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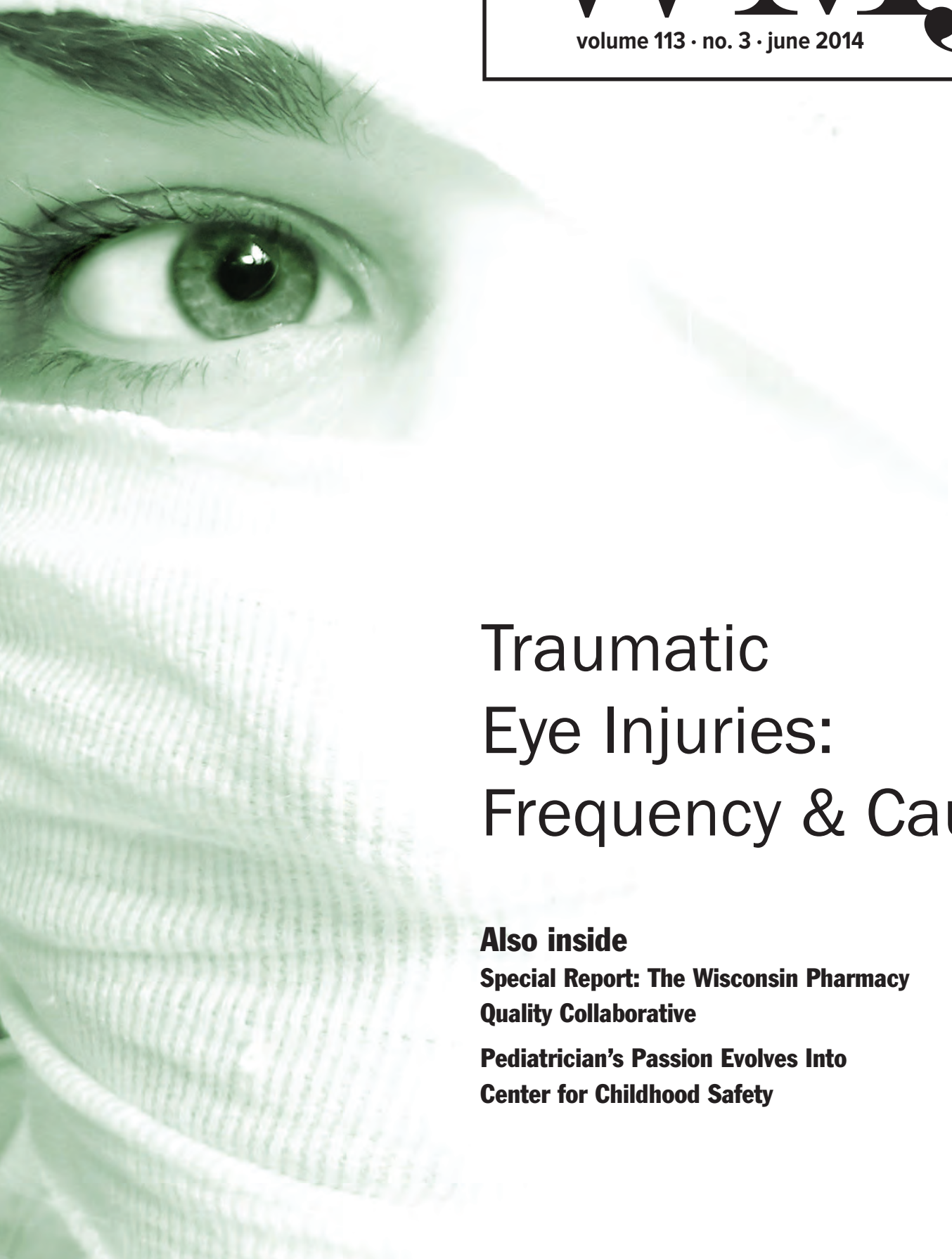

Traumatic Eye Injuries: Frequency & Cause

Also inside

Special Report: The Wisconsin Pharmacy Quality Collaborative

Pediatrician's Passion Evolves Into Center for Childhood Safety

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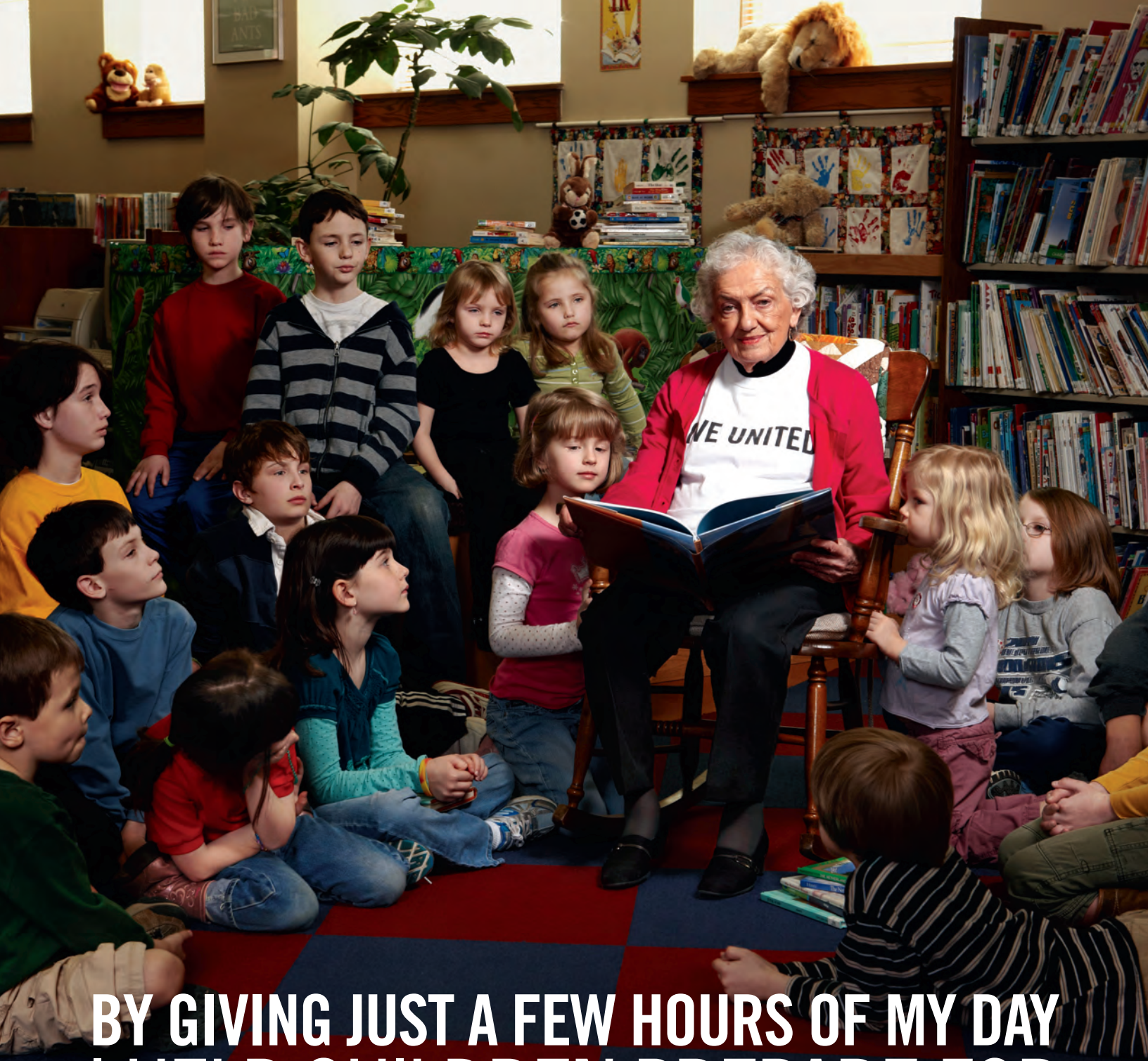

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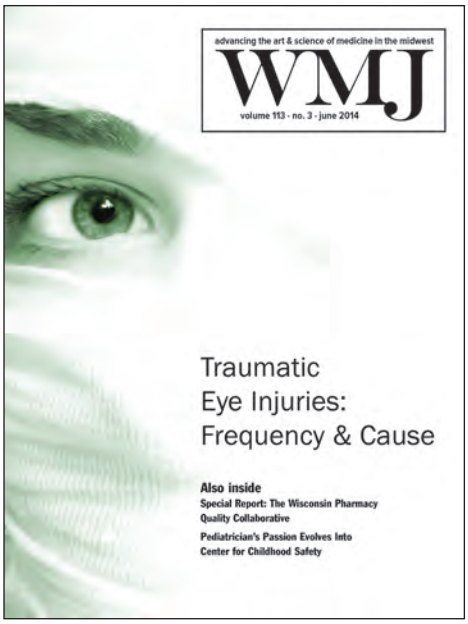

COVER THEME
Traumatic Eye Injuries: Frequency and Cause

Trauma is a significant source of severe ocular injury in the United States, with approximately 2.4 million eye injuries in the United States annually. A study in this issue of *WMJ* explores the causes and frequency of traumatic enucleation among patients treated in a large regional institution over a 12-year period.

Cover design by Mary Kay Adams-Edgette.

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CASE REPORTS

YOUR PROFESSION

YOUR PRACTICE

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Annual Address of the President of the State Medical Society of Wisconsin: Commercialism

C.S. Sheldon, MD

*Editor's note: In this excerpt from the Annual Address of the President of the State Medical Society of Wisconsin 100 years ago, C.S. Sheldon, MD, addressed one of the same issues we face today—making money vs professional ideals. (*WMJ, *Volume 13, p 182, October 1914.)*

It is true we cannot afford to make our profession wholly idealistic and altruistic. (This is a practical world, and we have to make a living, if possible.) But we can much less afford to make of it a mere trade, the main object of which is simply to make as much money as possible. I do not mean to intimate that these lower ideals are held by the profession as a whole, but here is a danger and a temptation against which we can not be on our guard too carefully.

This is a materialistic age, when money counts for much, and when much of it is needed to "keep the wolf from the door." The financial situation seems often absolutely impelling, and the temptation is almost irresistible to forget everything else in supplying present needs. I need not enlarge upon the baleful effects of this tendency, both on the individual and the profession. We can not serve God and Mammon at the same time, and when Mammon holds the stage, all the better ideals go by the board. If this financial greediness shall manifest itself very generally, whether in the shape of fee-splitting, commissions, excessive or unreasonable charges, unnecessary operations, or what not, we need not be surprised if the general public takes due notice and records its judgment.

I have laid stress upon this matter because I believe that the extreme and disproportionate emphasis which is so often placed upon the purely financial aspects of medical practice is fundamentally responsible for most of the criticism to which we are subjected. How this tendency can be corrected, with human nature unchanged, is hard to say. Our rapidly advancing educational standards and requirements ought to help in time, and they probably will. Meanwhile, a vigorous crusade in favor of higher professional ideals should be inaugurated all along the line; a campaign of education, in our medical schools, in our medical societies, and by our own personal influence and conduct.

Pediatrician's Passion Evolves Into Center for Childhood Safety

Kay Simmons

"If a disease were killing our children at the rate unintentional injuries are, the public would be outraged and would demand that this killer be stopped," said Former Surgeon General C. Everett Koop, MD, ScD. Those words describe exactly what Green Bay pediatrician Gordon Haugan, MD, is trying to do. He is working to stop the killer—unintentional injuries—in a way that is fun for kids through the Center for Childhood Safety (CCS), an agency he founded after witnessing the severe brain injury of a bright, young patient.

"This kid was the catalyst for me to want to start CCS, because he made me realize that the safety lectures I gave kids in my office weren't sinking in. It made me ask how we could make the point with kids in a more fun way," said Dr Haugan.

Dr Haugan was then—and still is—passionate about educating children and their families throughout northeast Wisconsin on the prevention and elimination of childhood injuries that lead to disability or death. When he was honored with the Wisconsin Medical Society's 2014 Physician Citizen of the Year Award during its Annual Meeting Dr Haugan said, "The greatest single health threat facing kids today is unintentional injury. Every year more kids die of that than of the combined total of homicide, suicide, genetic defect, pulmonary disease, cardiac disease, cancer, and AIDS." His continuous and unwavering support for the organization he founded has allowed thousands of children and families to be touched by the Center's educational messages and programs, and has undoubtedly saved the lives of an unknown number of children.

CCS was established in 1991 by Haugan,

Gordon Haugan, MD, accepts the 2014 Physician Citizen of the Year Award at the Wisconsin Medical Society Annual Meeting in Green Bay in April.

a Prevea Clinic pediatrician, whose dream was to "put bike helmets on heads" when he assembled a board of community volunteers to form the Bicycle Helmet Safety Coalition, Inc. The Coalition's goal was to increase bicycle helmet awareness by focusing on at-risk children in the greater Green Bay area. The Bicycle Helmet Safety Coalition was based on a program in Denver, Colorado at the time called Headstrong, which featured members of the Denver Broncos in its ads. According to Haugan, "I realized that being in a small community with an NFL team provided us with a similar opportunity and was able to get some of the kids of Packers players who were also my patients at the time to pose for posters promoting bike helmet use for the Coalition."

That initial dream of putting bike helmets on the heads of kids has grown to a full-service safety education "hub" with programs tailored to children from birth to teen. The Center now provides a variety of safety programs as well as injury prevention resources and sources on safety.

"Accidental injury is the number one killer of children under the age of 14. Each year more than 6.5 million young people are injured severely enough to land in a hospital emergency room, many with life-altering consequences. Yet, an astounding 90% of these deaths/injuries could be avoided through education and prevention measures like those offered through the Center for Childhood Safety," said Kimberly Hess, executive director of CCS.

The founding event for CCS was Winners Wear Helmets/Wee Winners Wear Helmets. This event—still held today—focuses on bicycle safety, brain injury prevention through helmet use, and understanding the rules of the road when biking. Each year 640 Green Bay at-risk 3rd graders and 400 Head Start students take part in this program. During the day-long event, which is a school district-approved field trip, students are fitted for their own bicycle helmets, made possible through the generosity of local service organizations. Students also view displays, complete bicycle safety courses, and participate in interactive demonstrations with area helmet-wearing professionals.

Another major concern of the Center is the safety of children when traveling in motor vehicles. Child passenger safety is a large part of the CCS program based on the fact that motor vehicle crashes are the number 1 killer and cause of injuries to kids in the United States. Statistics continue to show that 4 out of 5 car seats are installed incorrectly, which led the

Volunteers at Winners Wear Helmets – the longest running CCS program—demonstrate to kids how to properly fit their new bike helmets.

Center to establish its Child Passenger Safety (CPS) program in which certified technicians provide education and expert installation of child safety car seats through free community events and one-on-one appointments in collaboration with other Safe Kids Greater Green Bay agencies. In the history of the program, over 10,000 seats have been inspected in Brown County.

Hands down the most popular program at CCS is Safety Town according to Hess, which has graduated more than 3500 children since the program began 13 years ago. This fun, innovative program is a week-long, 15-hour summer safety camp, held in June and July, that teaches 4 through 6 year olds of all abilities and income levels how to stay safe in their homes, at school, and in the community.

"Safety Town is the bridge between what we as parents want to teach our kids and what is learned through life experiences and school… What an excellent resource!" said Kari Peterson of Luxemburg, parent of a Safety Town attendee.

This program offers children a classroom segment as well as a hands-on experience on the streets of the specially designed, child-sized Safety Town. With the help of trained safety professionals from throughout the community, children are taught to evaluate "safe from unsafe" and learn how to react safely when confronted with potentially dangerous situations. The children are put through a variety of simulated situations such as how to escape a house fire, how to safely cross a street, playground safety, and avoiding poisonous substances in the home. The kids who participate, and especially their parents, see the huge difference it makes in their lives.

"Safety Town thoroughly covers all the different areas that children this age need to be aware of—and in a manner that is easy for them to understand," said Angie R, a parent whose child learned to stay safe at Safety Town.

The Center also has developed programs to keep infants and teens safe. The Safe Sleep

Summer program participants drive through the streets of the miniature Safety Town.

A teen volunteer teaches a Safety Town participant about road rules and safety.

Community Collaborative is a partnership with other Brown County nonprofit and public agencies that focuses on one-on-one parent education and public awareness, and provides complimentary pack-n-plays to prevent deaths and injuries related to Sudden Infant Death Syndrome and unsafe sleep practices.

Teens learn about safe driving through events and activities in the Motor Vehicle Safety program. Using the proven curriculums of "Countdown to Drive," "Every 15 Minutes" and "Celebrate My Drive," youth learn about the avoidance of high-risk behaviors related to texting/distracted driving and drunken driving.

The demand for CCS's services has increased over the years and continues to grow. As the Center has expanded, Dr Haugan has remained actively involved.

"Dr Haugan has never wavered in his support for the organization that he founded. He has led the organization as President of the Board of Directors through funding and staff changes, is a tireless fund- and 'friend'-raiser and attends the monthly board meetings on his day off," said Kristin Bouchard, chair of the Center's Board of Directors.

> "The greatest single health threat facing kids today is unintentional injury. Every year more kids die of that than of the combined total of homicide, suicide, genetic defect, pulmonary disease, cardiac disease, cancer and AIDS."
> —Gordon Haugen, MD

Despite the praise from Bouchard, Dr Haugan is quick to point out that the Center has many volunteers and partners who help make the Center a success, as well as generous benefactors year after year who help cover program expenses, allowing them to be offered free or at low cost.

"It takes significant resources to reach children and families living in Green Bay and the surrounding area and that amount increases every year," said Haugan.

To help ensure CCS has annual resources now and in the future to continue its life-saving mission, a special endowment fund has been established. The goal is to build this fund to at least $250,000 within the next year. Haugan's new dream is to make the Center even better and bigger by developing a permanent Safety Town that could be used all year around instead of just during the week-long summer session.

"I would love to see us have a Safety Town that is like the one they have in Naperville, Illinois, with full-size stoplights, railroad crossings, and other features that make it more realistic and fun for the kids," he said.

When nominating Dr Haugan for the Society Physician Citizen of the Year Award, Prevea Health President and CEO Ashok Rai, MD, said, "Dr Haugan broadened his commitment to the well-being of children beyond the walls of the clinic." That has been proven thousands of time over with each child who participates in one of the Center's programs and is kept safer at home, school and play because of it.

To learn more about the programs offered by the Center for Childhood Safety visit http://centerforchildhoodsafety.org.

Data Sharing Needed to Increase Quality and Decrease Costs

John J. Frey III, MD, Medical Editor

Immunizations are primary prevention. We all learned that in medical school. The first regularly recommended immunizations were against early 20th century killers like diphtheria, pertussis, and tetanus. They were successful for a variety of reasons, not the least of which was that universal immunization was a public health campaign that worked. Photos from the 1930s in the heart of the Depression show lines of kids presenting their arms for the shot or squirming away from the needles. During my clinical lifetime, we have seen the disappearance of polio, measles, rubella, *H influenzae* meningitis, and significant decreases in other communicable diseases. Younger doctors—those under 50—almost forget why we immunize patients against many diseases, since in many cases it is the consequences of those diseases rather than the diseases themselves that are the rationale for immunization. They not only have never seen the disease, but they have not seen the consequences.

Having a record of immunizations is crucial for both individual health and "herd immunity" and we see how cracks in universal immunizations have led to outbreaks of pertussis, measles and other, now rare infections. When we all carried around little folded paper records of immunizations that had been received from a number of sources, the portability was great and it led to real communication between public health clinics and practices. Now with the onset of electronic data collection, we have new challenges. Patients don't carry their own records; they rely on their doctors and the data systems to do that. But those data systems contain human flaws that require both fixes to the technical process and assurance that the human beings entering data into systems are doing it correctly. Mistakes lead to either under- or over-immunization. The latter creates unnecessary costs, while the former creates gaps that could lead to serious health consequences.

Younger doctors—those under 50—almost forget why we immunize patients against many diseases, since in many cases it is the consequences of those diseases rather than the diseases themselves that are the rationale for immunization. They not only have never seen the disease, but they have not seen the consequences.

While electronic health records (EHRs) offer the opportunity to improve population management for chronic disease,[1] they are not convincingly better on day-to-day quality.[2] However, accurate universal reporting of immunization records may be the only current system of sharing electronic health information that works. If immunizations can be shared across platforms, why can't other medical information equally crucial to health? Until that happens, maybe we all should carry with us little books with our health records and medications should we wander outside of our insurance network.

Which leads us to the article in this issue of the *WMJ* by Schauer and colleagues comparing 2 methods of collecting immunization records—batched and real time.[3] As one might suspect, the winner is real time, when data is entered at the time of the visit and leads to an increase in documentation and completeness. While the evidence for increased quality is conclusive, the authors leave readers with a sobering thought: as more practices adopt electronic record systems, the statewide system of immunization recording and medical practices' electronic systems must talk with each other or the whole process falls apart.

The Wisconsin Pharmacy Quality Collaborative is a program of the Pharmacy Society of Wisconsin that received an Innovation Award from Centers for Medicare & Medicaid Services to improve medication management for the people of Wisconsin. The special article in this issue of the *WMJ* describes the project and its goals and makes the case—if one still needs to be made—that pharmacists will play a crucial role in improving quality and decreasing costs of care through collaboration with patients and physicians.[4] Having expressed skepticism about the potential for EHRs to address quality and cost, I have no doubt that getting pharmacists more engaged with patient care can only add value to a system of medication management. And data from electronic health records are essential to

the process. Keeping accurate medication lists will let pharmacists help us manage potential drug interactions, polypharmacy,[5] and chronic diseases.[6] The Collaborative needs physician involvement and commitment to make it work for everyone.

Lundin and her colleagues report on a large case series of enucleations resulting from trauma and found that young men were overwhelmingly the victims, assault was the primary cause, and the chief method of assault was guns.[7] Other countries have far less trauma from guns as the reason for posttraumatic enucleation. Perhaps the most prescient article from a series during the Lebanese civil war recommended, "Wearing special glasses and imposing an international arms embargo are recommended to decrease ocular injuries and blinding consequences in potential future wars."[8]

The movement of diseases around the world can be human-borne, vector-borne, or both. In a review of another tick-borne disease in the upper Midwest, Schotthoefer and her colleagues from Marshfield clinic[9] do a fine job of explaining the story of the spread of anaplasmosis, describing its presentation and outlining recommendations for treatment. Just in time for summer!

Our case reports in this issue highlight a frightening case of a man who almost died from an intercostal artery rupture, which is not a source one thinks of for a hemothorax without obvious trauma,[10] and a case of a very nasty scalp condition that, when successfully diagnosed and treated, will save the patient a lifetime of suffering.[11]

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The Wisconsin Pharmacy Quality Collaborative—A Team-Based Approach to Optimizing Medication Therapy Outcomes

Erika Horstmann, PharmD; Kari Trapskin, PharmD; Mark V. Wegner, MD, MPH

ABSTRACT

The Wisconsin Pharmacy Quality Collaborative is an initiative of the Pharmacy Society of Wisconsin, which connects community pharmacists with patients, physicians, and health plans to improve the quality and reduce the cost of medication use across Wisconsin. In 2012, the Pharmacy Society of Wisconsin received a $4.1 million Health Care Innovation Award from the Centers for Medicare and Medicaid Services to expand the Wisconsin Pharmacy Quality Collaborative statewide. The aims of the Health Care Innovation Award are to help reduce health care costs in Wisconsin by over $20 million and improve health and health outcomes during the 3-year project period. Methods include implementing a redesign of community pharmacy practices and facilitating medication management services, which include intervention-based services and comprehensive medication review and assessment visits for eligible commercial and Wisconsin Medicaid members. The goals of the project are to: (1) improve medication use among participating patients; (2) improve patient safety; (3) reduce health care costs for participating patients and payers; and (4) establish partnerships between pharmacists and physicians to enhance health outcomes.

Wisconsin Pharmacy Quality Collaborative Creation and Goals

Pharmacy practice today reaches far beyond the traditional role of dispensing. Pharmacists are trained to become integral members of the health care team, specializing in medication management to improve collaboratively clinical outcomes for patients. Numerous studies have showcased the financial benefit of this approach, not only to the patient, but also to the health care system.[1-4]

The Wisconsin Pharmacy Quality Collaborative (WPQC), an initiative created in 2007 by the Pharmacy Society of Wisconsin (PSW), has established a uniform set of pharmacist-provided medication therapy management (MTM) services and a quality credentialing process through a collaborative venture between third-party payers (health plans, employers, and government agencies) and pharmacy providers in the state. WPQC coordinates a network of pharmacies with certified pharmacists who have received specific MTM training. WPQC pharmacists meet privately with patients to review medication regimens, communicate potential opportunities to improve medication use with physicians and other health care providers, and educate patients on the appropriate use of their medications. WPQC's medication use and safety goals are to resolve drug therapy problems, improve adherence and coordination of care, and engage patients in their own care. For these goals to be realized, WPQC depends upon the development of relationships within the health care team to encourage referrals for WPQC services and to enhance health outcomes.

WPQC Services

WPQC takes a collaborative approach to health care in Wisconsin. Pharmacists are eager to partner and collaborate with physicians and other health professionals across the state to complement the quality of care patients receive and to assist with the management of difficult medication-related cases. A WPQC pharmacist can provide 2 levels of MTM services to patients: (1) intervention-based services, and (2) comprehensive medication review and assessment (CMR/A) services.

Intervention-based services, commonly referred to as Level I services, typically are conducted within a pharmacy's workflow and focus on optimizing drug therapy. Examples include medication adherence consultation, dose optimization (based on age, organ function, cost, dosage form, etc), and medication device instruction. All pharmacist-initiated interventions, except medication device instruction and adherence consultation, involve contacting the patient's physician or other health care provider for authorization if a change in the prescription regimen is recommended. *Pharmacists cannot make any changes without the approval of the patient's physician or other health care provider.* After receiving approval, the pharmacist coordinates the changes.

• • •

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Box 1. Wisconsin Pharmacy Quality Collaborative Clinical Advisory Group Members[a]

Asthma

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Cheryl Franz, RN, BSN, CDE, UW Health Medical Foundation, Madison, Wis
Denise Walbrandt-Pigarelli, PharmD, BC-ADM 2, UW School of Pharmacy, Madison, Wis

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Katie Valdovinos, PharmD, BCPS, Concordia University Wisconsin School of Pharmacy, Mequon, Wis

Adherence

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Health Literacy

Steve Sparks, Health Literacy Wisconsin, Madison, Wis

[a] These individuals are expert faculty and/or clinicians and represent the conditions and areas the WPQC program focuses on.

Box 2. Patient Referral Criteria for Wisconsin Pharmacy Quality Collaborative (WPQC) Comprehensive Medication Review

Patient has prescription insurance through one of the following:
Wisconsin ForwardHealth (Medicaid and SeniorCare)
Unity Health Insurance
UnitedHealthcare Wisconsin

Any patient with the above health insurance plans referred by a physician is likely eligible for WPQC services. WPQC pharmacists can help confirm eligibility.

Any patient who meets the above criteria can be referred for WPQC services. However, patients with the following conditions or circumstances are likely to benefit most from a comprehensive medication review and assessment:
Multiple medications to treat or prevent chronic conditions
Receives prescriptions from multiple providers
Recent discharge from the hospital or long term care setting
Poor health literacy

To refer a patient for a Comprehensive Medication Review, physicians should call or fax orders to a WPQC-accredited pharmacy. WPQC pharmacies can be located at www.pswi.org/wpqc or by calling the Pharmacy Society of Wisconsin at 608.827.9200.

Information provided or obtained during medication device instruction and adherence consultation services also is communicated to the patient's physician or other health care provider.

CMR/A visits, commonly referred to as Level II services, typically consist of a private face-to-face visit between the pharmacist and the patient (and/or sometimes the patient's caregiver or advocate). During the visit, the pharmacist gathers and reviews the patient's full medication list including over-the-counter medications, supplements, mail order medications, and samples. The pharmacist assesses health literacy, addresses adherence issues and patient concerns while reinforcing self-monitoring techniques. At the visit's conclusion, patients receive a Personal Medication List—a complete updated list of their medications—and a Medication Action Plan that is based on goals discussed during the visit and coordination with the physician or other health care provider. The pharmacist contacts the patient's primary care provider (at a minimum) to discuss any pharmacist-identified recommendations and to provide a visit summary. When considered appropriate for the patient, 3 follow-up visits are allowed annually. Patients who qualify for a CMR/A service include those taking 4 or more prescription medications, people with diabetes, those with multiple prescribers, those discharged from the hospital or long term care facility within 14 days prior to being seen by the pharmacist, and those with poor health literacy. Additionally, physician referral automatically qualifies patients covered by participating health plans for WPQC MTM services. Even if patients do not meet WPQC's standard eligibility criteria, physicians are encouraged to refer those patients they feel would benefit from these visits. CMR/A visits can be conducted at any time, whether prior to or following regularly scheduled physician visits.

RESULTS

Until recently, WPQC was concentrated in south-central Wisconsin due to the location of the participating health plans. However, in July 2012, PSW was awarded a 3-year, $4.1 million Health Care Innovation Award (HCIA) from the Centers for Medicare and Medicaid Services to expand WPQC statewide. The suboptimal use of prescription drugs is estimated to cost $290 billion nationwide.[5] Via WPQC, MTM services are being provided to patients statewide and, by enhancing team-based care, Wisconsin will be poised to achieve a significant reduction in health care costs.

During the 18-month pilot phase of WPQC in 2008-2010, Unity Health Insurance and Group Health Cooperative of South Central Wisconsin realized between a 5:1 and 10:1 return on investment (ROI) for services that directly affected medication cost. In addition, patients who received WPQC services saved on average $25.34 per prescription. Types of services included adherence to payer medication formularies when clinically appropriate, which has allowed continued payer support of the program. Additionally, it is assumed that patient access

to medications that cost less out-of-pocket contributes to increased adherence to medication regimens. Efforts are ongoing to investigate the longer-term outcomes and ROI anticipated from the other Level I and Level II services. Even when assuming no health care savings from the comprehensive medication reviews performed, the ROI was maintained at 2.5:1.[6]

While pharmacists have contributed extensively to the health care delivery system, there is room to further complement the busy physician's practice in an effort to impact patient care. Over the 3-year grant cycle, WPQC aims to retool the roles of community pharmacists to serve as medication therapy managers, enhance participant engagement in their care, improve medication use by participants, and reduce prescription drug costs for participants and health plans.

To meet these goals, the WPQC program set quality standards for participating pharmacies to become accredited as WPQC medication therapy management centers. Pharmacies are audited routinely to ensure they are meeting these standards. They are also responsible for creating policies and procedures that contain best practices for maximizing patient safety in the medication use process and ensuring the delivery of quality health care.

WPQC grant metrics are designed to evaluate both health care utilization and clinical outcomes subsequent to pharmacist intervention. Additionally, medication use measures will determine whether pharmacists are affecting care by improving medication adherence and coordinating with physicians to optimize medication regimens based on clinical guidelines.

For example, WPQC hopes to reduce asthma exacerbation rates during the grant period. Pharmacists will meet with patients who have asthma to ensure they are not using rescue medications excessively, are adherent to prescribed controller therapies, and know how to properly use their medication devices. This interaction may lead not only to a reduction in emergency department visits, but also to improvement of medication adherence rates and overall patient care.

To support these efforts, the WPQC program has a Clinical Advisory Group (CAG) comprised of experts in the areas of asthma, diabetes, geriatrics, heart failure, adherence and health literacy. These conditions were selected as areas of focus for the HCIA grant because they often involve high-risk patients with complicated medication regimens. CAG members hail from different health care backgrounds: physicians, pharmacists, and nurses. They are poised to ensure the WPQC clinical content is current, evidence-based, and outcomes-oriented. They also provide pertinent education and training as well as outreach for the program (Box 1).

Eligibility

Health plans that have joined WPQC and are compensating pharmacies for MTM services include Unity Health Insurance (prescription insurance members only), Network Health (commercial members only), United Healthcare Wisconsin (commercial, fully insured members only), and Wisconsin ForwardHealth, Medicaid and SeniorCare. Health plan participation has allowed WPQC pharmacies throughout the state to partner with physicians to serve as valuable medication management centers. Additionally, United Way of Dane County has partnered with WPQC since November 2011 to support low-income geriatric patients at risk of falls and adverse drug events. Since November 2011, over 500 geriatric patients in Dane County have received a comprehensive medication review service from a WPQC-certified pharmacist. In addition to supporting the provision of comprehensive medication reviews for these patients, United Way of Dane County has also supported partnerships with Home Health United's SAFE (Safety Assessments for the Elderly) program and Dane County senior centers, where many of the reviews occurred.

It is important to note that the partnership between the pharmacist and the physician or other health care provider is meant to complement the care provided, and not put the pharmacist in a primary care role. In all cases, the health care provider will be notified when a WPQC service has been performed. The patient's physician always retains the authority to decide which recommended changes are to be implemented.

The increased focus on quality improvement within the health care system makes adopting practices such as pharmacist-provided MTM even more valuable. For example, there are numerous measures within the Physician Quality Reporting System (PQRS) and the Wisconsin Collaborative on Healthcare Quality (WCHQ) that are medication-related. WPQC aims to assist with physician achievement and maintenance of these and other important metrics. With pharmacists more fully integrated into the medical care team, health systems can more effectively decrease variation in services and can increase the use of some services that are currently underutilized. In one study, a group of 26 community-based pharmacies worked collaboratively with physicians to promote compliance with hyperlipidemia therapy and reduce cholesterol levels. In 397 patients, 90.1% of patients were compliant with their medication therapy and 62.5% reached their National Cholesterol Education Program (NCEP) lipid goal by the end of the study.[7]

Furthermore, as more health systems become Accountable Care Organizations, the pharmacist-delivered MTM model can help drive cost savings and result in more efficient health care delivery. It may be feasible to look at the WPQC pharmacy network as part of an Accountable Care Community, in which cost savings and improved health care utilization are shared goals. The MTM model can help mitigate some of the most common barriers to successful patient care transitions post hospitalization, such as lack of standardization and time, patient confusion about current medications, new patients with no previous information on file, missing information, and primary care providers unaware of hospitalizations or medication changes.

Through WPQC, patients being discharged from the hospital or long term care setting are eligible to receive a CMR/A at no cost if they are seen by the pharmacist within 14 days of discharge. During a medication reconciliation-focused CMR/A, the pharmacist reconciles discharge medications, ensures the patient has the correct medications at the correct doses and knows how and when to take them, assists with disposal

Referring Patients to a WPQC Pharmacy

Physician Referral is an automatic qualifier for WPQC services for patients covered by participating health plans. Health care prescribers are encouraged to refer any patient they feel would benefit. Simply call in a verbal order or fax an order to a WPQC-accredited pharmacy requesting the patient's insurance coverage be evaluated for the potential to receive a covered comprehensive medication review and assessment.

To find a WPQC Pharmacy near you, visit www.pswi.org/wpqc.

of discontinued medications to reduce potential confusion, ensures all health conditions are being treated, and reinforces the importance of adherence to prescribed medications and self-monitoring techniques.

Soon, over 50% of Wisconsin community pharmacies will be participating in WPQC and there will be a WPQC pharmacy in almost every county in the state. Participating pharmacies can be accessed on the PSW website: www.pswi.org/wpqc. These pharmacies have transitioned to medication therapy management centers and are eager to partner with health care providers to complement medical practices and improve patient care.

How to Participate

All physicians are strongly encouraged to participate in this effective and cost-saving community-based initiative by referring patients as appropriate (Box 2). The process for referring a patient to a WPQC pharmacy involves simply faxing or calling an order for a comprehensive medication review and assessment to a WPQC-accredited pharmacy. To identify patients covered by participating health plans, it may be most effective to establish relationships with the WPQC pharmacies in the area. The WPQC pharmacist can help physicians identify which of their patients are utilizing that pharmacy. Additionally, WPQC pharmacists are available to meet with physicians and clinic staff to briefly describe the program and help determine the most efficient way to implement the referral and communication process.

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Ocular Trauma Resulting in Enucleation: A 12-year Experience From a Large Regional Institution

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ABSTRACT

Purpose: To review the frequency and cause of traumatic enucleation at the University of Wisconsin.

Methods: A 12-year retrospective chart review (2000-2012) from the University of Wisconsin Hospital and Clinics of patients who underwent enucleation following ocular trauma with specimens submitted to the University of Wisconsin Eye Pathology Laboratory.

Results: A total of 188 eyes enucleated following ocular trauma were identified between 2000 and 2012. One hundred eleven (59%) cases had an identifiable mechanism of injury recorded in the medical record and were included in the final analysis. The overall median patient age was 41 years with 83.8% male. Assault was the most common reason for enucleation (n = 30, 27.0%) of which 15 (13.5%) cases were related to gunshot wounds. Other causes included outdoor or recreational activities (n = 20, 18.0%), fall (n = 14, 12.6%), non-motor vehicle accidents (n = 6, 5.5%), motor vehicle accidents (n = 15, 13.5%), work-related injury (n = 15, 13.5%), and sports-related injury (n = 11, 10%).

Conclusion: Assault is the most common cause of traumatic ocular injury leading to enucleation. Gunshot and stab wounds were responsible for the majority of these cases. Men were much more likely to undergo enucleation due to ocular trauma with the exception being that caused by falls, where the rate was nearly equal between men and women.

INTRODUCTION

Trauma is a significant source of ocular injury in the United States, with approximately 2.4 million eye injuries and 40,000 patients suffering traumatic visual impairment annually.[1]

Unfortunately, enucleation is an occasionally unavoidable outcome following traumatic ocular injury. Several studies have examined the epidemiology of severe ocular injury and have shown young males to be at high risk.[2-6] Assault, motor vehicle accident (MVA), task-related (including workplace, travel), recreation, and falls have all been noted as significant causes of ocular injury.[2] Sharp objects (broken glass, knives, metal), blunt objects (fists, sports balls), and projectiles have all been implicated in severe ocular injury as well.[2,3,6]

The economic impact of enucleation is enormous. The National Safety Council estimates that job-related eye trauma costs amount to $300 million annually. This figure includes medical and hospital bills, worker's compensation, and lost production time.[7]

METHODS

After obtaining institutional review board (IRB) approval and ensuring HIPAA compliance, a review of all ocular pathology charts was conducted to identify which patients underwent enucleation with histopathologic analysis performed at the University of Wisconsin Eye Pathology Laboratory between July 2000 and December 2012. One hundred eighty-eight patients were identified who underwent enucleation following ocular trauma. Analysis was completed in 111 patients who had information recorded in the electronic medical record as to the cause of ocular injury. Patients were excluded if there was no history of trauma reported or if the cause of traumatic ocular injury was unknown.

The variables included in our study were patient age, gender, and cause of ocular trauma. Enucleated eyes were separated into the following categories based on the nature of trauma and the surrounding circumstances: assault, outdoor/recreational activity, fall/accident, motor vehicle accident, work-related injury, and sports-related trauma. We examined traumatic enucleation related to guns and falls separately.

RESULTS

A total of 188 eyes that were enucleated following ocular trauma were evaluated at the University of Wisconsin Hospital Eye Pathology Laboratory in a 12-year period between July 2000 and December 2012. Approximately 90% of all specimens received

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Table 1. Traumatic Ocular Injury: Mechanism and Object

Mechanism	N (%)	Mean Age	% Male	Object of injury	n (%)	% Male
Assault	30 (27.0)	34.2	96.7	Gunshot wound	15 (50)	93.3
				Knife/stab[a]	8 (26.7)	100
				Glass bottle (blunt)	1 (3.3)	100
				Fist	5 (16.7)	100
				Baseball bat to head	1 (3.3)	100
Outdoor/ Recreational Activity	20 (18.0)	40.6	90.0	BB gun/potato gun/ pellet gun	11 (55.0)	90.1
				Tree branch trauma	4 (20.0)	100
				Lawn mower rock	2 (10.0)	50
				All terrain vehicle accident	1 (5.0)	100
				Firework/bottle rocket	2 (10.0)	100
Fall/Accident	20 (18.0)	52.7	60	Fall	14 (70.0)	57.1
				Walker handle	1 (5.0)	0
				Cupboard door	1 (5.0)	0
				Bungee cord	4 (20.0)	100
Motor Vehicle Accident	15 (13.5)	44.0	86.7	Unknown	15 (100)	86.7
Work-related	15 (13.5)	42.6	86.7	Trauma with pipe/hose	5 (33.2)	100
				Nail injury	2 (13.2)	100
				Farming accident (unspecified)	1 (6.7)	100
				Crush injury	1 (6.7)	100
				Shovel	1 (6.7)	100
				Exposure		
	1 (6.7)	0				
				Attacked by animal—pig	1 (6.7)	0
				Tractor jack	1 (6.7)	100
				Wood fragment	1 (6.7)	100
				Metal	1 (6.7)	100
Sports-related	11 (10.0)	39.5	72.7	Softball	2 (18.1)	100
				Hockey puck	1 (9.1)	100
				Paintball	1 (9.1)	0
				Arrow	1 (9.1)	100
				Fishing-related	5 (45.5)	60
				Ski pole	1 (9.1)	100

[a]Trauma was induced with a knife in 6 cases, and in 2 cases with sharp glass from a broken bottle.

at the University of Wisconsin Eye Pathology Laboratory were submitted by Wisconsin ophthalmologists. Ten percent of all specimens were submitted by ophthalmologists in other states as the University of Wisconsin Eye Pathology Laboratory is a referral center for several other institutions throughout the country. Review of these 188 cases revealed 111 (59%) cases with an identifiable cause and object of injury. The median age for the cohort was 41 years (range 9-91 years) with 92 (83.8%) male. The median age of female patients was 62 years (range 12-91years), and the median age of male patients was 37 years (range 9-73).

Overall, assault was the most common underlying reason for enucleation (n = 30, 27.0%). Males represented 96.7% of patients in this group. The majority of violence-associated injuries were gunshot (n = 15, 13.5%) and stab wounds (n = 8, 7.2%). Other cases included outdoor/recreational activities (n = 20, 18.0%) and falls/accidents (n = 20, 18.0%). Motor vehicle accidents (n = 15, 13.5%), work-related injuries (n = 15, 13.5%), and sports-related injuries (n = 11, 10.0%) also were seen (Table 1). A separate analysis of gun-related injuries (including gunshot wounds, BB guns, pellet guns, and paintball guns) revealed a total of 26 cases representing 23.4% of all cases. Most (92.3%) gunshot wounds occurred in male patients. Falls represented 14 cases (12.6%), with nearly half (42.9%) occurring in females.

DISCUSSION

Assault was the most common cause of traumatic enucleation, with gunshot wounds and knife/stab wounds representing the majority of cases. This is consistent with the findings of Freitag, et al.[8] Other studies have shown work-related[3] and home-related[6] injuries to be the most common activity leading to enucleation.

Assault-related enucleation was approximately 30 times more common in males than females (29 males, 1 female) in our study. This is consistent with several other published studies in which males were far more likely to suffer traumatic enucleation than females.[2,3,5,6,9]

The only area where females nearly equaled that of males was in the fall category, in which 57.1% of patients were male and 42.9% were female. It is notable that females in this category were older than their male counterparts (62 years vs 37 years). Elderly patients are at high risk for falls.[10] The medical implications of falls including fractures, intracranial hemorrhages, and post fall anxiety are well known.[11-13] Smith, et al[2] also found older patients more likely to suffer severe ocular injury due to falls, but did not comment on whether or not there was a gender discrepancy. Our study demonstrates the risk of severe ocular injury resulting in enucleation in elderly patients after a fall. Ocular injury or loss of an eye may place them at an even greater risk for subsequent falls.

Many studies have found sports-related ocular injury to a common pediatric problem.[14-16] Patients who underwent enucleation resulting from sports-related trauma were older in our study than in a study by Patel et al[5] (39.5 vs < 16 years). Interestingly, there were relatively few sports-related ocular injuries in our study when compared to other categories. It is possible that more people are wearing eye protection while engaging in sports activities. Our study did not establish the presence of eye protection at the time of injury.

This study is limited by its retrospective nature, relatively small size, and recording bias. Also, the University of Wisconsin Hospital is a tertiary referral center. It is possible that the injuries seen in our study are more severe than those typically seen in other areas.

CONCLUSION

Trauma is a significant source of severe ocular injury that may lead to enucleation. Assault was the overall leading cause of traumatic ocular injury in our study. Gunshot and stab wounds were responsible for the majority of these cases. Men were much more likely to undergo enucleation following ocular trauma and they were significantly younger than women. Females were more likely to undergo enucleation after a fall than any other trauma. Sports-related ocular injuries may occur at any age.

Additional work in public education regarding causes of ocular injury and the value of eye protection may be beneficial. A low threshold for emergent referral of patients to those experienced in treating these injuries should be instituted when ocular injury occurs.

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The Wisconsin Immunization Registry Experience: Comparing Real-time and Batched File Submissions From Health Care Providers

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ABSTRACT

Context: The Wisconsin Immunization Registry is a confidential, web-based system used since 1999 as a centralized repository of immunization information for Wisconsin residents.

Objective: Provide evidence based on Registry experiences with electronic data exchange, comparing the benefits and drawbacks of using the Health Level 7 standard, including the option for real time data exchange vs the flat file method.

Design: For data regarding vaccinations received by children aged 4 months through 6 years with Wisconsin addresses that were submitted to the Registry during 2010 and 2011, data timeliness (days from vaccine administration to date information was received) and completeness (percentage of records received that include core data elements for electronic storage) were compared by file submission method.

Results: Data submitted using Health Level 7 were substantially more timely than data submitted using the flat file method. Additionally, data submitted using Health Level 7 were substantially more complete for each of the core elements compared to flat file submission.

Conclusions: Health care organizations that submit electronic data to immunization information systems should be aware that the technical decision to use the Health Level 7 format, particularly if real-time data exchange is employed, can result in more timely and accurate data. This will assist clinicians in adhering to the Advisory Committee on Immunization Practices schedule and reducing over-immunization.

BACKGROUND

Immunization information systems (IIS) have been used since the 1990s to serve as central repositories of immunization information. The primary foci of IIS use include sharing immunization data among health care entities and serving as a mechanism for immunizers to determine current and future vaccination needs. As of 2009, 56 federal grantees in the United States (includes states, territories, and select cities) have an IIS.[1] The Centers for Disease Control and Prevention (CDC) Healthy People 2010 Initiative encouraged direct data entry of immunization information by state and local public health departments and was the impetus to create links between the IIS and state vital records systems, thereby systematically populating the IIS with vital records data for each new birth cohort. Subsequently, private health care providers became the focus of outreach activities to provide immunization data for individuals, particularly as electronic medical/health records (EMR/EHR) become more commonly used. This new focus has resulted in the need for health care providers to be included in technical decisions regarding EMR/EHR and IIS because information exchange between these 2 systems can have clinical implications.

One important consideration is the format (standard) for securely and accurately sending health data between an electronic health data system and an IIS. There are currently 2 main standards used to send the message or, more specifically, arrange the message so all the different pieces are received and accurately read by the receiver. These standards are ASCII flat file (flat file) and the worldwide standard Health Level 7 (HL7). These 2 standards differ in their flexibility and the timeliness and completeness of data transmitted.

The initial format available for data exchange when the *Wisconsin Immunization Registry* (WIR) was launched was ASCII flat file, an older format with a relatively rigid structure. These files typically are submitted by health care providers on a weekly, monthly or quarterly basis. During 2001, the WIR also began accepting HL7 messages. The HL7 standard was created in 2001

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by a technical working group of the National Immunization Program, with the goal of providing a standard for the exchange of data that eliminates or substantially reduces the custom interface programming and program maintenance that may otherwise be required.[2] Since May 2002, the WIR has had HL7 real-time data exchange capability, which allows an EMR/EHR to communicate in real time with the WIR and update both systems immediately with the newly added information. Currently, the WIR supports data exchange using HL7 versions 2.3.1, 2.4 and 2.5.1.[3,4]

While the decision regarding which mechanism to use appears to be primarily one of a technical nature, it has clinical and technical implications that health care entities need to consider. Accordingly, in this report we provide evidence based on WIR experiences regarding the benefits and drawbacks of using the standard of HL7 for data submission compared to flat file data submission.

Table 1. Completeness of Data Submitted to the Wisconsin Immunization Registry by Submission Method, January 1, 2010 through December 31, 2010

	Percentage of Immunization Records with Data Submitted by Method Used	
Data Field[a]	**Flat File**	**HL7**
Date of administration	100%	100%
Vaccine group	100%	100%
CPT code	85%	96%
Vaccine manufacturer	47%	62%
Trade name	37%	42%
Vaccine lot number	26%	63%
Route of injection (eg, intramuscular or subcutaneous)	9%	96%
Body site (eg, left deltoid)	7%	91%
Vaccines for Children eligibility	0%	95%
Dose size	0%	100%
Administering physician	3%	57%

[a]Required fields include the date of administration, vaccine group or CPT code.
Abbreviations = HL7, Health Level 7; CPT, Current Procedural Terminology.

MATERIALS AND METHODS

Data from the WIR were extracted using Business Objects version 11.5 (SAP Business Objects, San Jose, California) in March 2011 and in December 2011. We defined an immunization record to be the record representing 1 administration of a vaccine to an individual. Thus, an individual who received 3 separate vaccinations during a single clinic visit would have 3 separate immunization records for that immunization encounter. To maximize completeness of data, all immunization records received by the WIR during calendar year 2010, regardless of when the vaccines were administered, were included in the analysis. Data elements examined included date of administration, vaccine group, Current Procedural Terminology (CPT) code, vaccine manufacturer, trade name, vaccine lot number, route of injection, body site, Vaccines for Children eligibility of the client (federal entitlement program), dose size, and administering physician. Immunization records were separated based on the method of submission (HL7 or flat file) and the percentage of immunizations that had a particular data element (eg, vaccine lot number) recorded in the WIR was calculated for each submission method.

The analysis of the timeliness of data submission was based on immunizations administered during January 1, 2010, through December 31, 2011 to children aged 4 months through 6 years with Wisconsin addresses. For each vaccination, the difference in the number of days from the date the vaccine was administered to the date the immunization was successfully submitted by the provider to the WIR was calculated for each method of submission.

RESULTS

Data Submission Methods

Among data exchange methods supported by the WIR, flat file was the most commonly used. Of the approximately 20.81 million immunization records for children aged 4 months through 6 years with Wisconsin addresses that were processed by the WIR during 2010, approximately 11.87 million (57%) were provided using a flat file format and 8.94 million (43%) were provided using the HL7 format. Of those submitted using HL7, approximately 1.53 million (17%) were sent using a real-time interface. Of the approximately 18.92 million immunization records processed by the WIR during 2011, 7.61 million (40%) were provided using a flat file format and 11.31 million (60%) were provided using the HL7 format. Of those submitted using HL7, approximately 3.06 million (37%) were sent using a real-time interface. The decrease in total number of records submitted during 2011 (18.92 million), compared to 2010 (20.81 million) was likely a result of the influenza H1N1 vaccination campaign that evolved during the 2009 pandemic, which added a significant number of immunizations (monovalent H1N1 vaccine) during 2010 that typically are not given.

Completeness of Data

While both flat file and HL7 have the capability to transmit all the same immunization record data fields, such as the vaccine lot number and the site of injection, data received during 2010 using HL7 were substantially more complete. Both types of submissions supplied a date of administration and the vaccine group for 100% of doses, while data in fields such as the route of injection (eg, intramuscularly or subcutaneously) or the body site (eg, left deltoid) were supplied for 96% and 91% of doses, respectively, using HL7 and only 9% and 7% of doses, respectively, using the flat file (Table 1). Additionally, vaccine lot number was supplied for only 26% of the doses using flat file, compared to 63% of doses for HL7.

Table 2. Comparison of HL7 and Flat File Data Submission to the Wisconsin Immunization Registry (WIR), January 1, 2010 through December 31, 2011

	Flat File		HL7	
	2010	2011	2010	2011
Individual Immunization Records Received by the WIR[a]	11.87M (57)	7.61M (43)	8.94M (43)	11.31M (57)
Time from Date of Vaccination to Date WIR Received the Information:	**Percentage of Immunization Records Received[b]**			
Same Calendar Day	0	0	10	23
Within 1 Calendar Day	8	5	8	17
2-7 Days	53	25	70	36
8-30 Days	27	21	6	11
>30 Days	12	49	6	13

Table shows the percentage of individual immunization records for children aged 4 months through 6 years received by the WIR by method of submission and the number of days after vaccination administration.
[a]Number of immunization records received by the WIR to the nearest 100,000 (M= million, percentages of yearly total in parentheses).
[b]Percentage of immunization records received by method of submission (flat file and HL7) and year. Column percentages add up to 100%.
Abbreviations = HL7, Health Level 7.

Timeliness

Reducing the interval from the time of administration of a vaccine to the time when the record is successfully entered into an IIS is a continued focus of the WIR. During 2010 and 2011, the timeliness of data submitted to the WIR using HL7 was substantially greater than the timeliness using flat file submission. Among the immunization records submitted to the WIR during 2010 using HL7, 18% were received within 1 calendar day of vaccine administration (primarily because of real-time data exchange), and 12% were received > 8 days following vaccination. In contrast, among the immunization records submitted during 2010 using flat file, only 8% were received within 1 calendar day of administration (0% on the same calendar day) and 39% were received >8 days following administration (Table 2). During 2011, 40% of records submitted using HL7 were received within 1 calendar day of vaccine administration (including 23% on the same calendar day) and 24% were received > 8 days after vaccination. In contrast, among the immunization records submitted during 2011 using flat file, only 5% were received within 1 day of vaccine administration and 70% were received > 8 days after vaccination (Table 2).

DISCUSSION

Use of Flat File Versus HL7

Many of the providers who were early users of the WIR provided data using the flat file format and have continued to do so. While there are significant advantages to switching to HL7 data submission, only several of the largest institutions have changed to HL7 thus far because it requires significant upfront resources. Formatting data into the flat file message requires limited technical expertise and can be done in a matter of hours. However, the change to HL7 requires a higher level of technical expertise to create and test the files and conduct maintenance. For example, updating HL7 messaging specifications likely will be an obstacle for those providers without an information technology department or a contract with an EMR/EHR vendor and for those who extract data from billing systems. Therefore, the flat file format continues to be the method used by many providers, particularly those with limited resources. Some of these financial obstacles are being addressed by federally funded "Meaningful Use" initiatives through the Medicaid and Medicare programs, which provide funding to health care providers who establish electronic interfaces with an IIS.[5] This funding has increased greatly the number of health care providers and EMR vendors interested and able to make changes regarding data submission to the WIR. Additionally, the Wisconsin Division of Public Health (WDPH) received an American Reinvestment and Recovery Act HITECH grant from the CDC, which provided Wisconsin with funds from 2010 to 2012 to assist providers and EMR/EHR vendors to make changes to facilitate bidirectional exchange of data using HL7.[5]

While the goal of ensuring all immunization providers are engaged in bidirectional, real-time data exchange with the WIR is desirable and health care providers and vendors are encouraged to consider these options, it is difficult to determine when this will be achieved, because progress depends on many different factors. Such factors include the organizations themselves (eg, whether they have interest and resources), the EMR/EHR vendor's willingness or ability to make changes, and the capacity of the WDPH to provide technical assistance and feedback to organizations. Additionally, the gold standard continues to change with the availability of new EMR and EHR products, the continual merging and evolution of health care providers and organizations, which includes changes in their information technology systems and priorities, and with continual updating of the HL-7 standards.

Completeness of Data

The WIR is compliant with the National Vaccine Advisory Committee specifications for electronically storing the 12 core data elements and requires certain data elements for all immunizations, such as date of vaccine administration and vaccine type/group (eg, DTaP), regardless of how the data are submitted.[6] However, other fields, such as manufacturer or body site of injection, are strongly recommended but not required.[5-7] While flat

file format can provide the same pieces of information as HL7, in practice this usually does not occur. One reason for this disparity is often the organizations that submit flat files are extracting the information from billing systems, and these systems may not collect all data elements. Additionally, billing systems often submit immunization data using CPT codes, which can lack specificity.[7] For example, the CPT code 90680 codes for 3 different categories: RotaShield, the no longer licensed tetravalent vaccine; RotaTeq, the currently licensed pentavalent vaccine, and the generic category "rotavirus" (Rotarix has its own CPT code). In these instances, the general vaccine group (ie, rotavirus) can be derived, but additional specific information regarding which vaccine was used is not available. This completeness of data is important to clinicians. For example, the Advisory Committee on Immunization Practices (ACIP) recommendations indicate that, when possible, doses of vaccine in a series come from the same manufacturer.[8] Additionally, having information such as lot number can facilitate identification of patients in the event of a vaccine recall.

Timeliness

Our findings demonstrate that immunization data submitted using HL7 are entered into the WIR in a more timely fashion because immunization data submitted using the flat file format usually are batched together and sent to the WIR by the health care provider on a routine schedule—daily, weekly, or monthly. While at least 76% of immunization data (88% in 2010 and 76% in 2011) were received within 7 days using HL7, only 61% or less (61% in 2010 and 30% in 2011) were received within 7 days using flat file. During 2011, 23% of immunization data submitted using HL7 were submitted on the same day as vaccine administration, compared to none submitted using flat files. This difference likely reflects the strength of the HL7 real-time option because immunization data submitted to the EMR/EHR are nearly simultaneously entered into the WIR. The increase from 10% in 2010 to 23% of immunization records received on the same calendar day as administration using HL7 messaging during 2011 also may be indicative of recent efforts to encourage use of the real time option among health care providers and organizations.

Notably, the percentage of immunization data submitted using flat file more than 30 days after administration increased from 12% in 2010 to 49% in 2011. This increase may be influenced by the type of organizations that continue to submit data using flat file. The organizations that are changing from flat file to HL7 submission tend to be those that administer the vaccines. Organizations that continue to submit data using flat file tend to be health maintenance organizations (HMOs) that do not administer vaccines, but compile immunization data from its associated health care providers. The HMOs often submit data to the WIR on a monthly basis. This is a concern because timeliness is a priority for the WIR. There is a greater likelihood of over-immunization which results in additional costs to providers and patients. Also, when a client is identified through reminder/recall efforts as needing an immunization based on a record that has not been updated in the WIR, it can be confusing to patients or their parents. Additionally, in Wisconsin there are school entry requirements for immunizations that include provisions for exclusion when children do not comply by the 30th day of school. Therefore, timeliness of data reporting to the WIR helps schools to ensure that children meet the requirements, and reduces the burden of waiting for this information to be reported to the school by the parent or health care provider.

Other Advantages of HL7

HL7 messaging provides several other advantages not available with flat file data exchange. For example, HL7 can provide a client's vaccine history and the forecast of future vaccinations needed back to an EHR/EMR. This allows the provider to use the updated information and determine, before the patient leaves the office, what vaccines are needed and when to schedule the patient's next immunization appointment. Additionally, HL7 provides unique identifier numbers for the health care provider, including a WIR assigned identifier number for the client and a unique identifier for each immunization. This information can be used by the provider's EMR/EHR to eliminate redundant duplicate data ("de-duplicate") from their client and immunization data, which results in more accurate, cleaner data for both the EMR/EHR and WIR, ensuring that there is only 1 record for each client. Providers who submit data using HL7 also can delete an erroneous immunization and replace it with correct information. Notably, the ability to provide authentication is available with HL7. This allows the submitting organization to provide additional information to the WIR, which creates a link between the clients and the submitting organizations in the WIR and allows a subunit within an organization (eg, the pediatric clinic instead of the entire organization) to determine and monitor clinic-specific immunization coverage levels and progress towards goals. This also allows identification of clients seen at a particular location or clinic who need immunizations. Finally, HL7 provides an inventory function that automatically adjusts the electronic vaccine inventory as doses are administered and therefore assists clinicians in maintaining their vaccine stock.

Disadvantages of HL7

While HL7 confers advantages over flat file, there are some drawbacks. For example, the HL7 standard often is called the "non-standard standard" because most commercial software packages do not conform precisely to the standard and have unique idiosyncrasies that require additional technical effort to properly format the data.[9] Health care providers can make choices regarding which optional data fields are submitted to the WIR, thus creat-

ing customized "packets" of information that may result in fewer of the recommended fields submitted to the WIR. This may, in part, have resulted in a recent trend noted in the WIR that as health care providers or clinics change from direct data entry to HL7 real-time interfaces, the data submitted is not as complete, with important information often missing including trade name and lot numbers. Accordingly, the WIR staff monitors this situation and works with providers and software vendors to encourage the collection and submission of data in all the recommended fields, instead of only the required fields.

CONCLUSIONS

The use of HL7 to submit data to IIS provides significant benefits when compared to flat file submission. This includes the ability to collect complete data and the option for real-time data submission, which has the advantage of substantially improved timeliness and an updated forecast of the vaccines recommended for a client. This assists clinicians in adhering to the ACIP schedule and reducing over-immunization. In addition, the use of HL7 provides nonmeasurable benefits, such as providing information back to an EMR for de-duplication and allowing providers to correct erroneous immunization data. Nonetheless, there are some important issues to consider such as cost and technical expertise needed for HL7-related implementation and ongoing support, and the effort needed to ensure data submitted using HL7 is complete in all necessary data fields and is kept up-to-date.

As more health care organizations begin to use (or change) vendors for EMR/EHR and submit data to a statewide or regional IIS, the technical decisions regarding which format to use should include clinicians within the health care organization who administer immunizations and rely on the data to ensure their patients are vaccinated appropriately. From the state immunization program perspective, it will be important to continue analyzing trends regarding data quality and timeliness as it relates to the method of submission, and discern EMR/EHR use throughout the state to ensure all immunization data is being submitted efficiently and accurately to the WIR. Our data suggests that careful implementation of HL7 data submission, preferably with real-time, should result in more robust, accurate, and complete immunization records and assist health care providers to ensure their patients are appropriately protected against vaccine-preventable diseases.

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A Clinical, Diagnostic, and Ecologic Perspective on Human Anaplasmosis in the Upper Midwest

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ABSTRACT

Introduction: Human anaplasmosis caused by the bacterial pathogen *Anaplasma phagocytophilum* was first discovered in the Upper Midwest in 1990. Since that time the number of cases in the region has steadily increased, such that today, the pathogen rivals that of Lyme disease in causing human tick-borne–related illness.

Objective: We provide an overview of the biology, clinical characteristics, and epidemiology of the disease in the Upper Midwest and discuss currently available diagnostic methods.

Findings: Rapid differentiation of anaplasmosis from other acute febrile illnesses and targeted treatment are important for preventing severe disease and potentially fatal outcomes in infected individuals. Beyond blood smear analysis and serology, the development of real-time polymerase chain reaction (PCR) assays for clinical use holds promise in improving our ability to make rapid diagnoses and to differentiate *A phagocytophilum* infections from those produced by closely related *Ehrlichia* pathogens, which are also present in the region.

Conclusion: Continuing expansion of the range of the black-legged tick *(Ixodes scapularis)*, the principal vector of the disease, into areas heavily populated or visited by humans in the region likely will result in this pathogen becoming an even greater burden on human health. Efforts are needed to better characterize the current geographic distribution of human *Anaplasma* and *Ehrlichia* cases to identify emerging foci and to better understand the enzootic cycles that maintain the pathogens in the region. Improved diagnostics may assist with such efforts.

INTRODUCTION

Human anaplasmosis (HA; synonymously known as human granulocytic ehrlichiosis [HGE] and human granulocytic anaplasmosis [HGA]) is a zoonotic, tick-borne disease caused by the intracellular bacterium *Anaplasma phagocytophilum*, a member of the order *Rickettsiales*. The pathogen was first described in association with a febrile illness in 12 patients from Minnesota and Wisconsin in 1990-1993[1] (Table 1). Investigations that followed revealed that about 10% to 15% of patients reporting with a nonspecific febrile illness during the summer months to clinics in these states had evidence of infection with the agent,[2-4] and active surveillance studies reported annual incidence rates ranging between 9.3 and 16.1 per 100,000 individuals for the region.[5,6] The agent subsequently has been reported in several northeastern US states and in northern California, as well as in other regions of the world, including Europe and China.[7,8] However, the Upper Midwest (defined here as Minnesota and Wisconsin) has continued to be a primary focus of the disease with more than 56% of all US cases reported to the Centers for Disease Control and Prevention (CDC) in 2011 occurring in this region.[9] Moreover, since its discovery, the number of cases reported annually has steadily increased in the region, with an estimated number of 690 and 770 cases reported in Wisconsin and Minnesota, respectively, in 2011. These numbers represent at least a 10-fold increase in the number of cases reported in these states since it became a nationally reportable disease in 1998.[9]

A number of factors help to explain the rise in the numbers of HA cases in the Upper Midwest, including increased physician awareness and changes in reporting practices. Of perhaps greater significance, however, is the geographic expansion of the primary vector for the agent, *Ixodes scapularis* (the black-legged tick, also commonly referred to locally as the deer tick or bear tick). When HA was first discovered, the tick was primarily restricted to east-central Minnesota and northwestern Wisconsin (Figure 1A). Over the last decade, the tick has spread across Wisconsin and now is being found near more heavily populated areas of the state outside of Milwaukee and Green Bay, as well as areas

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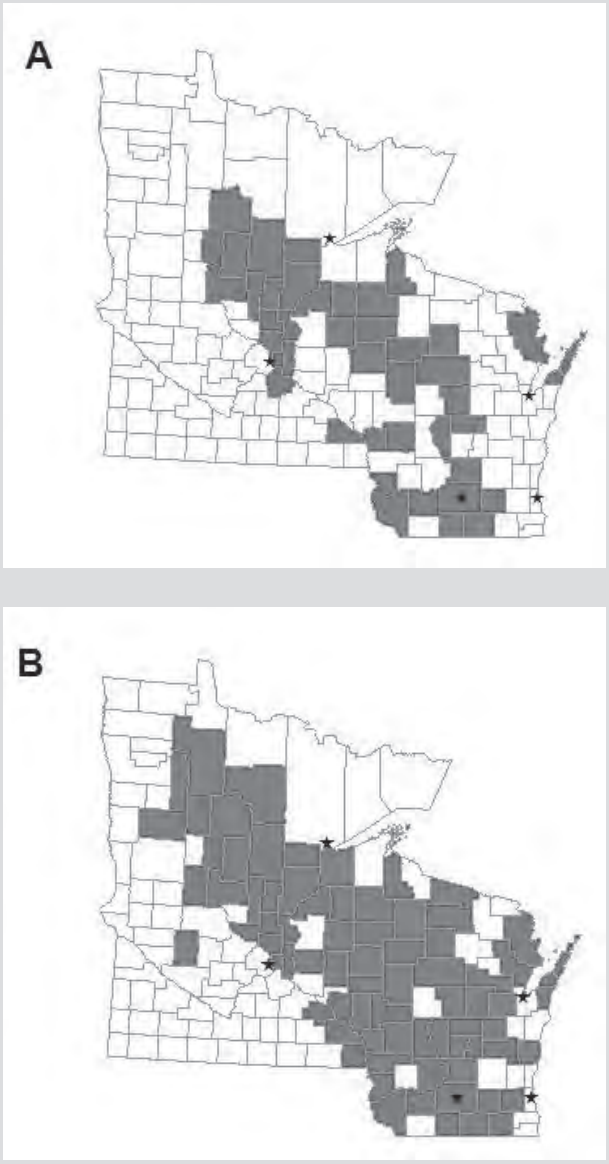
CME available. See page 115 for more information.

Table 1. Timeline of Major Events in the Discovery and Reporting of *A phagocytophilum* in the Upper Midwest

Year(s)	Event	Reference(s)
1990-1993	*A phagocytophilum* first detected in febrile patients in Wisconsin and Minnesota; designated as human granulocytic ehrlichiosis (HGE)	Chen, et al[1]
1995	HGE becomes a reportable disease in Minnesota	Bakken, et al[5]
1998	HGE officially becomes a nationally notifiable disease, including in Wisconsin	Council of State and Territorial Epidemiologists[9]
2001	HGE, *E equi* and *E phagocytophila* are synonymized as *A phagocytophilum*; designated as human granulocytic anaplasmosis (HGA) or human anaplasmosis (HA)	Dumler, et al[10]
2008	Case definition changes to accommodate reporting of infections with specific species of *Anaplasma* and *Ehrlichia*	Natonal Notifiable Diseases Surveillance System[11]

Figure 1. Expansion of *Ixodes scapularis* Populations in the Upper Midwest



Gray areas are counties where the tick was found during surveillance studies conducted through 1994 (A) and 2009 (B), based on previous reports.[12] Stars mark the locations of major metropolitan areas in the region: Milwaukee, Madison, and Green Bay, Wis; and Minneapolis-St. Paul and Duluth, Minn.

in northern Wisconsin that are visited each year by thousands of tourists who engage in summer recreational activities[12] (Figure 1B). In Minnesota, the tick also has spread into areas north and west of its original range, including into areas bordered by Canada.[13] Expansion of the tick into these areas is of concern not only because of the potential for increasing transmission of HA to humans, but also because the tick transmits other important diseases endemic to the region, including Lyme disease, babesiosis, and the Powassan encephalitis virus (Table 2). Because of the biological competency of *I scapularis* to carry and transmit a variety of etiologic agents, concurrent infections with HA and these other pathogens may be expected to become more frequent. Patients with co-infections are known to experience more severe illness and their effective treatment may require multiple therapies[14] (Table 2).

Increased contact between humans and ticks also creates opportunities for the emergence of new pathogens. In 2009 an agent novel to North America, designated as *Ehrlichia* species Wisconsin, was discovered in 1 Minnesota and 3 Wisconsin patients by a consortium consisting of the Mayo Clinic Laboratories, Wisconsin Division of Public Health (WDPH), and the CDC.[15] Although the importance of this new pathogen has yet to be elucidated, it emphasizes the need for continued disease surveillance in the region and the development of diagnostic tests that are sensitive and specific to each pathogen and that can be readily adopted by clinical laboratories. In addition, continuing efforts to educate health care providers and the public about these diseases will be important for their rapid diagnosis and treatment, as well as for their prevention.

In this review, we summarize the current state of knowledge regarding the biology, clinical characteristics and epidemiology of HA in the Upper Midwest and discuss the diagnostic methods employed in detection of the disease; areas for future research are also outlined. For more general reviews of anaplasmosis and erhlichioisis, readers are referred to Dumler et al[16] and Thomas et al.[17]

FINDINGS

Biology and Taxonomy

Anaplasma phagocytophilum, like all other members in the order *Rickettsiales* is an obligate intracellular bacterium.[10] It was

Table 2. Summary of Tick-borne Pathogens Occurring in the Upper Midwest

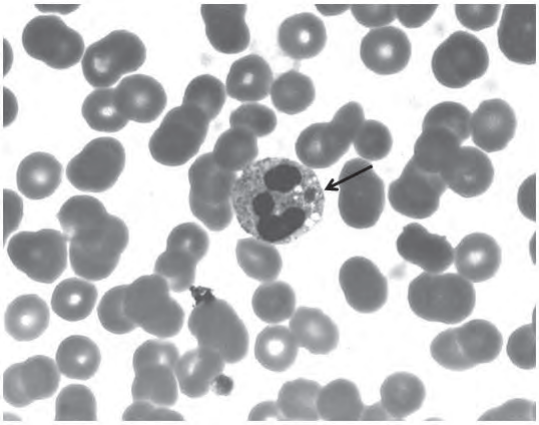
Pathogen	Name(s) of Disease	Primary Tick Vector	Diagnostic Tests[a]	Recommended Treatment[b]
Endemic and commonly transmitted to humans in the Upper Midwest				
Anaplasma phagocytophilum	Human anaplasmosis (HA), human granulocytic anaplasmosis (HGA), Human granulocytic ehrlichiosis (HGE)[c]	*Ixodes scapularis*	1. Blood smear tests for visualization of morulae in neutrophils. 2. Detection of antibodies in serum. 3. Real-time PCR assays for detection of DNA in peripheral blood.	**First line:** Doxycycline or tetracycline for 5-14 days for all age groups, including children. **Alternative:** Rifampin for pregnant patients or patients with a history of allergy to tetracycline.
Borrelia burgdorferi	Lyme Disease	*Ixodes scapularis*	1. Two-tier serologic testing for detection of antibodies in serum: enzyme immunoassay (EIA), followed by the immunoblot (Western blot) test. 2. Detection of antibodies in synovial fluid. 3. Real-time polymerase chain reaction (PCR) assay for detection of DNA in cerebrospinal fluid. 4. Growth of organism in cell culture from skin biopsy.	**For patients with early Lyme disease (eg, with erythema migrans):** Doxycycline for 10-21 days, or amoxicillin, or cefuroxime axetil for 14-21 days. **For patients with Lyme meningitis or early neurologic Lyme disease:** Ceftriaxone for 10-28 days. **For patients with Lyme arthritis:** Doxycycline, amoxicillin, or cefuroxime axetil for 28 days. **For patients with late Lyme disease (eg, recurrent Lyme arthritis and/or late neurologic disease):** Parenteral or intravenous treatment with ceftriaxone, cefotaxime, or penicillin G for 14-28 days.[18]
Endemic and emerging or rarely transmitted to humans in the Upper Midwest				
Babesia microti	Babesiosis	*Ixodes scapularis*	1. Blood smear tests for visualization of parasites in red blood cells. 2. Detection of antibodies in serum. 3. Real-time PCR assays for detection of DNA in peripheral blood.	Combination of atovaquone plus azithromycin, or clindamycin plus quinine for 7-10 days.
Ehrlichia species Wisconsin		Evidence suggests *Ixodes scapularis*	Real-time PCR assays for detection of DNA in peripheral blood.	**First line:** Doxycycline or tetracycline for 5-14 days for all age groups, including children. **Alternative:** Rifampin for pregnant patients or patients with a history of allergy to tetracycline.
Powassan virus		Evidence suggests *Ixodes scapularis*	Detection of antibodies in serum	Supportive therapy [WDPH; http://www.dhs.wisconsin.gov/]. Accessed May 14, 2014.
Not known to be endemic, but may be currently invading the Upper Midwest				
Ehrlichia chaffeensis	Ehrlichiosis, Human monocytic erhlichiosis (HME)	*Amblyomma americanum*	1. Blood smear tests for visualization of morulae in monocytes. 2. Detection of antibodies in serum. 3. Real-time PCR assays for detection of DNA in peripheral blood.	**First line:** Doxycycline or tetracycline for 5-14 days for all age groups, including children. **Alternative:** Rifampin for pregnant patients or patients with a history of allergy to tetracycline.

[a] Only the tests commonly offered by clinical laboratories are listed; other diagnostic tests may exist.
[b] Antibiotic therapies as recommended by the CDC, http://www.cdc.gov/ticks/index.html, and cited references.
[c] The name "ehrlichiosis" still is frequently used in the Upper Midwest in reference to infections with *A phagocytophilum*. It should be recognized that there are distinct *Ehrlichia* species agents that can cause similar diseases as *A phagocytophilum*, but that do not frequently occur in the Upper Midwest. Discontinued use of the name ehrlichiosis and adoption of anaplasmosis for infections caused by *A phagocytophilum* is recommended.

described first as a pathogen of veterinary importance and originally was designated as 2 separate *Ehrlichia* species: *E phagocytophila* in ruminants and *E equi* in horses.[8] When it was first detected in humans, it was referred to as the human granulocytic ehrlichiosis (HGE) agent.[1] In 2001, phylogenetic analyses based on molecular data supported the reclassification of *E phagocytophila, E equi,* and HGE into the single species, *A phagocytophilum*[10] (Table 1).

The pathogen naturally cycles between wild mammalian hosts and tick vectors. Within its mammalian hosts, including humans, the pathogen infects neutrophils and replicates within intracytoplasmic vacuoles to form inclusions known as morulae[10] (Figure

Figure 2. Human Peripheral Blood Granulocyte Infected with a Morula of *A phagocytophilum*



2). In the eastern United States, the nominal wild reservoir for infections is the white-footed mouse, *Peromyscus leucopus,*[19,20] although other small mammals, including short-tailed shrews, *Blarina brevicauda,* and eastern chipmunks, *Tamias striatus*, also significantly contribute to enzootic maintenance.[20] Other mammalian species, including white-tailed deer, *Odocoileus virginianus,* and birds also may harbor infections.[21,22]

Recent investigations suggest that the pathogen exists as biologically and ecologically distinct subpopulations that are adapted to specific reservoir hosts and tick species with varying capacities to infect and cause disease in humans and domestic animals.[23,24] In particular, the 16S rRNA gene variant referred to as Ap-ha is the only known *A phagocytophilum* variant that has been isolated to date from humans in the eastern United States and it appears to be maintained in the *P leucopus–I scapularis* enzootic cycle in that region.[25,26] Distinct variants not found in humans have been recovered from deer, other ruminants, and horses, suggesting only a subset of *A phagocytophilum* variants cause disease in humans.[25,27]

The potential role that different mammalian species have as reservoirs in the Upper Midwest remains largely unexplored; however, the Ap-variants 1, WI-1, and WI-2 have been detected in deer in the region.[28-31] Small rodents, including *P leucopus, T striatus,* and *Clethrionomys gapperi* have also been found to harbor *A phagocytophilum* infections, although the identities of the variants in these hosts have not been determined.[31]

Infections in dogs and horses also appear to be common in the region and may be on the rise.[32,33] For instance, more than 50% of dogs tested in some counties in Minnesota and Wisconsin were seropositive during a national surveillance study conducted in 2006-2007, and overall prevalence of samples with antibodies to *A phagocytophilum* was 6.7% in the Midwest, a higher prevalence than that reported for any other region.[34] Dogs appear to be infected with the same genetic variants of *A phagocytophilum* as humans[24,27] although their role, as well as that of wild canids, in maintaining HA infections is unknown.

In the Upper Midwest *I scapularis* is the principle vector for the pathogen. The tick species is widely distributed across the eastern USA and surveys conducted in Wisconsin and Minnesota have reported *A phagocytophilum* prevalences of 9% to 12% in adult ticks.[29,35-37] Ticks typically acquire infections as larvae or nymphs, following feeding on a reservoir-competent host. Ticks may retain infections as they molt between stages, but infected females are unlikely to transmit infections to offspring transovarially,[10] though transovarial transmission was demonstrated for a nonpathogenic variant of *A phagocytophilum* found circulating between *Dermacentor albipictus* and white-tailed deer in Minnesota.[30] Unlike transmission of *B burgdorferi,* which may require[36-48] hours or more of tick attachment, laboratory studies on mice indicated transmission of *A phagocytophilum* may occur within 24 hours of tick attachment,[38,39] suggesting that faster detection and removal of attached ticks is necessary to prevent transmission. Most human cases of HA occur in June and July, corresponding to the activity of nymphal *I scapularis*, suggesting this is the most likely stage to transmit infections to humans.

Clinical Characteristics and Epidemiology

HA is characterized by nonspecific symptoms including fever, headache, myalgia and fatigue that may be accompanied by other symptoms, including cough, abdominal pain, and nausea. Clinical features commonly associated with the disease are leukopenia, thrombocytopenia, and elevated serum hepatic aminotransferases.[5,6] Patients usually develop symptoms 5 to 21 days after receiving a bite from an infected tick[16] and most frequently seek medical attention during the acute phase of illness (< 1 week following onset of symptoms).[4,40,41] Although the case fatality rate in humans is less than 1%,[42] up to 50% of patients may be hospitalized and infections have been associated with severe organ failure and opportunistic infections that appear secondarily.[5,6,42]Risk factors associated with severity of outcomes include patient age, delayed diagnosis and treatment, and underlying medical comorbidities.[42] In particular, patients 60 years of age and older, or reporting an immunosuppressive condition, are at greatest risk of life-threatening complications and death.[42] Clinical infections in general are more common in older people, with the highest rates reported for patients 50 years of age or older; infections also appear to be slightly more common among men than women.[6]

The nonspecific clinical symptoms seen in infected patients can pose difficulties in diagnosing HA. Moreover, the clinical and laboratory manifestations of HA are similar to other tick-borne diseases, preventing differentiation of these diseases on symptomatology alone, although differences do exist in the frequencies

in which patients present with specific symptoms. For instance, patients infected with the closely related pathogen *Ehrlichia chaffeensis,* the causative agent of human monocytic ehrlichiosis (HME), are more likely to report rashes and gastrointestinal illness than patients infected with HA.[16] The hospitalization and case fatality rates for HME also are higher than for HA, as patients with HME are more likely to experience life-threatening complications related to renal failure, respiratory distress, disseminated intravascular coagulopathy, or meningitis/encephalitis.[5,42] Opportunistic infections, such as yeast pneumonitis caused by *Candida* and *Cryptococcus* species, and rhabdomyolysis have been reported more frequently as complications in HA infections.[14,42,43] Currently, however, HME and HA cases occur in fairly distinct geographic regions,[42] such that patients with ehrlichiosis-like symptoms in the Upper Midwest who have not travelled outside of the region would most likely be infected with *A phagocytophilum*. Conversely, the geographic distributions of HA and Lyme disease cases overlap significantly in the USA, such that identifying clinical differences in their presentations may be more useful. In a case-control study involving patients in Wisconsin, patients diagnosed with HA infections were more likely to report fever, chills, and dyspnea than Lyme disease patients, although these symptoms did overlap between the 2 groups of patients. Laboratory findings such as leukopenia, thrombocytopenia, and elevated alanine aminotransferase levels, on the other hand, were significantly more associated with patients infected only with HA.[44] Importantly, the rash of erythema migrans also is highly specific for patients infected with the Lyme disease spirochaete and not HA.[44] These general findings recently were supported in a comparison of Lyme disease and HA patients infected in the northeastern United States.[45]

Because *A phagocytophilum* is transmitted by the same tick species that transmits the agents of Lyme disease, babesiosis, and Powassan encephalitis, patients may be concurrently infected with more than 1 pathogen.[14] In Wisconsin in the 1990s, an active surveillance study detected apparent co-infections in 2 of 62 (3.2%) patients presenting with a summer febrile illness,[4] and a prospective study found 4% of 283 patients suspected of having a tick-borne disease with evidence of co-infection with HA and Lyme disease.[44] Further evidence that patients in the Upper Midwest may be concurrently or sequentially infected with more than 1 pathogen was obtained in a cross-sectional study during the same time period. Twelve of 115 (10.4%) patients that had a laboratory-confirmed diagnosis of acute HA or Lyme disease also had serologic evidence of infection with another pathogen; 3 patients (2.6%) in this study had evidence of triple infections with HA, Lyme disease, and babesiosis.[46] More recently, an HA and Lyme disease co-infection rate of 9% was detected in patients in northwestern Wisconsin where HA is an emerging disease.[37] An increased incidence of human co-infections in endemic areas of the Upper Midwest in recent years has not been investigated, but might be expected with increasing prevalence of infections in reservoir host and tick populations. Because patients co-infected with *A phagocytophilum* and Lyme disease may be less likely to report fever, chills, and fatigue than patients infected with HA alone and may still develop an erythema migrans rash[37,44] testing for both pathogens in patients suspected of a tick-borne illness may be indicated.

HA is treated effectively with doxycycline (Table 2). A 10 to 14 day regimen of 100 mg for adults or 2.2 mg/kg for children 8 years of age or older (weighing < 100 lbs) every 12 hours is recommended.[17,18,47] For children less than 8 years of age, doxycycline is still the recommended treatment, as the risk for dental staining has been shown to be minimal,[47] although treatment may be limited to 4 to 5 days or about 3 days after resolution of fever.[18] Response to therapy is rapid with clinical improvement in 24 to 72 hours. Rifampin has been used successfully when doxycycline cannot be used, such as in pregnant women.[18,47] Doxycycline is the recommended treatment for Lyme disease as well, therefore, a treatment course of 10 to 14 days should be sufficient in patients suspected to be infected with both HA and Lyme disease.[18,47] Because HA infections can rapidly progress to a life-threatening disease, treatment should not be delayed for confirmatory laboratory diagnosis. However, HA does appear to be a self-limiting infection in the majority of human patients. Ramsey et al[48] conducted a case-control study to evaluate the likelihood of persistent or recurrent symptoms in patients diagnosed with HA in Wisconsin in 1996-1998. Patients were more likely to report repeated fevers, chills, sweats, and fatigue 1 year after diagnosis, although there was no evidence that cases experienced more bodily pain or were in poorer physical condition than controls. Of the 85 enrolled cases in the study, one retained an elevated HA serologic titer (1:256) and reported recurrent fatigue, vomiting, and headaches.

Current Diagnostics

Infections with *A phagocytophilum* can be diagnosed using several methods, each of which has advantages and limitations. The most widely available methods in diagnostic laboratories include direct visualization of morulae on stained blood smears, serology, and polymerase chain reaction (PCR) assays (Table 2). The best diagnostic approach will depend on the stage of infection at which the presenting patient is tested and the agents known to occur in the geographic region where the patient may have been exposed. Typically, the first 1 to 2 weeks following onset of symptoms coincides with a high number of circulating infected leukocytes. Therefore, detection by direct visualization of morulae on blood smears will have its highest sensitivity during this phase of infection. However, sensitivity of this method rapidly wanes as the infection progresses and fewer infected neutrophils are present in

peripheral blood. Sensitivity also is optimized by having blood smears reviewed by an experienced technologist and/or pathologist.[47] Despite these limitations, examination of peripheral blood smears may allow for a rapid diagnosis and for the specific differentiation between *A phagocytophilum,* which infects granulocytes, and *Ehrlichia* species, which will be found primarily in monocytes.[16,17]

Serologic tests frequently are used clinical tests, but their accuracy also depends on the timing of sample collection with respect to the course of infection;[17,41] cross-reactivity between closely related organisms may also prevent definitive diagnoses.[47] The ability to detect antibodies during the acute phase of illness, in particular, is low.[49] Seropositivity also may represent asymptomatic or previously resolved infections when IgG class antibodies are detected by laboratory tests and which may persist for over a year in some patients.[49] While IgM-targeted HA antibody tests are available from some reference laboratories, and may prove helpful during acute infection, detection of these antibodies is highly problematic due to false-positive reactions known to occur with this class of antibodies. Because of these difficulties, the current CDC case definitions for confirmed diagnoses of anaplasmosis and ehrlichiosis specify a 4-fold increase in IgG-specific antibody titers in the indirect immunofluorescence assay (IFA) between paired acute and convalescent serum samples collected within 2 to 4 weeks of each other.[11]

PCR-based diagnostic tests for anaplasmosis offer several advantages over traditional diagnostic methods. They have sensitivity and specificity rates that may approach 100%, tend to have a higher degree of sensitivity than serology and blood smear tests in the acute phase of illness when the majority of patients are tested, and they have the potential to detect co-infections simultaneously in multiplexed reactions.[50,51] They also provide confirmatory laboratory evidence of infection.[11] A variety of PCR assays for *A phagocytophilum* have been developed that vary in their performance to accurately detect the implicated pathogen in clinical specimens. Several assays that target different regions in the 16S rRNA gene have been developed, with differing performance characteristics. In particular, an evaluation by Massung and Slater[52] revealed differences in detection limits and specificity for various primer sets, with some primer sets lacking the specificity required for definitive clinical diagnosis. Assays targeting other genes appear to perform as well, or better, with tests targeting amplification of genes with multiple copies (eg, amplification of genes with multiple copies (eg, major surface protein 2 [msp2] and ankyrin-repeat protein [ankA]) and that) and that are, in general, more sensitive than assays targeting the 16S rRNA gene.[37,52,53]

A real-time PCR assay developed by Bell and Patel[51] that targets the *groEL* operon of the heat shock protein, shows promise for molecular diagnosis and differentiation of the closely related pathogens *A phagocytophilum*, *E chaffeenis, E ewingii,* and the newly described *Ehrlichia* species Wisconsin.[15] In fact, the use of this test allowed for the discovery of the *Ehrlichia* species Wisconsin in patients presenting with an *Ehrlichia*-like illness.[15]Further work evaluating the use of this test in detecting *A phagocytophilum* infections in different phases of infection revealed that its greatest sensitivity was in patients reporting illness for 4 or fewer days, although the method was able to detect infections in patients that had been sick for up to 30 days. Moreover, the assay was more sensitive than blood smear analysis.[41] These results were similar to those reported for other PCR assays designed to detect *A phagocytophilum*.[2,16] Thus, despite the many advantages PCR-based methods may offer for diagnosis, their limited abilities to detect pathogens in patient specimens beyond the acute phase of infection persists. Multiple lines of testing still may be required for a definitive diagnosis in some patients, including amplification of pathogen-specific DNA, a 4-fold increase in antibody titer, or visualization of morulae on a blood smear.[41,50]

Future Needs in Diagnostics, Surveillance and Control

As we continue to learn more about the biology of *A phagocytophilum* and the risks it poses to human and animal health in the Upper Midwest, we are faced with the challenges of identifying effective methods of control and prevention. Current public health measures to combat tick-borne diseases in the United States rely primarily on an individual's abilities to minimize exposure to tick vectors. Such personal protection measures include wearing long pants and sleeves when working outdoors or during recreational activities, tucking pants into socks, and applying tick repellents to skin or clothing before entering tick habitats to reduce the risk of tick exposure. Conducting thorough and frequent body checks and promptly removing any attached ticks after spending time outdoors reduces the likelihood of pathogen transmission. It remains unclear if there are specific behavioral risk factors associated with tick-borne diseases in the Upper Midwest. In 1 study, HA cases were more likely to report residence in a rural neighborhood and camping compared to controls;[44] however, other studies reported that individuals who worked outdoors or spent time in the woods were at no greater risk of infection.[3,4] Therefore, it is unknown if education campaigns focused on changing people's behaviors would help reduce the incidence of these diseases.

Developing spatial risk maps to identify environmental factors correlated with ticks or human-tick encounters and to alert health care providers and the public to geographic regions where the risks of acquiring infections are greatest represents an alternate strategy that may improve the public's ability to make decisions regarding the use of protective measures and a provider's ability to correctly diagnose a tick-borne illness.[54,55] It is also possible that such risk maps could be used to cost-effectively target appro-

priate community-wide efforts aimed at the control of ticks or reservoir hosts in the environment.[55] High quality patient or tick infection data are required to develop maps that most accurately predict risk.[56] A major disadvantage of this approach, however, is that underlying models often are based on outdated or single time points of data, thus limiting their utility for predicting current or future risks. The adoption of electronic medical records, electronic case reporting systems, and molecular diagnostic assays that allow for the distinction between active and resolved infections, in addition to the availability of high quality environmental data, technological advances for processing data, and the public's widespread access to smartphones and the Internet may remove this disadvantage and allow for the distribution of relatively current information about the risks of pathogen exposure in a particular region. Delivery of such "real-time" alerts may have the greatest impact on an individual's decision to try to avoid ticks, and future efforts should explore the integration of surveillance systems with publicly available media (eg, websites and phone applications) to accomplish this.

A better understanding of the circulating variants of *A phagocytophilum* in the Upper Midwest, their enzootic cycles, and their abilities to infect humans and domestic animals is another priority. Such information would strengthen models that predict areas of greatest infection risk, and may help explain the distribution of human cases. For instance, Massung et al[26] demonstrated that varying prevalence of the AP-ha and nonhuman infecting *A phagocytophilum* variants in mice, chipmunks, and ticks corresponded to differences in rates of human infections in Connecticut and Rhode Island. Moreover, having the ability to differentiate distinct *A phagocytophilum* variants may allow for development of better diagnostic tests, or possibly vaccines, in the future.[57,58]

CONCLUSION

Tick-borne diseases represent some of the most important emerging infectious diseases affecting human and domestic animal populations in the temperate regions of the world. In the Upper Midwest, infections with *A phagocytophilum* particularly appear to be on the rise, though less is known about this pathogen in this region than in other parts of its range in the United States. To mitigate the effects of infections on human health, continued health care provider awareness, development and adoption of reliable diagnostic technologies, and efforts to better understand the ecology of *A phagocytophilum* in human-modified environments in the region are needed. In particular, diagnostic methods that reliably differentiate *A phagocytophilum* from closely related *Ehrlichia* spp infections should be adopted by clinical laboratories and health care providers to improve rates of definitive diagnoses and accurate case reporting and surveillance. In addition, identifying the principal reservoir hosts for the strains of the pathogen that are most likely to infect humans in the Upper Midwest would provide knowledge useful for predicting and, perhaps, controlling, transmission to humans.

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Quiz: A Clinical, Diagnostic, and Ecologic Perspective on Human Anaplasmosis in the Upper Midwest

EDUCATIONAL OBJECTIVES

Upon completion of this activity, participants will be able to:

1. Understand the epidemiology of human anaplasmosis and other diseases in the Upper Midwest transmitted by the bite of *Ixodes scapularis*.
2. Describe the clinical characteristics of infections with *Anaplasma phagocytophilum.*
3. Describe the evaluation and treatment of patients with human anaplasmosis.

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QUESTIONS

1. Human anaplasmosis (HA) is a zoonotic, tickborne disease caused by the intracellular bacterium *Anaplasma phagocytophilum* and is also known as human granulocytic anaplasmosis (HGA) and human granulocytic ehrlichiosis (HGE).
   ❑ True ❑ False
2. *A phagocytophilum* was first described in association with a febrile illness in patients from Sweden in the early 1900s.
   ❑ True ❑ False
3. About 10% to 15% of patients reporting with a nonspecific febrile illness during the summer months to clinics in Wisconsin and Minnesota had evidence of infection with *A phagocytophilum*.
   ❑ True ❑ False
4. *Ixodes scapularis* (the black-legged, deer, or bear tick) is the primary vector not only for HA, but also transmits other important diseases endemic to the region, including Lyme disease, babesiosis, and the Powassan encephalitis virus.
   ❑ True ❑ False
5. The range of *I scapularis* in Wisconsin and Minnesota has decreased significantly over the past decade.
   ❑ True ❑ False

• • •

You may earn CME credit by reading the designated article in this issue and successfully completing the quiz (75% correct). Return completed quiz to WMJ CME, 330 E. Lakeside St, Madison, WI 53715 or fax to 608.442.3802. You must include your name, address, telephone number and e-mail address. You will receive an e-mail from wmj@wismed.org with instructions to complete an online evaluation. Your certificate will be delivered electronically.

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6. Analyses based on molecular data supported the reclassification of *Ehrlichia phagocytophila, Ehrlichia equi*, and the human granulocytic ehrlichiosis (HGE) agent into the single species, *A phagocytophilum*.
   ❑ True ❑ False
7. In human hosts, *A phagocytophilum* infects monocytes and replicates within intracytoplasmic vacuoles to form inclusions known as morula.
   ❑ True ❑ False
8. Wild reservoirs for infections with *A phagocytophilum* include the white-footed mouse, short-tailed shrew, eastern chipmunk, and white-tailed deer.
   ❑ True ❑ False
9. Surveys conducted in Wisconsin and Minnesota have reported a prevalence of *A phagocytophilum* in 9% to 12% of adult *I scapularis*.
   ❑ True ❑ False
10. The transmission of *A phagocytophilum* may occur within 24 hours of tick attachment; this is distinctly different from *Borrelia burgdorferi*, the pathogen in Lyme disease, which may require 36 to 48 hours or more of tick attachment for transmission to occur.
    ❑ True ❑ False
11. HA is characterized by nonspecific symptoms including fever, headache, myalgia, and fatigue; clinical features that are common also include leukopenia, thrombocytopenia, and elevated serum hepatic aminotransferases.
    ❑ True ❑ False
12. Symptoms of HA usually develop within 2-3 days after receiving a bite from an infected tick.
    ❑ True ❑ False
13. Since *A phagocytophilum* is transmitted by the same tick species that transmits the agents of Lyme disease, babesiosis, and Powassan encephalitis, patients may be concurrently infected with more than a single pathogen.
    ❑ True ❑ False
14. The rash of erythema migrans is seen often in patients infected with the Lyme disease spirochete, but a similar rash also is seen frequently in patients with HA.
    ❑ True ❑ False
15. The recommended first-line treatment for HA is amoxicillin.
    ❑ True ❑ False
16. Current diagnostic tests for infections with *A phagocytophilum* include direct visualization of morulae on stained blood smears, serology, and PCR assays.
    ❑ True ❑ False

Idiopathic Spontaneous Rupture of an Intercostal Artery

Anahita Dua MD, MS, MBA; Arshish Dua; Sarah Jechow; Sapan S. Desai, MD, PhD, MBA; SreyRam Kuy, MD, MHS

ABSTRACT

Spontaneous rupture of an intercostal artery is exceptionally rare without an inciting event such as trauma or nontraumatic arterial wall weakening. This report details the diagnosis and treatment of a 47-year-old man who presented with a spontaneous hemothorax from an intercostal artery. There are very few reports in the literature documenting spontaneous intercostal artery rupture without associated illness or injury.

INTRODUCTION

Spontaneous rupture of an intercostal artery is a rare but life-threatening surgical emergency requiring prompt diagnosis and intervention for optimum outcome. Spontaneous intercostal artery hemorrhage (ICAH) may be complicated by hemothorax, hematoma formation, and/or retroperitoneal bleeding, which contributes to significant morbidity and mortality in these patients. The majority of intercostal artery bleeds result from trauma; however, nontraumatic predispositions (ie, Ehlers danlos, Marfans disease, Neurofibromatosis Type I) that result in arterial wall weakening and aneurysmal formation also contribute.[1-3] What is exceptionally rare is an idiopathic spontaneous intercostal artery bleed with nontraumatic or traumatic inciting factors. We present a case of a 47-year-old white man with a spontaneous hemothorax. To our knowledge, this is the third report in the literature documenting spontaneous intercostal artery rupture without associated illness or injury.[4]

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CASE PRESENTATION

A 47-year-old man with no significant medical history arrived at an outside hospital with shortness of breath and severe right-sided chest pain several hours following sexual intercourse. He denied any history of trauma. A CT scan completed at the hospital revealed a right hemothorax and prompted transfer to our level I trauma center. The patient was hypotensive and tachycardic on arrival even with appropriate resuscitation during transfer and had an oxygen saturation fluctuating between 70% to 90%. Physical examination revealed decreased breath sounds on the right side and mild tenderness over his right flank.

While in the emergency department, the patient became acutely unresponsive and required immediate intubation. A right chest tube was placed and drained 750 cc of frank blood. He was transferred to the surgical intensive care unit (SICU) but continued to have frank bleeding from his chest tube, resulting in further hemodynamic instability. This prompted an emergency surgical exploration of his chest in the operating room. A right posterior-lateral thoracotomy was performed and a large hemothorax evacuated from the right thoracic cavity. At this point no active intrapleural bleeding was noted but a large extrapleural hematoma had formed, separating the pleura from the chest wall. Here was noted frank, active extrapleural bleeding from an intercostal artery close to the 11th rib just medial to the spine. A second incision was made over the 11th rib to access this bleeding vessel and subsequent control of bleeding was achieved with ligation.

The chest tube was replaced and both incisions were closed. The patient was taken back to the SICU. Four hours postoperatively, significant output was noted from the chest tube and the patient was brought back to the OR for re-exploration. The incision over the 11th rib was re-opened and active bleeding was noted, this time from an anterior intercostal artery remote from the site of the original bleed. The vessel was controlled with suture ligation and the incision closed. He did well overnight with no

further acute bleeding and was extubated on postoperative day (POD) 2. His chest tube was removed on POD 3; he was tolerating a normal diet and his pain was controlled on oral narcotics. He was discharged home on POD 4 and has had no further instances of intercostal bleeding on follow-up examination. He was referred as an outpatient to the cardiology clinic for evaluation for vascular dysfunction. Though he did not undergo genetic testing, he was evaluated by a cardiology specialist and deemed to have no evidence of any vasculitis or arterial dissection.

DISCUSSION

This report discusses the third reported case of a spontaneous intercostal bleed documented in the literature. Our patient suffered this spontaneous intercostal artery bleed with no known predisposing factors, significant medical history, or traumatic insult.

Spontaneous intercostal bleeding is a rare occurrence. When diagnosed, usually it is associated with underlying etiologies—namely trauma, anticoagulation or bleeding disorders, lung infections, and/or predisposing medical conditions such as Neurofibromatosis Type I (Von Recklinghausen's disease, NF Type I), Systemic Lupus Erythematosus (SLE), and/or uncontrolled hypertension.[1-5] Most data on intercostal bleeds are from case reports, the most common cause being trauma and most common nontraumatic cause Neurofibromatosis Type 1.[1-3]

To our knowledge, there have been 6 case reports demonstrating spontaneous intercostal bleeds. Only 2 of these were associated with no predisposing medical conditions or probable etiologies, making our case the third.[1-7]

Presenting symptoms noted in the literature are highly variable and may include abdominal pain, dyspnea, thoraco-abdominal masses, flank pain, and/or shoulder and back pain.[1-7] Deciphering the probable location of the culprit intercostal is aided by clinical exam. In the literature and in our case, the most common location of intercostal spontaneous rupture is the 10th or 11th intercostal vessel and the majority of these patients were not on anticogulants.[1,5,6]

Probable underlying etiologies in these cases included violent coughing, uncontrolled hypertension, and SLE or NF1.[1-7] In this case, the patient presented several hours following sexual intercourse, but denied any trauma or violent coughing. Other than our case, the case reported by Matthew et al[7] described a male patient presenting with dyspnea and left loin pain with a subsequent finding of abdominal wall hematoma and hemothorax due to 10th intercostal spontaneous, idiopathic bleed. Similar to our case, blood was discovered in the thoracic cavity with hematoma formation, and the resultant area of bleeding in relationship to the rib was also similar in pattern to our case.[7]

Moon et al[5] described a case of a 45-year-old male patient who ceased taking his hypertensive medication 5 months prior to presentation and suffered a spontaneous intercostal bleed.[5] Although their patient had problematic coughing spells, that also may have been an etiological factor of the intercostal rupture such as in the case report by Lu et al,[2] they documented that the patient's intercostal artery rupture occurred prior to the onset of coughing, pointing to increases in blood pressure as an etiological factor.

On the nontraumatic side, Neurofibromatosis Type 1 (von Recklinghausen's disease) is the most common cause of intercostal rupture. This is an autosomal dominant condition that affects connective tissue and vasculature causing arterial stenosis due to intimal dysplasia of large vessels as well as development of numerous neurofibromas on the skin.[1-3] Other medical conditions also have been associated with the development of spontaneous hemothorax. Multiple hereditary exostoses, in which the patient experiences growth of multiple osteochondromas in childhood, has been reported to cause bleeding due to the protrusion of a lesion into the pleural space.[8] Isolated hyperostosis of a single rib also has been shown to have caused spontaneous hemothorax following erosion of the rib through an intercostal artery.[9] One report described hemothorax developing as the result of spontaneous rupture of a hydatid cyst, a concern in areas where sheep and cattle are raised.[9]

On physical exam of our patient, we found nothing suggestive of Neurofibromatosis, and following his recovery we referred him as an outpatient for evaluation for vasculitis. Although our patient did not undergo genetic testing, his past medical and family history were evaluated and his physical exam did not reveal any evidence of a vasculopathy. However, it is possible that he carries a missed diagnosis of a condition that may predispose him to spontaneous intercostal arterial rupture and resulting hemothorax. It is therefore incumbent upon the surgeon in such cases to consider this possibility and to be prepared for any potential problems during the operative procedure that may result from such disorders. Additionally, these findings merit further investigation once the patient is stabilized in order, if possible, to determine a cause for his hemothorax.

Overall, it imperative that any clinician encountering new onset hematoma/retroperitoneal bleed with unknown and obscure etiology at least consider intercostal bleed as a differential, particularly in patients with predisposing conditions such as trauma or NF Type I. In addition, as evidenced by our report and others, when intercostal artery hemorrhage is suspected prompt intervention can be lifesaving.

CONCLUSION

Spontaneous rupture of intercostal arteries in the setting of no underlying etiology such as trauma, NF1, and/or anticoagulation is extremely rare. Surgeons and other clinicians observing

new onset hemothorax/hematoma formation, shortness of breath, and atypical symptomology that does not correlate with clinical history should consider intercostal hemorrhage and/or hematoma formation especially in the context of underlying disease mechanisms that may weaken the arterial wall. Close follow-up of patients who are diagnosed with spontaneous arterial bleeds must be conducted to rule out underlying etiology.

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A Case of Pityriasis Amiantacea with Rapid Response to Treatment

Gabrielle Mannino, MS; Cort McCaughey, MD; Erin Vanness, MD

ABSTRACT

Pityriasis amiantacea is a rare cutaneous reaction pattern to various underlying inflammatory diseases of the scalp. The clinical findings are very characteristic but often under-recognized. This condition can lead to scarring alopecia, and can be refractory to conservative treatment. It is therefore important to recognize the condition so that appropriate treatment can be initiated promptly.

INTRODUCTION

Pityriasis amiantacea (PA) is an inflammatory condition of the scalp that is described as thick, adherent, asbestos-like scales. The scale attaches in layers to both the scalp and hair shafts, and when removed can lead to temporary or scarring alopecia. Studies suggest that PA represents a reaction pattern of the scalp to various inflammatory diseases, the most common being seborrheic dermatitis, psoriasis, and tinea capitis. Recent literature has entertained the notion that concomitant *Staphylococcus aureus also* may contribute to the pathogenesis of PA.

Case Presentation

A 25-year-old woman was seen in the dermatology clinic for evaluation of diffuse adherent scaly lesions on her scalp with associated hair loss. She had no evidence of cutaneous psoriatic plaques or characteristic nail changes to suggest psoriasis as an underlying cause. There was no evidence of fungal infection of the skin or nails and no discrete nummular areas of hair loss to suggest tinea capitis. She did claim a history of mild "dandruff," which was suggestive of seborrheic dermatitis as the underlying etiology. She had been treated with over-the-counter shampoos containing tar and salicylic acid as well as desonide cream, all of which were minimally helpful.

Scalp exam revealed thick, adherent, asbestos-like scales, which were attached both to the scalp and to the proximal hair shafts (Figure 1). Hair casts were revealed on removal of hair, leaving a moist erythematous base. There were thin ill-defined erythematous plaques with overlying greasy scale underlying the more thick adherent scale, which was suggestive of seborrheic dermatitis (Figure 2).

In this case, the PA responded rapidly (near complete clearance within 2 weeks) to topical mineral oil under occlusion, daily salicylic acid shampoo, clobetasol solution twice daily, and a 2-week course of cephalexin. Treatment included a combination of previously reported successful treatment algorithms.

DISCUSSION

PA appears primarily to affect young adults and is more common in females.[1] The condition is easily diagnosed by its typical clinical appearance. Alopecia is a prominent feature of PA, but is temporary when early, appropriate treatment is initiated.[2]

Clinicians continue to be puzzled by the etiology of PA and have struggled to define the most appropriate treatment modality. The pathogenesis of PA is challenging because the scalp appears to react with a similar pattern to various inflammatory dermatoses. Scalp biopsy has revealed pathologic diagnoses that include seborrheic dermatitis, psoriasis, superficial pyogenic or fungal infections, lichen planus, lichen simplex chronicus, and atopic dermatitis.[1,3] Despite these disease associations, the mechanism of formation of the scale that defines PA is uncertain.

Knight isolated *S aureus* in 4 of 71 patients with PA, and Abdel-Hamid et al observed positive bacterial cultures in 83 of the 85 patients with this condition.[1,4] In these cases, *S aureus* was thought to most likely represent a secondary infection. In one more recent report, *S aureus* was isolated in the majority of patients with PA (81.3%) compared to the control group (3.1%). Moreover, all patients in this study responded quickly to a regimen that included systemic antibiotics as well as topical corticosteroids and coal tar.[5]

PA is notoriously treatment resistant and there are currently no specific treatment guidelines. It is agreed, however, that treatment

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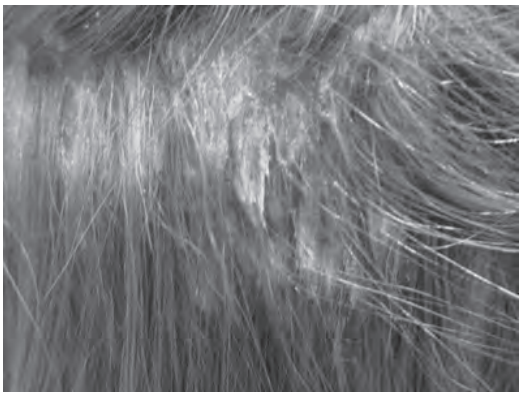
Figure 1. Scales Characteristic of Pityriasis Amiantacea



Examination of the scalp revealed thick adherent scales which were attached both to the scalp and to the proximal hair shafts.

Figure 2. Erythematous Plaques

Poorly defined erythematous plaques with greasy scale, suggestive of seborrheic dermatitis, underlie the more thickly adherent scale.

should target the underlying inflammatory condition; ie, seborrheic dermatitis, psoriasis, tinea, etc. Previous case reports/series have observed variable improvement with topical and systemic corticosteroids, keratolytics, and other immunosuppressants.[6] In more recent reports, treatment success was improved when more conventional treatments were combined with systemic antibiotics targeting *S aureus*. This favors the hypothesis that bacterial infection may play an important role in the pathogenesis of this condition.

CONCLUSION

Without timely and effective treatment, PA may evolve into a chronic skin condition and may result in scarring alopecia. Therapy should be directed toward the underlying dermatosis. More recent literature suggests improved treatment success when combination anti-inflammatory and antibiotic treatment is initiated.

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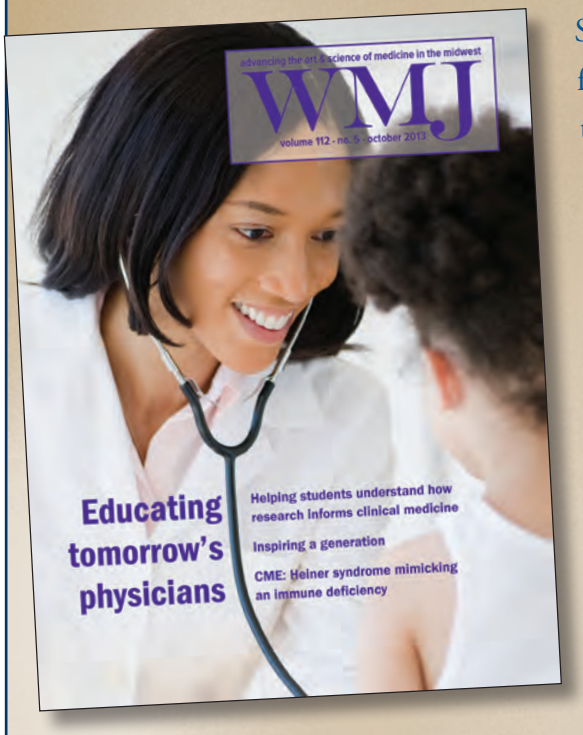

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Cheryl A. Maurana, PhD;

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Endowment Transitions from Grantmaker to Changemaker

Cheryl A. Maurana, PhD; Joseph E. Kerschner, MD

Improving the health of communities is a foundational mission of the Medical College of Wisconsin (MCW). The last 10 years have been characterized by substantial progress in fulfillment of our promise to the public, and plans for the future are poised to be even more transformative.

The enhanced capacity to effect change began with Blue Cross & Blue Shield United of Wisconsin's decision in 1999 to become a for-profit stock corporation. This conversion led to the Insurance Commissioner of Wisconsin issuing an order directing that the proceeds from this process be allocated equally to Wisconsin's two medical schools, MCW and the University of Wisconsin School of Medicine and Public Health. MCW's portion of the funds was used to create an endowment with an initial value of $318 million called Advancing a Healthier Wisconsin. In 2004, MCW funded its first initiatives through the endowment in community health, research, and education.

In the years that have followed, the Advancing a Healthier Wisconsin (AHW) endowment has helped over 150 MCW faculty members engage more than 350 diverse community groups to advance public and community health. The AHW endowment has awarded $164.8 million to 311 initiatives dedicated to improving community health, advancing biomedical and population health research, and enhancing education for health professionals in Wisconsin. In addition, these opportunities to work with partners to change the health of Wisconsin were accomplished with an underlying purpose of excellent financial stewardship. With this philosophy, the endowment has grown to more than $419 million, allowing MCW and its partners to be well positioned to further advance the AHW vision into the future.

On May 8, the Advancing a Healthier Wisconsin endowment formally celebrated its 10-year anniversary by looking forward and pledging to build on the knowledge and experience gained during the last decade. The vision for the future is to shift from an emphasis on grantmaking to an emphasis on changemaking. This will challenge AHW to be proactive in seeking initiatives that focus on strategic, long-term change for maximum impact in the community.

As a changemaker, the AHW endowment will shift its focus to other roles beyond making grants. These roles include convening needed multisector discussions and partnerships, informing smart policies and effective health improvement efforts, and investing differently to seek sustainable results and more substantially transform systems throughout Wisconsin.

> With our partners, MCW maintains a commitment to inform by bringing meaningful and data-driven ideas into the public sphere to encourage healthy behaviors.

With our partners, MCW maintains a commitment to inform by bringing meaningful and data-driven ideas into the public sphere to encourage healthy behaviors. Through the leadership of our faculty and community stakeholders, we aim to influence participation and collaboration in community-engaged research and interventions as well as strong public policy that enhances the quality of life in Wisconsin. Intrinsic to these goals is the responsibility to learn about the most urgent problems facing Wisconsin communities through dialogue and research so MCW can bring to bear the resources and talents of its faculty to begin

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Dr Maurana is Professor and Director of the Advancing a Healthier Wisconsin endowment, Vice President for Strategic Outreach, Medical College of Wisconsin; Dr Kerschner is Dean of the Medical School and Executive Vice President, Medical College of Wisconsin.

translating knowledge into solutions.

As a whole, the Advancing a Healthier Wisconsin endowment, using a community-academic partnership model, has supported research into basic, clinical, translational and population science; enhancement in undergraduate and graduate medical education; and education for health and public health professionals, as well as patients, to improve the health of people in Wisconsin. Capitalizing on strengths in these essential areas, the endowment's framework for the future will integrate cross-cutting initiatives that address Wisconsin's leading causes of death and disability. In our role as changemaker, we will make strategic, targeted investments designed to result in measurable improvement in long-range outcomes.

These initiatives will be complemented by responsive funding opportunities dedicated to pilot and development projects whose results will demonstrate the viability of new ideas for further implementation. This approach will allow MCW to be nimble while also upholding our core priorities.

Both the Advancing a Healthier Wisconsin endowment's history and future are built on collaboration and the diligence of community partners statewide. The evaluation of our efforts to date and the development of our plan for the next 5 years and beyond were solidly informed through input from public stakeholders, our board of trustees, MCW faculty, staff, and students, and the directors of other similar conversion foundations, who contributed lessons learned and best practices. This model has served the state well and has our full confidence as we move ahead.

Through the past 10 years, the Medical College of Wisconsin has been acutely aware of the unique responsibility and opportunity that has been provided to the medical schools in Wisconsin through this conversion fund. Working with our partners, MCW and the Advancing a Healthier Wisconsin endowment is committed to catalyzing positive change to secure better health for Wisconsin communities.

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