening results) will be limited to those classes that the volunteer is working directly with.

Project 20/20 Manager Portal: The *Project 20/20* Manager will have an expanded portal based on the volunteer portal. The manager will have the ability to modify the reports of each volunteer. Also, the manager will be able to review the screening results performed to date in order to mitigate anomalies in screenings. The *Project 20/20* Manager portal will be secured through SSL (Secure Socket Layer) and other security mechanisms.

MPS Administration/Staff Portal: This portion of the web site will allow school administrators and teachers to view the results relevant to their specific students. For instance, teachers will be able to access allowable information on their students. This information can then be used to adjust teaching methodologies, or used during parent/teacher conferences to assure follow-up for students who have vision care needs. This portal will be accessible only on the successful completion of identification via our security mechanism.

Qualifications: CUPH will provide a majority of the technical expertise to develop the three main *Project 20/20* components. CUPH has been developing a population-based data warehouse to support geographically distributed researchers and projects and runs multiple complex projects collecting various types of health information on this infrastructure. For this project, the Center will provide three key staff members. Health Informatics Professor Min Wu from UWM (Appendix T) will focus on the human factors of technology interface and system design. The IS Project Leader, Dale Steber, of CUPH (Appendix U) will be accountable for the development of the handheld program, desktop web application, and the portal architecture. The Project Leader will oversee an intern or graduate student in Computer Science who will develop the portals. Aurora Health Care will provide backups, monitoring, and maintenance in its corporate data center. The Project Director, Kathleen Murphy (Appendix V) will oversee the project, be the liaison for the partners, supporting activities of the project manager, communicating results to the community and monitoring the timeline and the budget expenditures. The project manager (Appendix W) will be accountable for the day-to-day coordination of the project and communicating with the other project personnel/partners, schools, and volunteers.

Privacy and Security: CUPH will use multiple layers of security to protect project participants (Appendix X). Sensitive data items used in *Project 20/20* operations include student ID, name, parent name, address, and phone number and vision screening results. Other demographic data used in the evaluation will be delivered in person by MPS to CUPH and will not be accessible via the Internet. The heart of the security scheme will reside at the database level, which uses discretionary access control, security policies, encryption, and row-level security. The database will reside behind two firewalls on a trusted network and sensitive data will not be stored in the DMZ on the application server. Transmission of data will be accomplished through Secure Socket Layer (SSL) and will use password and/or pass-phrase authentication. All usage of data will abide by FERPA and HIPAA rules and regulations.

1