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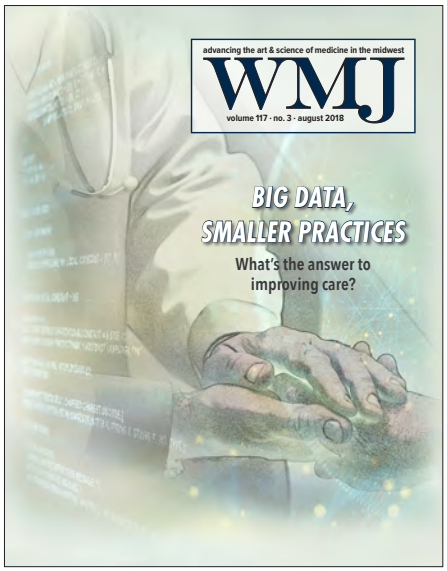

COVER THEME
Big Data, Smaller Practices: What's the answer to improving care?

Finding ways to improve the quality of care is an ongoing goal in health care, and two key efforts are highlighted in this issue of *WMJ:* the value of using "big data" to drive quality and the recent growth of direct primary care.

Cover design by Jane Lee

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WMJ

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EDITORIAL

REVIEW ARTICLE

ORIGINAL RESEARCH

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Wisconsin Medical Society

The Loneliness of Mental Illness at the End of Life

Eileen Ahearn, MD, PhD

When we first met her, it was about hospice care. She was a small, elfish woman, 75, with thin spindly legs and sunken eyes. Standard-issue green nonslip hospital socks pointed out from underneath an old crocheted afghan. Her daughter, worried and tearful, sat at the foot of the bed. The room was late American nursing home: beige with reprints of placid winter scenes on the walls. The decor was a wan attempt to warm up an unmistakably clinical setting.

She said she was trying to make the best of it. The news was barely 2 weeks old. Someone noticed a strange yellow tint to her skin, then there came ultrasounds, CT scans, visits with surgeons and the oncologist, and the diagnosis of advanced pancreatic cancer. "I don't want to do all that," she said. "I am ready to go." We told her we were there to help her have a good death, her way, with some dignity and as little pain as possible.

She told us of her miserable marriage, her belittling husband, her tormented life. She had done everything to be a good wife and mother, raised 4 children, cooked, cleaned, kept the house going. But it was never good enough for him. She had been trapped for years. Finally, 4 months ago, she had gotten the courage to escape. She moved to a shelter for abused women, at a secret location. She wanted to make a clean break, and decided to break from her husband, from her entire family.

The people at the shelter helped her to get an apartment and plan for divorce. They were wonderful, she said. They really understood her. And, she loved having her own place. It was liberating. She got a small dog named Sam and she planned their days around walks and watching TV, side by side. She could make her own schedule, go out with new friends. She started going to a local Lutheran church with some neighbors down the hall. She was a Catholic, but it didn't make much difference to her. Church and then lunch afterwards. She was happy and safe, finally shed of her abusive husband.

But then the cancer diagnosis. She was shocked at first, but then it seemed in accord with the harshness of her life. She settled into the news. She contacted her daughter to drive her to her appointments and move her into the nursing home. The other siblings came by to visit. The family was invited back into her life, except of course for the abusive husband.

After our visit, the daughter followed us out of her mother's room. We walked down the hall, past milling patients with walkers, past the nurses' station and the portable medicine carts. There is something you need to know, she tells us. Her mother's story is "not quite right."

"None of what she said about my father ever happened. He was a devoted husband who never was mean to her. She remembers her life all wrong." As it happens, none of her adult children nor her husband know what started this derailment in thinking. "Now she wants us back in her life, as if nothing has happened. And there is hardly any time left."

We are drawn up short. We can't be certain of the cause, we tell her, but we will try to shake loose these false beliefs. We offer words of support, a medication to try, a promise to return, and the hope that there is still time to reunite the family. The daughter looks at us. She is worn out and doesn't seem hopeful. The terminal cancer diagnosis was hard news, but the ongoing rupture of the family has been devastating. It has all been too much.

Cancer may ravage the body, but there is a known trajectory of treatment options and outcomes. People understand what terminal cancer means and they come by to visit: the minister, the old neighbor, the former colleague. They come and go as you lie in bed and your spouse sits quietly nearby. In the end, you can hope to experience the end of your life surrounded by family and friends with soothing words and gentle care as you take your last breath.

Her cancer death will be a sad passage, but all the more so if she remains lost in a delusion that has rewritten her life, taken her family from her, erased her husband, and left her utterly alone. Her children do not recognize the person she has become. The husband will not be there at the end; the daughter will do what she can between shifts at work. Perhaps the minister can stop by. The staff will show kindness, but it will be a lonely death if she does not return to her right mind. Mental illness has a cruelty all its own.

Postscript

The patient was admitted to hospice care and an antipsychotic was tried with no improvement. The hospice team focused on comfort measures and helped the family through this complex goodbye. The patient died peacefully 2 weeks later and the entire family, including the husband, was present at her funeral.

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Small Is Beautiful* – or Is It?

John J. Frey III, MD, *WMJ* Medical Editor

One of the more interesting areas of discussion in health care in the United States is, on one hand, the value of "big data" in improving care and, on the other, the value of downsizing practices away from large systems and creating small practices with a fixed population of patients. Wisconsin and the Upper Midwest may be an important laboratory for examining those two seemingly disparate trends, and this issue of the *WMJ* contains articles that illustrate both.

Perhaps no region of the country has been as dedicated to the creation of larger and larger health systems with emphasis on multispecialty group practices as Wisconsin and Minnesota. Madison and Konrad, in their seminal paper on the history of employed physicians and large groups wrote 30 years ago, "The revolutionary change, the one likely to introduce a new era of medical practice, is the ascendancy of the organization-employed physician."[1] Well that era is here and has been for quite a while. Nationally, physicians are employed in systems rather than owning their own practice either solely or in partnership. Family physicians nationally are 71% employed, with 21% being members of large multispecialty groups and 28% employed by hospital health systems. (Facts about Family Practice. American Academy of Family Physicians. https://www.aafp.org/about/the-aafp/family-medicine-facts/table-4.html) Wisconsin has led the country in the percentage of employed physicians where estimates are that 50% of all physicians in the state are employed in one of 17 large group practices.

So the review by Carlesare[2] and the Office of Professional Satisfaction and Practice Sustainability of the American Medical Association on the rise of direct primary care practices might seem like the description of a small sailboat in a sea of ocean liners. However, the forces that Madison and Konrad wrote about in the 1970s that were driving physicians to form groups, Carlesare argues, have come back to push medical practice to exploring older ways of organizing practice: small or solo groups, direct "retainer-based" business models, low overhead, high continuity, and neighborhood based. Many physicians are choosing a higher risk, likely lower paid practice model over comfort, salaries, and routine. Not only do they feel that they have more control over their lives, they feel a sense of ownership. Anyone who has gone to a locally owned restaurant or small business or talks with a dairy farmer understands the motivation behind physicians wanting to have a sense of ownership. An abiding belief in themselves motivates people all over the world to make a business theirs.

A national study by Eskew and Klink about the distribution of direct primary care practices in the United States found that Wisconsin was among the 3 states with the highest number of registered direct primary care practices.[3] That doesn't mean there are a lot, but most primary care physicians know of someone in their community who has or is thinking about transitioning from a large group to a direct primary care practice. So far, the movement is under the radar, but not likely to remain there as long as the dysphoria among employed physicians remains high. Carlesare's article in this issue will add to the discussion of what has increasingly become an alternative to the large multispecialty and hospital owned groups in this country. One challenge that might change the current malaise in large multispecialty groups might be for them to use the experience of direct primary care practices to create small, neighborhood, high value, low overhead practices within large systems. There is really no reason except inertia for large groups in Wisconsin not to try that approach. Maybe David has something to teach Goliath.

> Health systems and insurance companies have entire buildings full of people whose job it is to measure, analyze, and provide "oversight" for clinicians. Has it made a difference?

Big Data for Better or Worse

Anyone practicing medicine in the past 25 years has felt the increasing burden of measuring things. Where it all started is hard to pin down, but measuring things came with good intentions driven by the simple logic that if we don't understand where we were, we will not be able to know where we should go. Measuring was simple because the tools we had were simple—cards, ledgers, typed lists, and one's own memory. It took Hart a decade to publish the first measurement of the blood pressure of everyone in a community in 1970.[4] The publication of studies that

*E.F Schumaker; *Small is Beautiful: Economics as If People Mattered.* Harper Collins 2010

showed wide variability in quality and cost drove government, the public, and eventually insurers to decide that decreasing variability and increasing reliability was an important goal. The march to quality had begun, along with the continuing disagreement about what constitutes quality. The result was, in effect, if we can't agree on quality, we will measure everything in the hope of finding it.

Decades later, the advent of supercomputers and electronic health records expanded ways to collect data that required codification, analysis, and use. An entire industry for coding, measuring, reporting, and forcing compliance with "standards" was launched. The Coding and Compliance industry has arguably become the largest overhead cost in American medicine in the past 25 years. Health systems and insurance companies have entire buildings full of people whose job it is to measure, analyze, and provide "oversight" for clinicians. Has it made a difference? Not particularly.

The Commentary in this issue from Stiles, Barrett, and Beasley[5] is an attempt to bring some sense to the runaway world of measuring everything. They review the history, intentions, results, and consequences of using metrics for every aspect of medicine and make a case for bringing measurements back to their original intent – constructive data to help physicians understand how to improve our care without oppressing our lives. They don't advocate moving away from measuring or collecting information but want to revise the process to center on physician and patient and community needs, not insurance or corporate needs.

On the other hand, Munson and colleagues demonstrate the value of big data and accurate measurement to affect important clinical outcomes.[6] They describe a statewide, systematic collection of evidence for resistance in pathogenic bacteria and, not surprisingly, find that there are wide variations in regions and communities. Treating common infections may require different antibiotics in Rhinelander, Wisconsin compared to Kenosha. Standardization of data is essential to forming clinical care initiatives. Just as all politics is local, much of therapeutics is local. One of the largest obstacles to the rational use of antibiotics remains the dissemination of information and education about its use to the practicing community. Electronic Health Records may be useful in this regard but require individualization and continuous updating from studies like Munson et al.

Clinical Studies and Clinical Stories

The brief research report from Rongstad and colleagues about food insecurity in a convenience sample of pediatric patients in Dane County makes the case for using screening tools for social determinants of health.[7] However, the small percentage of patients who have food security issues in their sample compared to statewide studies or studies from other regions showed different results. A study of children visiting an emergency department in Milwaukee found much higher levels of food insecurity.[8] Not only where you live but where you access care might be worth analyzing.

The study by Berg and colleagues shows an essential fact of prevention and clinical practice: if we ask about risks, we need to have an action step based on the answer that has a chance of mitigating that risk.[9] In this case, they studied whether primary care clinicians ask patients about smoking (they do for the most part but still ask less often young people and people of color) and whether, having identified smokers, clinicians would invite them to engage in an effective intervention to decrease or stop smoking (they did two-thirds of the time). Having something to offer other than encouragement is an important incentive for clinicians. This study shows that, armed with help and an intervention that has a good chance of working, primary care clinicians will take a more active role in preventive counselling.

Two case reports to point out that rare things happen. Muganda and colleagues describe a case of meningoencephalitis in a toddler due to raccoon roundworm.[10] Fortunately they were able to treat the child who continues to have some residual neurological problems. How did he get it? Ask parents if a child exhibits pica or geophagia, and while some research supports the value of dirt for the enterobiome, dirt from the wrong places can be fatal!

Libricz and colleagues report on 2 cases of inadvertent cannulation of the carotid artery when trying to place a central venous line.[11] The cases demonstrated quick thinking and recovery of the cannula using a technique assisted with ultrasound. One hopes this never happens but if it does, it is nice that there are some alternatives possible.

Finally, a remarkable "As I See It" essay/story from Ahearn is a moving account of the terrible disruption that mental illness can bring to end-of-life care.[12] Her essay raises the specter of who and what to believe as a palliative care clinician and how the line between truth and delusion can be a very fine one at times.

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METRICS for Metrics

Melissa M. Stiles, MD; Bruce Barrett, MD, PhD; John W. Beasley, MD

Metrics are pulling medicine into a large data vortex at the potential expense of patient care and physician satisfaction. Primary care clinicians are inundated with data from patient satisfaction scores, patient panel size reports, quality metrics, and electronic medical record (EMR) meaningful use metrics. The use of metrics, like other medical interventions, has potential costs and harms as well as benefits and should be based on good science and a careful analysis of outcomes.

As physicians, we have a professional and ethical obligation to apply the same rigor of evidence to implementing metrics as we do for diagnostic testing and therapeutic decision-making. In this essay, we ask the following questions: Do metrics lead to positive patient care outcomes? What is the cost of measuring and reporting metrics? What are the risks and unintended consequences of focusing on metrics? We cannot definitively answer these questions, but we do provide a rubric to guide such endeavors.

Do Metrics Improve Patient Outcomes?

Of all the metric systems, the most studied are pay-for-performance programs (P4P). To date, these programs have failed to achieve the Institute of Healthcare Improvement Triple Aim of high quality care, improved population health, and lower health care costs.[1] Several systematic reviews have concluded that P4P programs have not consistently shown improvements in quality measurements.[2-4]

For example, the United Kingdom has a 10-year history of national-level systematic P4P experience that includes clinical metrics, patient satisfaction, and organizational indicators. The Quality and Outcomes Framework (QOF) was initiated in 2004 and included paying primary care physicians up to 25% of their income for achieving 147 quality metrics. Initially there were minor improvements in a few of the quality metrics related to diabetes and asthma, but they were not sustained after 2 years.[5-7] In response to these results, the program is now undergoing a major revision in England and has been abandoned altogether in Scotland in favor of local "quality circles" of 10 to 15 practices working collaboratively on quality improvement.

Similarly, a P4P program in the state of Washington was not associated with any significant changes in quality measures over 4 years.[8] A recent analysis assessing the validity of 86 Quality Payment Program measures in the United States found only 32 (37%) were rated as valid and 24 (28%) were deemed of uncertain vailidity.[9]

What is the Cost of Tracking Metrics?

Tracking metric costs include payment to physicians; administrative cost of developing, implementing, and maintaining programs; committee time in deciding what metrics to use; and administrative staff, including highly trained professionals with data-management and statistical experience. The current cost of the QOF program in England is approximately 1 billion English pounds per year (1.4 billion US dollars), which would make cost-effectiveness questionable even if improvements were clearly shown.[10] In the United States, the total cost of implementing and sustaining outpatient and inpatient P4P programs is unknown. A recent study estimated that US physician practices spend more than $15.4 billion each year reporting quality metrics, which equals about $40,000 per physician per year.[11] To our knowledge, there are no cost-effectiveness studies.

> "Sometimes the more measureable drives out the more important."
>
> —*Rene Dubos*

Unintended Consequences

All practice changes have unforeseen consequences, and the focus on metrics is no exception: there are negative effects on the physician-patient relationship and workforce satisfaction.[12]

P4P programs may shift the focus of the visit towards data collection and questions relevant to what is being measured rather than what is actually important.[13] This is often at the expense of the patient's agenda, with a "by the way, what brings you in?" question at the end of a litany of metric-aimed questions. P4P programs have the potential to disrupt the physician-patient relationship. In the QOF experience, there were no significant improvements

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in patient satisfaction between 2003 and 2007.[7] Although mean scores on the physician-communication scales and wait times did not change, continuity of care decreased significantly.[6] There is also a potential to discharge patients from the practice if they are not meeting targets. In a qualitative study comparing English physicians with California physicians, California physicians were more likely to express frustration with nonadherent patients, sometimes discharging these patients from their practices.[14]

METRICS for Metrics

The judicious use of valid metrics has the potential to significantly improve quality of care, health inequities, and population health; their use should not be altogether abandoned. Going forward we propose the following basic principles for metrics, similar to those proposed by Young Roberts & Holden, and by Saver et al.[15,16]

1. Metrics should address patient-centered, clinically **M**eaningful outcomes.
2. Metrics should be **E**vidence-based.
3. Metrics should be re-evaluated in a **T**imely fashion when new evidence emerges.
4. The **R**eturn on investment, benefits and risks of measuring the metric should be evaluated.
5. Metrics should be **I**ndividualized.
6. Metrics should address meaningful **C**ommunity and population health outcomes.
7. **S**hared decision-making should be accounted for, whether or not a patient accepts or declines a test or treatment.

CONCLUSION

As US health care systems continue to invest large sums while linking compensation to "quality metrics," it is time to insist that the use of metrics be supported by evidence and guided by scientific and ethical principles. All interventions should be useful, cost-effective, and have limited "side effects." To date, P4P metrics have not met that test. There are legitimate concerns that as more and more metrics are being measured, we may be losing focus on our patients' concerns, and on the more meaningful but less measurable determinants of health. We should learn from the United Kingdom's 10-year experience with P4P programs. Health care organizations and governmental bodies must pause and ask what has been achieved thus far—and at what cost—before proceeding down a costly and potentially ineffective path.

Box. METRICs for Metrics

M	Meaningful
E	Evidence-based
T	Timely
R	Return on Investment
I	Individualized
C	Community and Population Health Outcomes
S	Shared Decision Making

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Defining the Place of Direct Primary Care in a Value-Based Care System

Lindsey E. Carlasare, MBA

ABSTRACT

Introduction: Direct primary care, one of several retainer-based practice models, is a niche practice type that offers an alternative to the traditional fee-for-service and insurance-based practices most prevalent in US health care. In Wisconsin, the prevalence of direct primary care practices is higher than in most other states. The market for direct primary care practice may be growing along with the industry shift to value-based care and an increase in physicians' desire to reduce the increasing administrative work and regulations that detract from patient care and increase burnout. Many physicians are seeking ways to reduce these burdens so they have more time with patients. Some are transitioning their practice to a retainer-based model, such as direct primary care, in which they collect a retainer from patients in exchange for more time, freer communication, and less paperwork.

Objective: The objective of this review is to provide information about the direct primary care practice model, possible drivers to this model of care, and its advantages and drawbacks for physicians and patients. This discussion also aims to evaluate the care model's place in the shift to value-based care, and key positions and policy from leading organizations.

Methods: A literature review was conducted to collect and analyze current evidence about the prevalence of retainer-based practices, the average fees associated with such models, the contributors to physician burnout that may lead to a transition to the direct primary care model, and the relevant ethical and policy considerations associated with direct primary care.

Discussion: Eighty-two percent of Wisconsin physicians report some level of burnout. Estimates demonstrate an increase in the number of direct primary care practices, and that Wisconsin is among the top 3 states with the highest number of direct primary care practices. The literature suggests that since the early stages of modern retainer-based models, patient fees have decreased and the patient base for these practices has expanded. The practice model is relatively rare, although there are indicators that its presence has increased in recent years.

Conclusions: Physicians seeking strategies to reduce administrative burden, spend more time with patients, or simply streamline their practice may experience benefits in transitioning to a retainer practice such as direct primary care. There are foundational concepts about direct primary care, including advantages, drawbacks, and ethical considerations, to heed when transitioning to this model. There is a need for further research to quantify key data about direct primary care and its effects on patient outcomes and physician burnout and satisfaction.

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INTRODUCTION

Health care in the United States has transformed in recent years as influences throughout the system necessitate changes in the ways patient care is delivered and paid for. Physicians increasingly find themselves facing burdensome administrative work,[1] pressure to increase the quantity of patients,[2] and increased levels of burnout.[3] Recent research shows 82% of Wisconsin physicians report some level of professional burnout and over half feel their work environment is chaotic or hectic.[4] Insurers are navigating higher costs and regulatory changes, and patients contend with a lack of transparency about their care and higher out-of-pocket costs. Often patients are forced to mediate between their providers and insurance carriers to ensure their care is covered and avoid the potentially serious financial consequences of receiving noncovered treatment.

Managing this ever-changing assortment of influences has become burdensome and problematic for some physicians. An increasing number of physicians are seeking ways to reduce the time spent on tasks that take away from patients and spend more time on activities that contribute to professional satisfaction and better patient care.[2] For some, this has meant transitioning their practice to a retainer-based model in which many of the administrative tasks are eliminated and they are able to spend significantly more time with their patients. Little quantitative data exist about the prevalence or implications of this practice model. This review aims to provide a synopsis of direct primary care, clarify misconceptions about the retainer-based practices, and emphasize the need for clarity and more substantial data about physicians and patients participating in this type of care setting.

METHODS

A literature review was conducted to identify information about various practice models in which a retainer fee is paid in exchange for open access to a physician's care. Articles and statistical analyses reviewed included those that focused on direct primary care, concierge and, to a lesser extent, other types of retainer-based practices. Literature on the effects of administrative and regulatory burdens on physicians also was reviewed to identify if there exists a connection between increases in physician burnout and a desire to enter into a practice model that may reduce or eliminate those burdens. There was some inconsistency throughout the literature in the label used to identify the practice type—"concierge," "direct primary care," "cash practice," and "membership medicine" all were observed. As a result, this review required diligence in ensuring consistency in concepts and topics in the literature used for analysis.

DISCUSSION

Retainer-based practices exist in several forms, including what are known as "boutique medicine," "concierge medicine," "direct primary care," and "membership medicine." Retainer-based medical care has been a part of health care in the United States for at least a century.[5,6] The practice model in its current form, however, is relatively new. Modern concierge practices were introduced in the mid-1990s and other variations, including direct primary care, emerged later in the early 2000s.[7,8] There are distinctions to be drawn between the various practice types that fit in this model, however the following content provides a review of "direct primary care," so the information throughout may not necessarily reflect attributes found in other similar models.

The primary feature of this practice model is a recurring fee, paid by the patient directly to the physician, in exchange for virtually unlimited access to the physician. In its early form, fraternal organizations like lodge clubs or worker's unions paid a physician a regular retainer to provide for their members' health care needs. Decades later, in much different economic times, retainer-based practices were largely available only to the wealthy, since the fees were often tens of thousands of dollars per year. Over time the model has evolved to be more inclusive, and many physicians have made their practices more accessible and affordable to a larger array of patients by reducing the fees and opening their doors to people who do not have insurance.[8,9] The fee, paid on a monthly or annual basis, is often the only exchange of money between the patient and physician, since in most direct primary care practices patients are not charged additional fees for services rendered. The average monthly cost to patients in a direct primary care practice, according to a study published in the *Journal of the American Board of Family Medicine (JABFM)*, is $93.26. For those practices that also charge an additional one-time enrollment fee, the average cost for that fee is $78.39.[8]

Some physicians in this type of practice do not participate in insurance networks or transact with insurance companies, eliminating the need for claims and preauthorizations that can lead to delays in care, complicated paperwork, and interference with the physician-patient relationship.[10] Deviations from this structure exist, as some physicians charge additional fees for certain procedures, and some accept Medicare and other types of third-party reimbursement. Seventy-five percent of physicians in this type of practice arrangement still accept third-party reimbursement,[11] and patients in these settings still may carry some insurance to help cover services the primary physician cannot or will not provide.

Accurately quantifying how many direct primary care practices are in operation is difficult since there is no federal registry or national database listing all physicians in this type of practice. Estimates from industry organizations are based on voluntary self-reported data from various surveyed audiences, so estimates differ across the board. For example, in 2017 the American Academy of Family Physicians (AAFP) estimated nearly 3% of family physicians operated in direct primary care practices.[12] The Medscape Physician Compensation Report 2017, a study of responses from 19,000 physicians in 27 specialties, estimated cash-only practices accounted for 6% of practices in the United States, an increase from 3% five years prior.[13] Additionally, in a 2016 Physicians Foundation survey of 17,236 physicians, 6.6% of respondents indicated they currently practice in a retainer-based setting, and another 8.8% indicated they plan to switch to a cash-based practice within the next 3 years.[14] A study published in the *JABFM* found that Wisconsin, with 21 identifiable direct primary care practices, is among the top 3 states with the highest number of direct primary care practices.[8] The *Direct Primary Care Journal* estimates there are currently 500 to 600 direct primary care practices in operation in the United States, and Philip Eskew, MD, a leading expert in direct primary care, similarly estimates 620.[15,16] These figures suggest the overall market penetration of direct primary care practices is low, although some reports indicate their prevalence has increased in recent years and will continue to do so for the near future. The growth projections vary, however, depending on the analyst's definition of what qualifies as direct primary care. For instance, The Heritage Foundation reported in 2014 that approximately 4,400 direct primary care physicians were in practice, compared to 756 four years prior.[17] Using a different set of criteria, DPC Frontier estimates that by 2020, 2,000 direct primary care practice locations will be in operation.[16]

The literature reviewed demonstrates a variety of potential contributors to physician entry or transition into a direct primary care practice model. Demand for health care services has increased in recent years as a result of growth in the insured population and other factors. Increased demand in care has not been met with increased physician supply, however, resulting in more patient visits to fit into the clinic day, which is a known contributor to phy-

Box 1. Potential Benefits and Drawbacks of the Direct Primary Care Model

Possible Advantages for Physicians	Potential Drawbacks for Physicians
More time with patients	Possible lower income at start
Reduction in administrative work	Risk of feeling isolated
Improved professional satisfaction	Fewer patients
Decreased interaction with payers	May overburden other, non-retainer-based practices
Improved work-life balance	Difficult to recruit and build patient base
Fewer patients	Insurers may not cover services
Lower overhead costs, fewer staff	
Possible Advantages for Patients	**Potential Drawbacks for Patients**
More time with physician during visits	Does not eliminate requirement to carry insurance
Increased access to physician after hours	Additional monthly payment
Improved quality, personalization of care	
Possible lower out-of-pocket costs	
Ease of communication with physician via email, text, or telephone	
Increased price transparency	

sician dissatisfaction.[18] Physicians also face a significant amount of administrative work in complying with payer demands and regulatory requirements.[19] Over half of physicians report symptoms of burnout, and the percentage of physicians who are satisfied with their work-life balance has decreased to just 40%.[3] Considered together, these factors are likely contributors to the attraction to a model of care that eliminates many of these burdens.[10,20,21]

Retainer practices as a whole currently are not heavily regulated. A clause in the Patient Protection and Affordable Care Act requires that the insurance exchanges include direct primary care with another wraparound policy to ensure adequate coverage.[22] States have largely been left to choose if and how to regulate the practice model, and, to date, many have enacted laws exempting direct primary care practices from insurance regulations. Wisconsin is currently among the states with no existing laws.[23]

Retainer-Based Practices in Value-Based Health Care

The shift to value-based care in the US health care system is driven by a need to improve patient outcomes and reduce costs for patients, as well as health care spending overall. Both physicians and payers have been driving forces behind this pursuit of higher quality care at a lower cost.

One of the primary advantages to practicing in the direct care model is the ability to spend more time with patients, providing more thorough and personalized care.[17,20] Physicians at Solstice Health, a direct primary care clinic in Wisconsin, experience this effect in practice. Compared to a national average of 7 minutes spent with a patient during a visit, Solstice Health physicians spend an average of 60 minutes with their patients.[24] For some physicians, another advantage of direct primary care is the elimination of the need to interact with payers, thereby reducing administrative functions such as documentation requirements, prior authorization, and electronic health record and desk work which are known to contribute to burnout,[1] as well as potential costs that would otherwise get passed on to the patient. Patients at Solstice Health work only with their physician, while in traditional models other clinicians and payers may have a role in deciding a course of treatment. Another direct primary care practice in Wisconsin, ReforMedicine, asserts that its practice model saves patients up to 50% on costs compared to traditional insurance-based practices.[25]

For patients, the increased attention and more open, personal, and regular access to the physician may strengthen their relationship with their physician, which can improve the patient health care experience and enable better outcomes and lower costs.[26] Accenture consumer research shows prior knowledge of out-of-pocket health care costs is important to 91% of patients,[27] suggesting that increased price transparency provided in direct primary care models could improve the patient experience. Possible drawbacks for patients are that the recurring fee is an additional cost, and receiving care from a direct primary care physician does not preclude the requirement for carrying health insurance. See Box 1 for potential benefits and drawbacks for both physicians and patients.

Ethical Considerations

Critics of the retainer-based medical practice model cite ethical concerns about access, quality, and continuity of care that arise in the fundamental concept of limiting the volume of, and thus access to, one's health care practice. For example, AAFP reports that the average patient panel of a direct primary care physician is between 600 and 800, compared to a panel of 2,000 to 2,500 for a physician in a traditional fee-for-service setting.[28] There could be perceived ethical concerns about the limitations of access to care that would result from reducing a patient panel at this rate. Proponents of direct primary care assert that it is their obligation to provide competent and ethical patient care that makes retainer practices a well-suited model of care.[29]

Also of note are the implications for the physician workforce. The United States is facing an increase in physician demand projected to leave the nation with a shortfall of 40,000 to 100,000 doctors by 2030.[30] Reasons for the anticipated shortage include an aging senior population, retiring physicians, and a growing total population. Physician burnout is also a significant threat to the physician workforce,[31] as it can drive physicians to reduce their work hours, see fewer

patients, or retire from practice altogether.[32] There are concerns that if physicians move to practice models that inherently reduce their patient panel, it will exacerbate the physician shortage, leaving patients without access to care, and that many patients will be priced out of the practice, potentially leaving them without a physician. Limiting the patient base to only those in certain geographical areas or those who can afford the annual fee can be perceived as intentional restriction of access to care for underserved or low to middle income populations—a "social injustice" that some believe is an outcome that physicians are obligated to diminish.[29] To help mitigate this, physicians who transition to a direct primary care practice can make an effort to help patients who do not want to participate in the new arrangement find another provider.

The American Medical Association (AMA) Code of Medical Ethics recognizes that regardless of the model in which they practice, physicians must uphold their primary professional obligation of fidelity and their responsibility to treat all patients with courtesy and respect for patients' rights and dignity.[33] Physicians should also ensure that all patients in the physician's practice receive the same quality of medical care, regardless of contractual arrangements for special, non-medical services and amenities.

Box 2. Common Myths and Truths About Retainer-Based Practices

Myth	Truth
Retainer-based practices are only available and affordable for wealthy and elite patients.	While concierge or boutique medical practices started out as a type of practice catered only to the wealthy, in recent years other types of retainer practices, like direct primary care, have emerged. These models typically have lower monthly fees,[8] which allows patients of a wider variety of socioeconomic statuses to have access to this type of care. Average annual fees range from $1,200 to $3,000 nationally,[38] and the average monthly fee is $93.26.[8]
Direct primary care practices do not accept insurance.	It is true some direct primary care practices do not accept reimbursement from insurance payers, but many do. The decision to accept insurance is at the sole discretion of the physician, but consideration should be given to the health care market in the area, patient pool, type of specialty/services provided, and willingness to accommodate the administrative requirements of submitting claims to and receiving payment from insurers.
Patients do not need insurance if their physician practices in direct primary care.	Retainer-based medical practices are not insurance. Current federal law mandates that every individual maintain health insurance coverage, and going without will result in a tax penalty. Some patients may choose to forego comprehensive health insurance, but having basic, prescription, or catastrophic coverage can help provide payment for services that may not be covered by the retainer paid to the physician. Medicare-eligible patients also may benefit from seeing a physician who accepts Medicare payment in addition to the retainer.
Retainer-based practices such as direct primary care make a significant amount of money quickly.	While the eventual income can be very rewarding, the upfront costs of opening a new practice can be high. Additionally, like any business startup, a new retainer-based practice takes time to develop and grow. Building a strong patient base and steady income can take years.

Organized Medicine

Many physician and health care focused organizations recognize the potential for a surge in direct primary care practices, and have issued policy, guidelines or principles to assist physicians in making decisions about their practice. The AMA, for example, supports physician choice of practice and the inclusion of direct primary care as a qualified medical expense for IRS tax deductions. Additionally, the AMA adopted principles for operating a cash-based practice that include guidance on how to transition to such a model.[34-36]

The AAFP recognizes direct primary care as a sensible solution to the issues that physicians face in practice today. Approximately 3% of its membership practices in this setting.[12] The AAFP has actively endorsed legislation that expands access to these types of practices and supports the model as a true alternative to fee-for-service payment models. The AAFP also draws a distinction between direct primary care and concierge medical practices, describing the lower retainer fees of direct primary care as the key difference.

The American College of Physicians (ACP) issued a policy position paper on direct patient contracting practices that assesses the effects on access, cost, and quality of care, and discusses ethical principles that should apply to all practice types.[37] While the ACP supports physician and patient choice of practice and delivery models, its primary concern with the practice model is the potential for limiting access to care for low-income populations, patients with chronic disease, or underserved populations. Other concerns are its effects on physician workforce and the unknown effects on overall costs of care.

The Future of Direct Primary Care

Given the relative newness of the practice model in its modern form, there is a lack of evidence to demonstrate the long-term effects on patients and physicians of participating in direct primary care. Additionally, while the recent growth in the market has stirred up more attention, it also has instigated confusion and misinformation about the practice type. See Box 2 for a description of common myths and truths about retainer-based practices, including direct primary care.

Widespread adoption of direct primary care practices has been slow, and while its presence in Wisconsin is larger than in most states, direct primary care practices remain only a small portion of the physician practices at the state and national levels. As changes in federal and state insurance regulations and advancements in health information technology continue to influence the practice of medicine, physicians increasingly may transition or enter into

direct primary care in an effort to reduce administrative costs and improve the quality of patient care. In addition to dispelling myths about the practice model, further research should be pursued to gain a deeper understanding of direct primary care, its implications for physicians and patients, practicality and sustainability, and its effects on the costs of health care and health outcomes. The need for outcomes analysis and the development of best practices will become increasingly important as the number of physicians transitioning to this practice model grows.

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Identifying Differences in Rates of Invitation to Participate in Tobacco Treatment in Primary Care

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ABSTRACT

Introduction: The progress achieved in reducing tobacco use has not been consistent across groups of smokers, and health systems are inconsistently implementing best practice guidelines. Guideline implementation could be associated with improved treatment invitation rates.

Aims: To evaluate differences in tobacco treatment invitation rates based on patient characteristics in primary care clinics implementing best practice guidelines.

Methods: A secondary analysis of patients presenting to 11 primary care clinics from 2 Wisconsin health systems from June 2010 to February 2013. The main outcome was whether patients received an invitation to participate in tobacco treatment. Invitation rates were examined by sex, age group (≤24 years, 25-44, 45-64, ≥64), race (white, black, other), insurance status (private, Medicare, Medicaid, none), and visit diagnosis ("high-risk" [cardiovascular and pulmonary disease, malignancy, pregnancy] vs "low-risk" [all other ICD-9 categories]). Moderation effects of health systems also were examined.

Results: Of the 95,471 patients seen, 84,668 (89%) were screened for smoking. Among the 15,193 smokers, 10,242 (67%) were invited to participate. Invited patients were older, white or black, and carried low-risk diagnoses. Invitation rates and patient-level differences varied between the health systems.

Conclusions: Variable treatment invitation rates and health system differences remain evident in the primary care setting employing robust clinical practice guideline recommendations.

INTRODUCTION

In 2008, the United States Public Health Service clinical practice guideline, *Treating Tobacco Use and Dependence*, highlighted the importance of having a systematic team-based effort to deliver smoking cessation treatments to smokers. Critical to achieving smoking cessation is the identification of, and intervention with, *all* smokers, harnessing the capabilities of the electronic health record to do so.[1] Offering consistent, evidence-based tobacco use treatment by health systems and insurers may be the most effective preventive clinical intervention available to primary care and would help to reduce the nearly $200 billion spent annually on medical care and lost productivity due to tobacco use in the United States.[1]

Despite these strong recommendations to identify and treat all smokers, the United States continues to see disparities in the use of tobacco products. Younger individuals, men, some racial and ethnic minority groups, those with substance use or mental health diagnoses and individuals from socioeconomically disadvantaged backgrounds have a higher prevalence of smoking than individuals over 65 years of age, women, non-Hispanic whites, and individuals with larger household incomes or higher educational attainment.[2] Wisconsin does not escape these national trends; the state loses $4.6 billion annually in health care costs and lost productivity due to smoking.[3] Smoking is nearly 4 times as prevalent in individuals who live in poverty and twice as prevalent in blacks as whites.[4] Wisconsin's insurance coverage for tobacco use treatment is also suboptimal: the state did not expand Medicaid and does not have a private insurance mandate for provision of tobacco cessation services.[5]

The difference in prevalence of tobacco use could be related to the fact that younger individuals, men, certain racial and ethnic minority groups, individuals struggling with mental health and substance use, and socioeconomically disadvantaged individuals are less likely to receive cessation advice and treatment from health care

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providers. This has been demonstrated in multiple studies since 1997.[6-9] One reason for the continued disparities in identification and treatment rates could be the limited numbers of health care systems that are able to implement all clinical practice guideline recommendations.[5] It has been demonstrated that quality improvement projects with clinical practice guidelines yield higher quality health care.[10] It has also been demonstrated that smokers are more likely to be identified and given cessation assistance by their primary care provider than by a clinician who is not their primary.[8]

In an attempt to address barriers to providing cessation treatment, the University of Wisconsin Partnership to Assist and Serve Smokers (UW-PASS) study, funded by the National Cancer Institute, was designed and implemented in 11 primary care clinics in southern Wisconsin. While its primary purpose was a primary care clinic-based effectiveness study,[11-13] UW-PASS included several key clinical practice guideline recommendations designed to improve smoker identification and invitation to treatment. Specifically, UW-PASS utilized a team-based approach to smoking cessation, standardization of the invitation to treatment via the electronic health record (EHR), elimination of the cost of treatment, and expansion of the reach of treatment services to all smokers, whether they were ready to quit or not.

This study is a secondary analysis of UW-PASS data, specifically documentation of tobacco treatment invitation rates in the setting of these multiple clinical practice guideline recommendations. It further assessed whether invitation rates varied based on sex, age, race, socioeconomic status, and medical conditions. This analysis could serve as an approximation of treatment invitation rates in primary care clinics implementing clinical practice guideline recommendations for tobacco use treatment. As such, results of these analyses may serve to document whether disparities remain despite standardization of the care process and elimination of the cost of treatment.

We hypothesized that treatment invitation rates in this study would demonstrate less variability with respect to patient-specific factors, as compared to previously reported literature.[6-8] In studies instituting an EHR intervention to increase tobacco use treatment rates, there have been mixed results, with some studies showing a lessening of differences,[14,15] while others showed continued differences in referral rates.[16,17] We hypothesized that team-based care, elimination of the financial burden to the patient, and standardized invitation prompts via the EHR would be associated with higher and less variable tobacco use treatment invitation rates. While multiple studies have examined tobacco use screening and treatment rates, this study examines these rates in an optimized outpatient setting to evaluate whether disparities decrease.

MATERIALS AND METHODS

Study Design, Setting

This study is a secondary analysis of tobacco treatment invitation rates in the UW-PASS comparative effectiveness research project that evaluated different counseling and medication interventions for smokers who wanted to quit and for those who wanted to cut down.[11-13] UW-PASS was implemented in 11 primary care clinics from 2 separate health systems (health system A and health system B) in southern Wisconsin. Patients presenting at these clinics were screened for tobacco use by clinic staff. If the patient was a current smoker, the EHR would prompt the clinic staff to invite the patient to participate in tobacco treatment—either cessation or reduction. All treatments related to the study were provided at the clinic with no cost to participants. Study staff worked with clinic staff to set and reach invitation goals, including providing feedback on invitation rates and incentives such as bagels or pizza parties.

Participants

Participants were recruited from June 2010 to February 2013. Inclusion criteria included >17 years old; >4 cigarettes/day for the previous 6 months; motivation to quit or willingness to cut down; ability to read, write, and speak English; agreeing to complete assessments; no plan to move from the area in the next 6 months; not currently taking bupropion or varenicline; agreement to use only study medication for the duration of the study (discontinuing any ongoing nicotine replacement therapy [NRT] use); no medical contraindications to NRT use; and agreement by female patients of child-bearing age to use an approved method of birth control. See Cook et al, Piper et al, and Schlam et al.[11-13] for additional details, including CONSORT diagrams. UW-PASS was approved by the University of Wisconsin Health Sciences Institutional Review Board and funded by the National Cancer Institute. Informed consent was obtained from all individual participants included in the study.

Invitation to UW-PASS

Upon rooming a patient, the clinic staff assessed smoking status as part of the patient's vital signs. If a patient reported being a current smoker, clinic staff were provided with a Best Practice Alert (BPA: an EHR prompt), which included a scripted invitation to join the UW-PASS research study. The accessibility of the BPA differed between the 2 health systems: in health system A, the BPA would only provide the invitation script if manually accessed by clinic staff after identifying a patient as a smoker. There were no cues to access the BPA in health system A. In health system B, the BPA was highlighted in yellow (it provided a visual cue) if the patient screened positive for smoking, prompting clinic staff to deliver the invitation.

Patients were considered "invited" if clinic staff recorded whether the patient was or was not willing to be referred to the study (ie, they were considered "invited" even if they declined to participate in the trial). Patients were identified as *not* being invited if they presented to the clinic during the recruitment timeframe and reported current smoking, but the BPA invitation was

either not accessed or there were no actions recorded by clinic staff to address the BPA. It was assumed that this lack of action indicated that the patient was not presented with the invitation to join the study.

Predictor Variables

This study examines a cohort of patients who had not yet consented to participate in the UW-PASS project. Accordingly, only aggregated, deidentified data were used. Data were obtained from the 2 health systems for both invited and not-invited participants. Data included sex, age, racial identification, insurance status, and visit diagnosis. Age was categorized as less than 24 years old, 25-44 years, 45-64 years, and older than 64 years old. Race was based on patient's self-identification as white, black, or nonwhite/nonblack. Insurance status included private, Medicare, Medicaid, or no insurance. Visit diagnosis was determined using the International Classification of Disease 9 (ICD-9) codes and grouped into high-risk versus low-risk. High-risk was any ICD-9 category pertaining to cardiovascular disease (codes 390-459), pulmonary disease (including infectious; 460-519), malignancy (140-239), and pregnancy (630-679). Low-risk was any other ICD-9 category.

Statistical Analysis

All analyses were completed using SAS/STAT software, Version 9.4 (Cary, NC). Univariate logistic regression examined the ability of each variable to predict invitation to the UW-PASS project. Multivariate analysis of patient-level predictors was not possible due to the nature of the aggregated dataset and lack of individualized data. We were able to test the potential moderating effect of health system on each of the patient-level predictor variables with multivariate logistic regression models. These models included the patient-level predictor variable, the health system variable (A or B), and the interaction between the predictor variable and health system. This allowed determination of whether the unique health systems were associated with different referral rates based on patient-level characteristics. Patient-level predictor variables that demonstrated significant moderation were then evaluated separately for each health system using univariate logistic regression to document the variability in invitation rates by patient-level characteristics within the unique health system.

RESULTS

During the recruitment period, a total of 95,471 patients were seen in the 11 Wisconsin-based clinics. Of these, 84,668 (88.7%) were screened for smoking, and 15,193 (17.9%) were identified as current smokers. Of current smokers, there were significant differences between the health systems. Health system A had more women and more high-risk diagnoses. Health system B had younger patients and more individuals with private insurance. Both health systems cared for patients who were predominantly white (Table 1). Within the 2 health systems, 10,242 (67%) were invited to participate in the UW-PASS program; 4,951 smokers (33%) were not invited. The 11 clinics varied widely in invitation rates, from 40% to 88% (mean = 73%).

Univariate logistic regression analyses revealed that smokers who were invited to participate in UW-PASS tended to be older, self-identified as either white or black, and had a low-risk diagnosis (see Table 2). Patients with Medicare insurance were more likely

Table 1. Demographics of Smokers in Health System A and B

	Health System A	Health System B
Sex*		
Men	4,438 (45%)**	2,579 (50%)**
Women	5,373 (55%)**	2,565 (50%)**
Age*		
18-24 years	983 (10%)	623 (12%)
25 – 44 years	3,933 (40%)	2,187 (43%)
45 – 64 years	4,105 (42%)	1,854 (36%)
≥ 65 years	823 (8%)	472 (9%)
Race*		
White	8,657 (88%)	4,541 (88%)
Black	694 (7%)	311 (6%)
Other	463 (5%)	292 (6%)
Insurance*		
Private	5,032 (56%)	3,406 (66%)
Medicare	1,450 (16%)	449 (9%)
Medicaid	1,578 (18%)	900 (17%)
None	945 (10%)	389 (8%)
Visit Diagnosis*		
Low-risk	4,083 (69%)	4,371 (75%)
High-risk	1,836 (31%)	1,455 (25%)

*Denotes statistically significant difference, P < 0.05, between health systems.
**238 smokers were of unreported gender which accounts for the discrepancy in the first 2 lines of Health System A and Health System B.

Table 2. Univariate Predictors of Receiving an Invitation for Tobacco Treatment

	Invited	OR (95% Confidence Interval)	*P*-value
Sex			
Male	4,662 (66.4%)	Reference	0.2452
Female	5,345 (67.3%)	1.04 (0.97 – 1.12)	
Age			
18-24 years	950 (59.2%)	Reference	< 0.001
25-44 years	3,944 (64.4%)	1.25 (1.12 – 1.40)	
45-64 years	4,208 (70.6%)	1.66 (1.48 – 1.86)	
≥ 65 years	927 (71.6%)	1.74 (1.49 – 2.04)	
Race			
White	8,904 (67.5%)	Reference	< 0.001
Black	681 (67.8%)	1.01 (0.88 – 1.16)	
Other	419 (55.5%)	0.60 (0.52 – 0.70)	
Insurance			
Private	5,742 (68%)	Reference	< 0.001
Medicare	1,390 (73.2%)	1.28 (1.14 – 1.43)	
Medicaid	1,653 (66.7%)	0.94 (0.86 – 1.04)	
None	876 (65.7%)	0.90 (0.80 – 1.02)	
Diagnosis			
Low-risk visit	5,706 (67.5%)	Reference	
High-risk visit	2,022 (61.4%)	0.77 (0.71 – 0.83)	< 0.001

Table 3. Health System-Specific Predictors for Smokers Receiving an Invitation for Smoking Treatment

	Health System A OR (95% CI)	Health System B OR (95% CI)
Sex		
Men	Reference	Reference
Women	1.00 (0.92 – 1.09)	1.34 (1.18 – 1.54)
Age		
< 24 years	Reference	Reference
25-44 years	1.52 (1.32 – 1.75)	0.93 (0.75 – 1.15)
45-64 years	2.16 (1.87 – 2.48)	1.22 (0.97 – 1.52)
> 65 years	2.16 (1.78 – 2.61)	1.25 (0.92 – 1.68)
Insurance		
Private	Reference	Reference
Medicare	1.61 (1.42 – 1.83)	1.06 (0.83 – 1.36)
Medicaid	1.01 (0.90 – 1.13)	0.90 (0.75 – 1.07)
None	1.12 (0.97 – 1.29)	0.68 (0.54 – 0.86)
Diagnosis		
Low-risk visit	Reference	Reference
High-risk visit	0.70 (0.62 – 0.77)	1.03 (0.90 – 1.19)

to receive an invitation compared to those with private insurance.

Differences in invitation rates by health system were noted. Health system A had a lower tobacco screening rate (88%), higher tobacco use prevalence (22%), and only 61.5% of smokers were invited to join UW-PASS. Health system B had a 96% tobacco screening rate, 14% tobacco use prevalence, and nearly 80% of smokers were invited to join UW-PASS. Moderation analyses revealed that health system moderated the relation between invitation rates and all predictor variables except race ($Ps < 0.05$). For instance, health system A had lower invitation rates for younger smokers and those with high-risk diagnoses. In health system B, invitation rates were higher among women. (See Table 3 for differential odds ratios by health system.)

DISCUSSION

This study sought to determine whether tobacco treatment invitation rates would differ based on age, sex, race, and socioeconomic status, in the setting of a research study in primary care clinics implementing key clinical practice guideline recommendations. While we obtained a 67% overall invitation rate, we demonstrated that patient-specific factors remained associated with whether or not a patient was invited to a tobacco use treatment program.

Despite having incorporated multiple clinical practice guideline recommendations as part of the research protocol, younger individuals, those who identify as nonwhite/nonblack, and those with high-risk diagnoses were invited less frequently. The age and racial differences have been noted in previous research,[16,17] although age has shown mixed results.[14,15,18] The observation that Medicare patients were more likely to be invited to participate is likely confounded by our age findings. Unlike prior research, which demonstrated that the presence of comorbid conditions either did not change or increased rates of tobacco use treatment,[9,18–22] we demonstrated that individuals with high-risk diagnoses received fewer invitations to treatment than those with low-risk diagnoses. This could be explained by time demands in caring for patients with high-risk diagnoses. Alternatively, perhaps high-risk individuals frequented the clinics more often, resulting in clinical staff anticipating that they would not be interested in smoking cessation based on past knowledge of their interactions with the patient, leading to fewer invitations.

Treatment invitation rates in general were higher in health system B, and the differences in invitation rates by patient-level characteristics were lower. There are important factors to consider beyond just the limitations inherent in comparing 2 different health systems. Health system B served younger smokers with private insurance, utilized a visual cue to prompt medical staff to invite the patient to UW-PASS, and their clinics were located in more affluent communities compared to the clinics in health system A. With respect to the visual cue to prompt invitation, previous research does not provide a direct test of the effects of 2 different styles of EHR functionality. However, 2 studies examined cue-based EHR interventions and patient-level characteristics.[16,23] They found that high-risk patients and older patients were at least as likely to receive treatment for tobacco use compared to low-risk and younger patients, although nonwhite patients were still screened for smoking less often than white patients. The fact that 1 health system had clinics in less affluent areas increases the chances of more medically and socially complex patients seen by that clinic,[24] possibly contributing to the greater differences in treatment invitation rates.

The current study has limitations. First, because the data collected was prior to the consent process, data were aggregated to be HIPAA compliant; as such, inferences about individual patient characteristics are limited. Second, this study is a secondary analysis; the original study was not specifically designed to examine differences in invitation rates. This study did not collect preintervention rates of tobacco use treatment invitation, so we are unable to determine if the invitation rates presented are an improvement over baseline tobacco use treatment invitation rates at those clinics. This study also assumed that patients were not invited if the BPA was not accessed; it is possible that patients may have been invited, and declined, without the clinical staff accessing the invitation script. It is also possible that patients were not invited to the UW-PASS study based on eligibility criteria (of chief concern is the requirement to read/write English). However, clinic staff were not explicitly informed about UW-PASS eligibility criteria, and of the 600 patients referred and screened for eligibility, only 9 failed due to the language requirement. Finally, different clinics had differing levels of clinical staff engagement in the study, reflecting clinic-specific factors such as staff burden or the presence of a smoking cessation "champion," potentially contributing to the wide range of intervention rates seen in the different clinics.

CONCLUSION

This secondary analysis of a study incorporating several clinical practice guideline recommendations into patient care at 11 Wisconsin-based primary care clinics, including an EHR prompt to encourage tobacco treatment engagement, found encouraging rates of smokers being invited to participate in treatment. However, younger patients, patients of nonwhite/nonblack racial background and patients with high-risk diagnoses were still being invited less frequently than their counterparts. It also found important invitation rate differences by health system, which need further research to better understand the causes of these differences. Wisconsin, like the United States, continues to struggle with uneven declines in smoking rates among different populations. This paper shows that despite organized systems (ie, EHR) in place to prompt the delivery of clinical practice guideline tobacco treatment recommendations, there are disparities in treatment invitation rates in primary care clinics and health systems. More intervention research is needed in this area to improve these rates of screening and treatment.

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Surveillance of Wisconsin Organisms for Trends in Antimicrobial Resistance and Epidemiology: Introduction to the Program and Summary of 2016 Geographic Variation

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ABSTRACT

Background: Antimicrobial resistance merits surveillance because of its impact on quality health care. Past surveillance efforts in Wisconsin involved generation of a statewide antibiogram on the basis of antibiogram compilation. However, this modality of surveillance possesses limitations.

Methods: To characterize Wisconsin antimicrobial susceptibility patterns and elucidate geographic variation in antimicrobial resistance, a statewide surveillance network was created. Clinical microbiology laboratories submitted clinically significant bacterial isolates to a centralized testing facility for performance of standardized broth microdilution testing. Analyzed data included organism-specific susceptible, intermediate, and resistant percentages, along with median and 90th percentile minimum inhibitory concentration values.

Results: In comparison of 378 isolates of *Escherichia coli (E coli)* and 279 isolates of *Proteus mirabilis (P mirabilis)*, susceptibility rates of *E coli* were generally lower than *P mirabilis*, particularly in areas of Wisconsin bordering Lake Winnebago. *P mirabilis* resistance rates were generally higher in northern Wisconsin. From a 211-isolate collection of *Pseudomonas aeruginosa*, it was determined that higher rates of antimicrobial resistance were found in Southeast Wisconsin. On a geographic basis, susceptibility rates within a 212-isolate collection of *Streptococcus pneumoniae* were fairly consistent. However, Southcentral Wisconsin experienced increased rates of erythromycin resistance with this organism, as well as increased aminoglycoside resistance trending with other organisms. Antimicrobial agents with generally lower susceptibility rates statewide included fluoroquinolones and trimethoprim-sulfamethoxazole.

Conclusions: A surveillance program has been initiated in Wisconsin that not only summarizes susceptibility patterns but also has the capacity to indicate potential emerging resistance trends. Future annual studies can begin to characterize antimicrobial resistance in Wisconsin on a temporal basis.

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INTRODUCTION

Considerable attention has been given to the issue of antimicrobial resistance throughout the United States, both in peer-reviewed literature and the popular press. Specific vigilance has been granted by the Centers for Disease Control and Prevention (CDC) to a number of clinical scenarios, stratified by degree of threat.[1] Included in the category of urgent threat are *Clostridium difficile* disease and carbapenem-resistant *Enterobacteriaceae* (CRE). Drug-resistant *Streptococcus pneumoniae (S pneumoniae)*, multi drug-resistant *Pseudomonas aeruginosa (P aeruginosa)*, and extended-spectrum β-lactamase-producing *Enterobacteriaceae* constitute examples within a dozen scenarios of serious threat. Predisposing factors for antimicrobial resistance are not localized to inpatient or long-term care facilities. Hicks et al[2] investigated antibiotic prescription burden within outpatient settings in the United States and reported that over 260 million oral courses were prescribed by clinicians in 2011. Agents within 7 antimicrobial classes accounted for 94% of total outpatient prescriptions. These ranged from penicillins and macrolides (each accounting for approximately 23% of outpatient utilizations) to tetracyclines and trimethoprim-sulfamethoxazole (each at 8% of outpatient utilizations).

The CDC has advocated a 4-tiered approach to combat the continued emergence of antimicrobial resistance.[1] In addition to strategies advocating research and development, initiation and maintenance of antimicrobial stewardship programs, and infection prevention practices, the CDC promotes the concept of antimicrobial resistance

tracking. Means to accomplish this include data collection and subsequent studies of disease epidemiology. On the basis of the aforementioned outpatient prescription data,[2] antimicrobial resistance tracking may become increasingly necessary in the Midwest. It was reported that an average of 897 antibiotic prescriptions per 1,000 persons was issued in this 12-state region in 2011, second only to the southern United States (931 prescriptions per 1,000 persons).

One initial surveillance undertaking in Wisconsin was orchestrated by the Wisconsin Clinical Laboratory Network (WCLN) Laboratory Technical Advisory Group.[3] The basis for that 2013 investigation was voluntary submission of local antibiogram data from 72 health care entities, with compilation of those data stratified by 7 geographic regions demarcated by WCLN. However, limitations exist with the practice of antibiogram compilation. These apply to both the procurement of primary data for the antibiogram (particularly as it relates to variability in local susceptibility testing),[4-7] as well as generation of the antibiogram itself.[8-10] In contrast, a program by which a centralized laboratory assesses representative organisms using a standardized antimicrobial susceptibility testing method would advance the paradigm of resistance surveillance. Moreover, discreet data associated with each tested organism may provide an additional means for identifying emerging patterns of antimicrobial resistance and begin to elucidate epidemiologic trends relative to antimicrobial resistance. Herein we describe creation of the Surveillance of Wisconsin Organisms for Trends in Antimicrobial Resistance and Epidemiology (SWOTARE) program and present selected statewide findings from the first year of surveillance.

MATERIALS AND METHODS

Selection of Study Sites

The 7 Bioterrorism Preparedness Team regions of the WCLN[3] provided the basis for geographic demarcations of the SWOTARE program; 21 clinical microbiology laboratories participated in the program. In general, to prevent potential bias provided by facilities in urban areas, 2 laboratories per region were set in more rural areas, with the 3rd participant from a larger population center. This strategy was executed less efficiently in regions with increased population density and fewer rural microbiology laboratories (Southeast, Lake Winnebago regions).

Isolates and Demographic Data

Study sites were requested to submit consecutive isolates of *E coli,* (18), *P mirabilis* (15), *P aeruginosa* (10), and *S pneumoniae* (14) identified from in-house culture of clinically-significant infection. Duplicate isolates were excluded. Because of the lack of direct involvement in the collection of specimens and because of the utilization of deidentified isolates from routine clinical care, the SWOTARE program was not considered to be actively engaged in human subjects research by the Marquette University Institutional Review Board.

Antimicrobial Susceptibility Testing

Broth microdilution antimicrobial susceptibility testing was executed[11] and interpreted[12] using standards published by Clinical and Laboratory Standards Institute (CLSI). Panels consisted of antimicrobials described in Tables 1 and 2 using customized dilution ranges that extended beyond individual CLSI breakpoints.

Data Analysis

Percentage susceptible, intermediate (susceptible-dose dependent, when indicated), and resistant values, as well as median minimum inhibitory concentration (MIC_{50}) and 90th percentile (MIC_{90}) determinations were made on a statewide or geographic basis. To characterize geographic variation, the statewide (mean) susceptibility percentage for a given organism/antimicrobial combination established a baseline value. An interval of 5% on either side of that mean represented normal distribution. Region-specific values ≥ 5% less than the state mean indicated areas with increased resistance. Region-specific values ≥ 5% greater than the state mean indicated less resistance potential.

RESULTS

Distribution of Isolates

In 2016, 1,080 isolates were submitted and tested. *E coli, P mirabilis*, and *P aeruginosa* per-region contribution percentages ranged from 12.2% to 16.1%. In contrast, individual region contribution percentages of *S pneumoniae* ranged from 7.5% (Southeast) to 20.8% (Lake Winnebago).

Statewide Assessment of Gram-Negative Bacilli

Agents demonstrating greatest potency against Wisconsin *E coli* isolates included carbapenems (100% susceptibility), nitrofurantoin, piperacillin-tazobactam, and aminoglycosides (93.1%; Table 1). β-lactam agents other than carbapenems demonstrated greater variability, ranging from 56.3% susceptibility (ampicillin) to greater than 92% susceptibility (3rd- and 4th-generation cephems and aztreonam). Other agents with less potency included fluoroquinolones (less than 80% susceptibility), trimethoprim-sulfamethoxazole (80.7%), and ampicillin-sulbactam (62.7%). Susceptibility of *P mirabilis* isolates to several agents was generally increased when compared to *E coli* (greater than 91% susceptibility to 12 of 16 agents tested, Table 1). Exceptions included ampicillin and trimethoprim-sulfamethoxazole. Interestingly, significant fluoroquinolone resistance was documented throughout Wisconsin, with the *in vitro* ciprofloxacin susceptibility rate lower than that for levofloxacin. Statewide *P aeruginosa* isolates demonstrated highest rates of susceptibility to aminoglycosides and less susceptibility to aztreonam and fluoroquinolone agents (Table 1). Most isolates were susceptible to 3rd- and 4th-generation cephem agents.

Statewide Assessment of *S pneumoniae*

Approximately 70% of *S pneumoniae* isolates yielded penicillin

Table 1. Characterization of *Escherichia coli*, *Proteus mirabilis*, and *Pseudomonas aeruginosa* Isolates on the Basis of Susceptibility to Clinically Relevant Antimicrobial Agents, Wisconsin 2016

Organism	n	Percentage Susceptible																
		Penicillin Derivatives			*Cephems*					*Monobactam*	*Carbapenems*		*Fluoroquinolones*		*Aminoglycosides*		*Others*	
		AMP	A/S	P/T	CFZ	FOX	CAX	CAZ	FEP	AZT	MER	ERT	LEV	CIP	GEN	TOB	T/S	NIT
E coli	378	56.3	62.7	97.6	87.3	91.5	92.6	93.4	94.7	92.9	100	100	79.9	79.1	93.1	93.1	80.7	97.9
P mirabilis	279	84.6	93.9	100	96.1	98.6	98.6	99.6	99.3	99.6	100	99.6	81.0	75.6	91.4	92.1	82.4	
P aeruginosa	211			93.4				94.8	96.7	81.0	92.9		88.2	88.2	99.1	99.5		

Abbreviations: AMP, ampicillin; A/S, ampicillin-sulbactam; P/T, piperacillin-tazobactam; CFZ, cefazolin; FOX, cefoxitin; CAX, ceftriaxone; CAZ, ceftazidime; FEP, cefepime; AZT, aztreonam; MER, meropenem; ERT, ertapenem; LEV, levofloxacin; CIP, ciprofloxacin; GEN, gentamicin; TOB, tobramycin; T/S, trimethoprim-sulfamethoxazole; NIT, nitrofurantoin.

Table 2. Characterization of 212 Isolates of *Streptococcus pneumoniae* on the Basis of Susceptibility to Clinically Relevant Antimicrobial Agents, Wisconsin 2016

Antimicrobial Agent	Percentage Susceptible
Penicillin	70.3*
Ceftriaxone	93.9**
Cefepime	95.3
Meropenem	87.7
Levofloxacin	98.6
Moxifloxacin	99.1
Erythromycin	54.2
Clindamycin	87.3
Tetracycline	84.4
Trimethoprim-sulfamethoxazole	75.9
Chloramphenicol	97.6
Linezolid	100
Vancomycin	100

*Penicillin susceptibility (MIC ≤ 0.06 μg/mL) percentage listed in Table is based on Clinical and Laboratory Standards Institute (CLSI) interpretive criteria for parenteral delivery vs meningeal *S pneumoniae* isolates.
**Ceftriaxone susceptibility (MIC ≤ 0.5 μg/mL) percentage listed in Table is based on CLSI interpretive criteria for parenteral delivery versus meningeal *S pneumoniae* isolates.

MIC ≤ 0.06 μg/mL (Table 2). Nearly 94% of statewide isolates exhibited ceftriaxone MIC ≤ 0.5 μg/mL. Fluoroquinolone susceptibility rates approximated 99%. Decreased rates of susceptibility were noted with erythromycin (54.2%), trimethoprim-sulfamethoxazole, tetracycline, and clindamycin.

Geographic Variation in Gram-negative Bacilli Susceptibility

With respect to *E coli*, the Lake Winnebago region demonstrated susceptibility rates lower than the state mean for 12 of 17 antimicrobials tested. In contrast, Northwest and Southwest regions yielded susceptibility rates greater than the state mean for 13 and 12 antimicrobials tested, respectively. Regional levofloxacin susceptibility distribution (with corresponding MIC_{50} and MIC_{90} values) is presented in Figure 1A as a representative summary of *E coli* resistance throughout the state. In addition to the decreased susceptibility rate demonstrated in the Lake Winnebago region, this region and the Southcentral region also exhibited increased MIC_{90} values. The continuing and potentially emerging trends of increased resistance for the Lake Winnebago and Southcentral regions, respectively, were also noted for tobramycin (Figure 1B) and trimethoprim-sulfamethoxazole (Figure 1C).

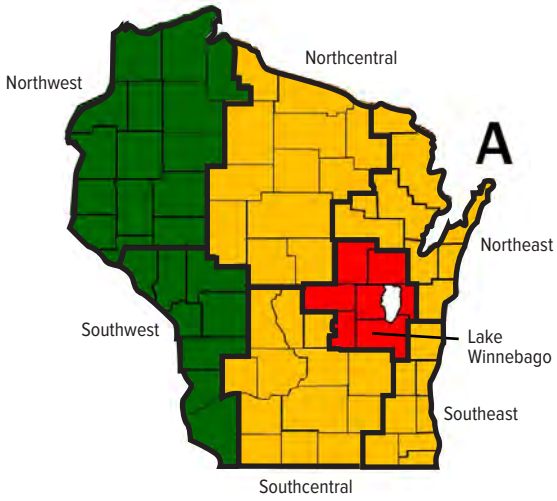
Region-specific *P mirabilis* susceptibility rates mirrored or exceeded the state mean for 9 of 16 agents tested. Susceptibility rates for fluoroquinolone agents, trimethoprim-sulfamethoxazole, ampicillin, ampicillin-sulbactam, and aminoglycoside agents were decreased in the Northcentral region (Table 3) when compared to state mean data (Table 1). Additional evidence of decreased aminoglycoside susceptibility in the Southcentral region was observed via increased *P mirabilis* MIC_{90} values.

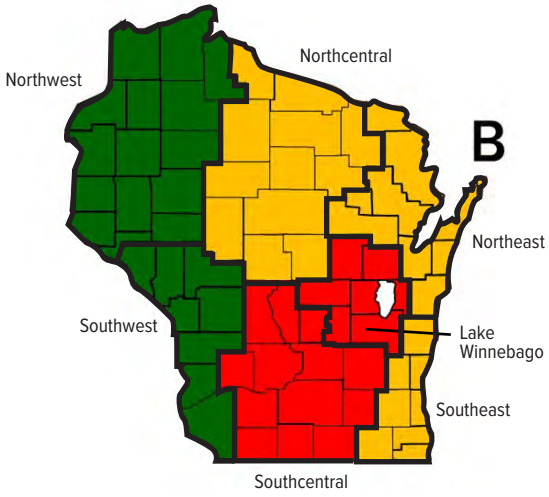
With respect to *P aeruginosa*, the Southeast region demonstrated susceptibility rates lower than the state mean for aztreonam, ceftazidime, and fluoroquinolone agents (Table 3). Increased MIC_{90} values were noted for piperacillin-tazobactam in this region. Susceptibility rates of *P aeruginosa* to aztreonam were also decreased in the Northeast and Southcentral regions. Despite high values of aminoglycoside potency statewide (Table 1), the Southcentral region was the only region to submit *P aeruginosa* that demonstrated resistance to both gentamicin and tobramycin.

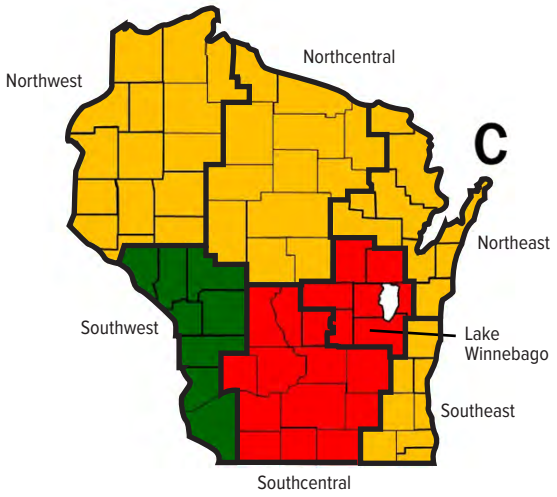
Geographic Variation in *S pneumoniae* Susceptibility

Region-specific susceptibility rates for 8 of 13 agents tested against *S pneumoniae* isolates approximated or exceeded the statewide average. One noteworthy exception was erythromycin in the Southcentral region. In addition to the 40% susceptibility rate characterized by these isolates (Table 3), this region exhibited an MIC_{50} value exceeding those from all other regions. The Southcentral region also exhibited a trimethoprim-sulfamethoxazole susceptibility rate that was 13.4% less than the state average. *S pneumoniae* susceptibility to clindamycin was decreased in the Southwest region when compared to the state mean. The Northwest region yielded a ceftriaxone susceptibility rate that was > 5% less than the state mean. MIC_{90} values for this agent, as well as penicillin (data not illustrated), suggested a potential trend toward increased resistance.

Figure. Geographic Variation With Respect to *E coli* Susceptibility to Levofloxacin (A, also presented with median and 90th percentile MIC data), Tobramycin (B), and Trimethoprim-sulfamethoxazole (C), Wisconsin 2016







LEVOFLOXACIN (0.25-32)						CLSI breakpoints 2/4/8
Region	n	MIC_{50}	MIC_{90}	%S	%I	%R
Northwest	52	≤0.25	0.5	92.3	0.0	7.7
Northcentral	55	≤0.25	16	78.2	0.0	21.8
Northeast	53	≤0.25	16	83.0	0.0	17.0
Southwest	56	≤0.25	16	87.5	0.0	12.5
Southcentral	55	≤0.25	32	80.0	0.0	20.0
Lake Winnebago	55	≤0.25	32	61.8	0.0	38.2
Southeast	52	≤0.25	16	76.9	0.0	23.1
Wisconsin	378	≤0.25	16	79.9	0.0	20.1

Abbreviations: I, Intermediate; R, Resistant; S, Susceptible.

Regions outlined in gold represent percentage susceptible rates ± 5% of the Wisconsin mean rate for the antimicrobial agent. Regions outlined in red represent percentage susceptible rates ≥ 5% less than the state mean rate for the antimicrobial agent. Regions outlined in green represent percentage susceptible rates ≥ 5% greater than the state mean rate for the antimicrobial agent.
Abbreviations: MIC, minimum inhibitory concentration; CLSI, Clinical and Laboratory Standards Institute.

DISCUSSION

Limitations of an antibiogram compilation method for antimicrobial resistance surveillance have been described. Beyond assumptions that laboratories that procure these data are properly utilizing FDA-cleared and laboratory-validated susceptibility testing formats on clinically significant isolates,[6] CLSI provides additional specifications regarding preparation of the antibiogram document itself.[13] One tenet involves the inclusion of species with an *n* value of at least 30 isolates per annum. It is therefore probable that smaller participating institutions would not be contributing data for certain organisms to a statewide antibiogram survey; as such, clusters of certain resistance patterns may be overlooked. Furthermore, due to variable configurations of susceptibility testing panels used by local microbiology laboratories, a statewide antibiogram may not have consistent antimicrobial agent representation within each organism group from all laboratories. In addition, antimicrobial susceptibility testing practices can impact final antibiogram data by way of selective reporting,[4] particularly with organism groupings in which cephem cascading is an advocated practice.[12]

An alternative paradigm in which a single facility conducts standardized testing and analysis will advance the cause of antimicrobial resistance surveillance. Because all antimicrobial agents are simultaneously tested on a single panel, categorical interpretations are recorded without the influence of selective reporting or laboratory information system collation. The demarcation of SWOTARE geographic regions paralleled those described in a pre-

Table 3. Selected foci of decreased susceptibility of *Proteus mirabilis*, *Pseudomonas aeruginosa*, and *Streptococcus pneumoniae* to selected antimicrobial agents, Wisconsin 2016

Organism	Region	Selected Antimicrobial Agent	Region-specific Data			Wisconsin Data†	
			Percentage susceptible	MIC_{50} (μg/mL)	MIC_{90} (μg/mL)	MIC_{50} (μg/mL)	MIC_{90} (μg/mL)
P mirabilis	Northcentral	Levofloxacin	55.8	≤0.25	>32	≤0.25	16
		Trimethoprim-sulfamethoxazole	72.1	≤1	>16	≤1	>16
		Ampicillin	72.1	≤8	>64	≤8	>64
		Ampicillin-sulbactam	83.7	≤4	16	≤4	8
		Tobramycin	86	≤2	8	≤2	≤2
	Southcentral	Gentamicin	88.4	≤2	8	≤2	≤2
		Tobramycin	88.4	≤2	8	≤2	≤2
P aeruginosa	Northeast	Aztreonam	74.2	8	16	8	16
	Southcentral	Aztreonam	75.0	8	16	8	16
	Southeast	Aztreonam	65.3	8	32	8	16
		Ciprofloxacin	73.1	≤0.25	16	≤0.25	2
		Levofloxacin	76.9	0.5	32	0.5	4
		Ceftazidime	84.6	≤2	16	≤2	4
		Piperacillin-tazobactam	88.5	≤8	32	≤8	16
S pneumoniae	Northwest	Ceftriaxone	87.5	≤0.12	1	≤0.12	0.5
	Southwest	Clindamycin	76.2	≤0.06	>4	≤0.06	4
	Southcentral	Erythromycin	40.0	4	>4	≤0.06	>4
		Trimethoprim-sulfamethoxazole	62.5	0.25	4	0.25	4

†Corresponding Wisconsin percentage susceptibility values presented in Tables 1 and 2.
Abbreviation: MIC, minimum inhibitory concentration.

vious report[3] with 2 exceptions. On the basis of hospital microbiology laboratory availability, Grant County was reassigned from the Southcentral to Southwest region to allow participation of a health care facility in Platteville. On the basis of geographic location, Fond du Lac County was reassigned from the Southeast to Lake Winnebago region. These assignments may slightly affect comparisons between 2016 SWOTARE data and those derived from the previous antibiogram compilation.[3] As the SWOTARE program progresses on an annual basis, it is anticipated that the same geographic demarcations will be employed, with largely the same health care facilities, for relevant geographic comparisons on a temporal basis.

One additional advantage of the SWOTARE program lies in its extensive inventory of MIC values. When considering antibiogram compilation-based surveillance, the end point of the antibiogram (percentage susceptibility) does not specifically describe frank resistance or increases in rates of intermediate resistance. In certain instances, Farner[5] related that monitoring of changing MIC values for a given antimicrobial/organism combination can detect local increases in the rate of resistance before such changes can be observed in an antibiogram. In data presented in Figure 1, increased *E coli* resistance to levofloxacin in the Lake Winnebago region was characterized not only by an overall susceptibility percentage of 61.8%, but also by an MIC_{90} of 32 μg/mL (MIC breakpoint of ≥ 8 μg/mL for resistance). While the same antimicrobial/organism combination for the Southcentral region appeared to resemble the state mean on a percentage susceptible basis, it was noted that its MIC_{90} value was also 32 μg/mL. Such data should warrant continued monitoring and vigilance during succeeding annual SWOTARE collections. Moreover, surveillance efforts at the level of the bacterial isolate allow for the collection of demographic and epidemiologic information associated with the isolate.[14]

CONCLUSION

In conclusion, a statewide antimicrobial resistance surveillance system has been formulated to characterize individual clinically-significant isolates using a standardized testing system. Results from the program in 2016 indicate geographic differences in Wisconsin for a number of antimicrobial/organism combinations. Median and 90th percentile MIC data derived from the surveillance program may indicate antimicrobial/organism groupings that warrant vigilance for potential emerging resistance prior to the categorical reporting of frank resistance. Annual continuation of this program should allow for trending of antimicrobial resistance patterns on a temporal basis. Timely dissemination of these findings to important stakeholders provides an informed opportunity to impact local clinical and prescription practices.

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Screening Pediatric Patients for Food Insecurity: A Retrospective Cross-Sectional Study of Comorbidities and Demographic Characteristics

Rachel Rongstad, BA; Megan Neuman, MD; Parvathy Pillai, MD, MPH; Jen Birstler, MS; Larry Hanrahan, PhD, MS

ABSTRACT

Background: Food insecurity is a household-level economic and social condition of limited or uncertain access to adequate and nutritional food that is associated with diabetes, obesity, anxiety, depression, and behavioral disorders. The presence of these comorbidities motivated the UW Health Pediatrics Department to start screening for food insecurity.

Methods: Our study describes demographic characteristics of screened patients, comparing risk factors and health status between food insecure patients and food secure patients. We extracted variables on all screened patients: sex, age, race, ethnicity, insurance type, height, weight (to calculate body mass index [BMI] and BMI percentile), and any diagnosis of diabetes, hypertension, sleeping problems, restless leg syndrome, anemia, elevated blood lead levels, depression, anxiety, or attention deficit disorder/attention deficit hyperactivity disorder (ADD/ADHD).

Results: Over the 8-month screening period, 1,330 patients were screened for food insecurity, and 30 screened positive. Insurance type was a significant predictor for food insecurity; patients on public or with no insurance had 6.39 times greater odds of being food insecure than those on private insurance (CI 3.81, 13.29). Also, diagnoses of anemia and ADD/ADHD were both significantly higher in the food insecure group. The odds of having anemia was 8.47 times greater for food insecure patients (CI 3.03, 23.63), and the odds for having ADD/ADHD was 5.89 times greater for food insecure patients than food secure patients (CI 1.48, 23.55).

Discussion: These results provide useful information to clinicians as the screening process moves toward widespread adoption. These results also provide a baseline for expanded research once screening is implemented throughout all pediatric clinics within our health care organization.

BACKGROUND

Food insecurity is a household-level economic and social condition of limited or uncertain access to adequate and nutritional food.[1] Since the United States' 2008 recession, food insecurity has increased and currently affects 14.1% of the US population—approximately 45 million people.[1] Certain populations are especially susceptible to food insecurity such as low income groups, minority races, rural populations, and children.[1] In Wisconsin, the prevalence of food insecurity is similarly high in all urbanicity levels and across all state public health regions,[2] and the food insecure rate of 11.5% is lower than the national average of 14.1%.[1] However, when broken down by race and ethnicity, marked disparities are apparent. Among both Hispanic and black families in Wisconsin, the food insecurity rate is 35%, which is significantly higher than the national rates of 24% and 26% for each group, respectively.[3]

Recent studies have linked food insecurity with chronic diseases such as diabetes, obesity, metabolic syndrome, anxiety, depression, and behavioral disorders[4,5] including persistent hyperactivity/inattention.[6] Further, families of low income children with food insecurity report more behavioral, emotional, and academic problems than do low-income children without food insecurity, which suggests a possible dependent relationship with food insecurity and these other health issues.[7] Thus, there is considerable evidence of the social determinants and health outcomes of food insecurity nationally.

Little has been studied in Madison, Wisconsin, the state's 2nd largest city, which is located in Dane County and served in part by our health care organization. However, a 2014 study found a 33.9% food insecurity rate in La Crosse, Wisconsin, which was much higher than expected and prompted clinicians to consider patients' access to food as part of the health history.[8]

We sought to describe demographic characteristics and health

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conditions of those patients screening positive for food insecurity compared to those who did not screen positive within our health care organization. Doing so can improve understanding of the social and health issues surrounding food insecurity and can inform the screening process and better tailor subsequent interventions.

METHODS

We conducted a retrospective cross-sectional study comparing characteristics of food insecure patients to food secure patients. Variables for all screened patients were retrieved from the electronic health record (EHR).

A previously validated 2-question paper screen developed by the US Department of Agriculture was used to identify food insecure patients.[9] A family was identified as food insecure if they answered "often true" or "sometimes true" to either of the following questions: "We worried whether our food would run out before we got money to buy more," and "The food we bought just didn't last and we didn't have money to get more."

In November 2015, local health care organizations partnered with The HungerCare Coalition, a local nonprofit program that helps educate health care professionals on issues related to food insecurity, to pilot screening for food insecurity in primary care pediatric clinics. Screens were given to all patients seen for a well-child visit from November 2015 through June 2016 by 4 physicians participating in the pilot program at a downtown Madison general pediatric clinic. The parent/caregiver answered the screen rather than the child. All screens were accompanied by a brief explanation to the parent/caregiver on the importance of checking for food insecurity.

Due to the nature of the study, there was no field in the EHR to collect screen results, so positive screens were identified manually on paper. It was assumed that any patient seen for a well-child visit who was not identified as a positive screen during the screening period was a negative screen.

UW Health Information Technology Services provided information on the following variables for each screened patient: age at time of encounter, race, ethnicity, insurance type at time of encounter (public/no insurance or private), height, weight, and any diagnosis of or medication for diabetes, hypertension, sleeping problems, restless leg syndrome, anemia, elevated blood lead levels, depression, anxiety, or attention deficit disorders. BMI percentile was calculated using the height, weight, age (months), and sex of each patient. Weight percentile was calculated for patients under the age of 2 years.

We determined if the patient characteristics were significantly associated with a positive food insecurity screen. In addition to descriptive statistics (counts), an odds ratio, 95% confidence interval about that odds ratio, and *P*-value using binomial logistic regression were calculated. Because the prevalence of depression/anxiety and attention deficit disorder/attention deficit hyperactivity disorder (ADD/ADHD) varies by age and sex, age- and sex-adjusted models were used for those comorbidities. Likelihood ratio tests were used to compare models with and without insurance for depression/anxiety and ADD/ADHD to determine if insurance should be included as a covariate.

Table 1. Summary of Population Demographics by Food Insecurity Status

	Food Secure	Food Insecure
Total	1,300	30
Sex (male) (%)	643 (49.5)	18 (60.0)
Age in years (mean (SD))	7.8 (4.74)	5.46 (3.97)
Age Group (%)		
0-1	64 (4.9)	6 (20.0)
2-5	464 (35.7)	10 (33.3)
6-10	419 (32.3)	12 (40.0)
11-15	260 (20.0)	1 (3.3)
16-20	93 (7.2)	1 (3.3)
Race/Ethnicity (%)		
White, non-Hispanic or Latino	1,018 (78.3)	12 (40.0)
White, Hispanic or Latino	72 (5.5)	7 (23.3)
Black or African American	59 (4.5)	3 (10.0)
Non-white, Hispanic or Latino	32 (2.5)	1 (3.3)
Asian	57 (4.4)	0 (0.0)
Multiracial and other	62 (4.8)	7 (23.3)
Insurance (%)		
Private	1,124 (86.4)	15 (50.0)
Public/None	176 (13.6)	15 (50.0)

Table 2. Food Insecurity by Insurance Type

	Food Secure Total	Private, Food Insecure Total, Odds Ratio (95% CI)
Private	1,124	15, 1
Public/None	176	15, 6.39 (3.07, 13.29)*

* *P*-value < 0.05

Table 3. Health Outcomes by Food Insecurity Status

	Food Secure	Food Insecure
BMI mean (SD)	17.49 (4.26)	16.51 (5.31)
BMI percentile (mean [SD])	57 (29)	58 (33)
Overweight BMI n (%)	272 (21.0)	9 (30.0)
Underweight BMI n (%)	42 (3.2)	2 (6.7)
Depression/anxiety n (%)	63 (4.8)	2 (6.7)
ADD or ADHD n (%)	33 (2.5)	3 (10.0)
Hypertension n (%)	2 (0.2)	0 (0.0)
Elevated blood lead levels n (%)	1 (0.1)	0 (0.0)
Restless leg syndrome n (%)	13 (1.0)	0 (0.0)
Sleep problems n (%)	8 (0.6)	0 (0.0)
Anemia n (%)	30 (2.3%)	5 (16.7%)

Abbreviations: BMI, body mass index; ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder.

Table 4. Comorbidities by Food Insecurity Status

	BMI >85% OR (95% CI)	BMI <5% OR (95% CI)	Anemia OR (95% CI)	Depression/ Anxiety* OR (95% CI)	ADD or ADHD** OR (95% CI)
Non-Food Insecure	Ref	Ref	Ref	Ref	Ref
Food Insecure	1.62 (0.73, 3.57)	2.13 (0.49, 9.26)	8.47*** (3.03, 23.63)	4.11 (0.79, 21.31)	5.89*** (1.48, 23.55)

*Model controls for age and sex.
** Model controls for age, sex, and insurance.
****P*-value <0.05.
Abbreviations: BMI, body mass index; ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder.

According to the guidance of the University of Wisconsin-Madison Health Sciences Institutional Review Board, this quality improvement work does not constitute research per the definition of the Common Rule (45 CFR 46).

RESULTS

During the 8-month screening period, 1,330 patients were screened for food insecurity, and 30 (2%) screened positive. Demographic differences were identified between the food secure and food insecure groups (Table 1), most notably by race/ethnicity ($P<0.001$). Of the food secure patients, 78.3% identified as white, non-Hispanic/Latino, compared to 40.0% of the patients in the food insecure group. Of the food secure patients, 10% identified as either Hispanic/Latino or black, compared to 33.3% of patients in the food insecure group.

When considering insurance status, patients with public/no insurance had 6.39 times greater odds of being food insecure compared to privately insured patients (CI 3.07, 13.29) (Table 2).

Several health outcomes associated with food insecurity were never or rarely (<1%) identified in food insecure patients, including hypertension, elevated blood lead levels, restless leg syndrome and sleep problems (Table 3).

We found significant relationships in our sample between food insecurity and diagnoses for both anemia and ADD/ADHD. Food insecure patients have 8.47 times greater odds for being diagnosed with anemia (CI 3.03, 23.63). Further, after adjusting for age, sex, and insurance, these patients had 5.89 times greater odds for being diagnosed with ADD/ADHD (CI 1.48, 23.55) (Table 4).

DISCUSSION

Food insecurity is caused by a lack of resources for obtaining enough nutritional food including money, transportation, and local availability. We found that a key correlation with food insecurity is insurance type and that being food insecure increases a patient's risk of being diagnosed with either anemia or ADD/ADHD. Since we did not have access to patient financial information, we used insurance type as a proxy for income. We were not surprised to find that patients with public/no insurance had higher odds of being food insecure, as national data suggests that income is the number one predictor of food insecurity.[10] Further, because rates of poverty are higher among Hispanic/Latino and black families in Dane County, this income disparity contributes to those groups' higher rates of food insecurity.

We also hypothesized that we would find a relationship between anemia and food insecurity since childhood anemia is often related to nutritional issues, including inadequate iron intake. The relationship between food insecurity and ADD/ADHD also is grounded in the literature.[8,9] Indeed, a prospective study of children found that food insecurity was predictive of hyperactivity/inattention.[6]

Our analysis supported a correlation between food insecurity and both BMI and anxiety/depression, as would be predicted by the results of other studies,[4] but the overall low numbers of food insecure patients did not allow for statistical significance. The paradox of being food insecure, and thus not having enough food, and having an elevated BMI is explained by the fact that food insecure families typically resort to calorically dense yet nutritionally sparse food, such as processed or fast food. However, as the obesity epidemic becomes more widespread, even food secure families have increased prevalence of elevated BMIs, which also could account for why our 2 groups showed no statistical difference in BMI.

The main limitations to our study include its descriptive cross-sectional design and a small patient sample. Associations, but not causality, can be determined by the observational data and cross-sectional design. Nonetheless, the BMI, anemia, and ADD/ADHD findings are consistent with the literature. Since only 30 patients screened positive for food insecurity, the differences between the 2 groups must be evaluated carefully. Because of variation in the physician documentation process and problem list utilization rates, patient health status was synthesized from diagnoses, medications, and problem lists. Patients could have been misclassified or health status was underreported, but the utilization of electronic health records reflects the information available to clinicians. Finally, this paper-based screening was a

preliminary test of a subsequent EHR implementation, so there could be a concern that variation occurred in the application of the screening rules. However, we are confident that the 3 selected providers consistently tested the screening process and applied it to each patient encounter. Thus, we believe that all patients were screened, no patient refusals were documented, and the lack of a positive food insecurity screen was indicative of food security for the patient. Given the small scale of the implementation with just 3 providers at 1 clinic site, the processes were considered to be used reliably. There is some margin of error in this assumption.

We hope that these data are useful for clinicians as the screening process moves past the implementation pilot program into more widespread screening. This study is a framework to guide screening in the future, perhaps to include it as standard screening for specific medical conditions, not only at preventive care visits. It is important to know which patient populations are at risk for food insecurity and to also understand the health implications that accompany being food insecure to most appropriately assist patients who screen positive. We plan to conduct a similar study once the screening process is in place at all primary care clinics in our health system to see if other clinics yield similar results. A longitudinal study would be useful to determine if food insecure patients becoming food secure would alleviate some comorbidities, which would indicate successful social interventions.

In summary, we found that patients with a lower income, as represented by having public/no insurance, had significantly increased odds of being food insecure, and that food insecure patients were subsequently at increased odds of having anemia or a diagnosis of ADD/ADHD.

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Ultrasound-Enabled Noninvasive Management of Inadvertent Carotid Cannulation

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ABSTRACT

Introduction: Despite ultrasound use, accidental carotid cannulation is possible during placement of a central venous catheter (CVC), requiring operative repair of the carotid artery and removal of the catheter.

Case Presentation: We report 2 cases—a 59-year-old Hispanic man and an 86-year-old white man—of inadvertent placement of a CVC into the left common carotid artery, removed via a pull-and-pressure technique under real-time ultrasound guidance. No complications occurred and follow-up imaging was negative for fistula creation, hematoma, or cerebral infarcts.

Discussion: Prior cases have reported accidental carotid cannulations that required operative repair. Our discussion focuses on the complications of removal of CVCs from the common carotid, and the utility, feasibility, and safety of using real-time ultrasound guidance in the removal.

Conclusion: While operative removal of CVCs accidentally placed in the carotid is recommended, an ultrasound-enabled pull-and-pressure technique may prevent complications and avoid need for surgical repair in critically ill patients.

BACKGROUND

Approximately 6 million central venous catheters (CVC) are inserted every year in the United States.[1] The current reported incidence of arterial cannulation is between 0.1% and 1%.[2] Ultrasound-enabled central venous cannulation has become the standard of care endorsed by multiple medical societies as well as the Agency for Healthcare Research and Quality.[3] Two meta-analyses have indicated that ultrasound-guided insertion of central lines led to greater first pass success and fewer complications when compared to a blind landmark technique.[4-5] However, accidental arterial cannulation is possible even with the use of ultrasound guidance.[6] This is more likely to occur in emergent conditions and in patients who are severely hypotensive and/or hypoxic where the pulsatility and color of blood may be difficult to determine. Underrecognized, it may lead to vessel dilation and catheter insertion leading to significant arterial injury/risk of stroke, and other complications. A video analysis of accidental arterial cannulations indicated that the short axis view provides a false sense of security to the practitioner and allows for potentially dangerous accidental arterial cannulation.[3] The recommendation from the Society for Vascular Surgery in cases of accidental arterial cannulations is to keep the catheter in place and urgently seek assistance of vascular surgeons for operative repair of the artery.[7] Past experiences of pull-and-pressure technique have been reported to be associated with significant complications including stroke and hemorrhage.[7]

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Materials and Methods

Two patients who had accidental carotid cannulation in the past 10 years at our institution were identified. This case report received exemption from the Institutional Review Board. Their clinical courses were reviewed, and information regarding their past medical history, comorbid disease, physical examination, laboratory investigation, and imaging results were recorded.

Case 1

A 59-year-old Hispanic man with type 2 diabetes and obesity was transferred to our hospital for management of cardiogenic shock post-myocardial infarction. An intra-aortic balloon pump was placed through a right femoral vein and a hemodialysis catheter

through the right internal jugular vein. He was then transferred to our hospital for evaluation of a mechanical cardiac device implantation. On admission, he was hemodynamically unstable with systolic blood pressures ranging from 60 to 80, on dobutamine, epinephrine, vasopressin and norepinephrine drips, and an intra-aortic balloon pump at 1:1 augmentation. The patient was anticoagulated with heparin. He was ventilated mechanically with high ventilator settings of 100% and 10 cm of positive end expiratory pressure, yet remained hypoxic with oxygen saturation ranging from 87% to 93%. A decision was made to place an 9 French Cordis introducer and Swan-Ganz catheter for hemodynamic monitoring. Ultrasound guidance utilizing the Seldinger technique was used to access the left internal jugular vein (LIJV). Dark red blood was aspirated, and manometry estimation of vessel pressure was performed and believed to be venous, as there was no pulsatility. The wire was visualized with ultrasound in the short-axis view and verified to be in the LIJV.

After the Swan-Ganz catheter was transduced, the wave form observed correlated with the systemic arterial waveform and pressures. Vascular surgery was consulted. A duplex ultrasound confirmed the catheter sheath had pierced the anterior and posterior walls of the left interior jugular and entered the left carotid artery (Figure 1).

The patient was considered extremely high risk for operative morbidity and mortality, as even transport to the operating room would have been a logistic challenge. Therefore, after multidisciplinary discussions, and based on the recommendation of the senior vascular surgeon, it was decided to proceed with ultrasound-guided compression and removal of the catheter—an ultrasound-enabled "pull-and-pressure" technique. The catheter was pulled, and the ultrasound technician held sonographic compression for 60 minutes with real-time visualization of the carotid and internal jugular vessels. Post ultrasound-enabled compression images were acquired after 60 minutes of compression and 24 hours later. No color flow was noted between the internal jugular vein and carotid artery, and therefore, there was no evidence of fistulous connection (Figure 2). The patient recovered hemodynamically over several days and was able to maintain a normal neurologic exam. A computed tomography (CT) head obtained after the event for mechanical circulatory assist device evaluation work-up

Figure 1. Central Venous Sheath in the Carotid Artery Before Removal and Compression

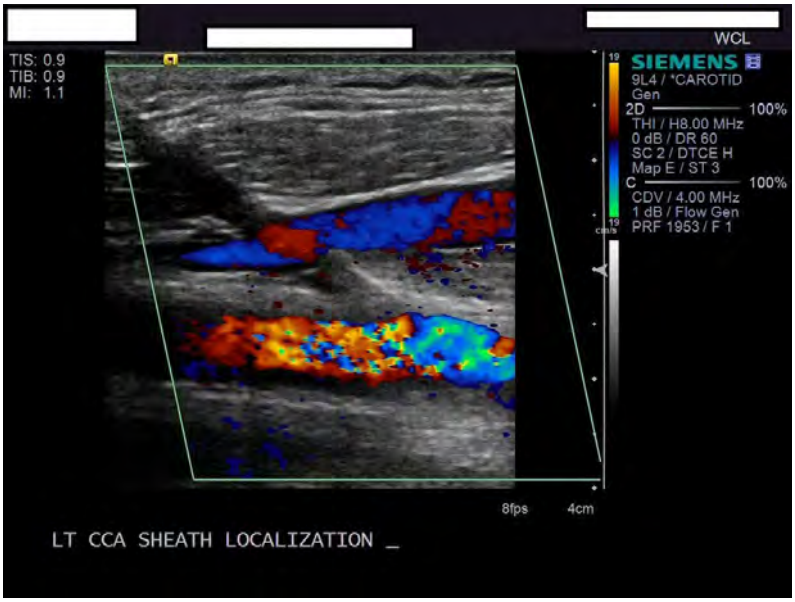
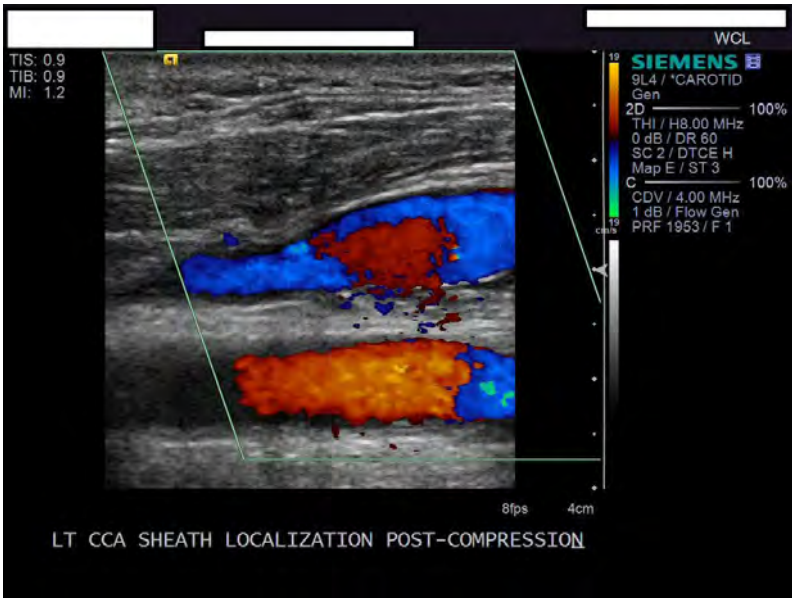


Figure 2. Internal Jugular and Carotid Artery After Removal of Venous Sheath and Ultrasound-Enabled Compression



revealed no infarcts. However, in the following 2 weeks, the patient deteriorated again with septic and cardiogenic shock and was deemed ineligible for a mechanical circulatory assist device and comfort care measures were initiated.

Case 2

Our second case involves an 86-year-old white man with atrial fibrillation, pulmonary hypertension, congestive heart failure, mitral stenosis, previous aortic valve replacement with porcine valve, and 2-vessel coronary artery bypass graft. He presented to our institution with lightheadedness and was found to have atrial fibrillation with rapid ventricular response. He was admitted to the cardiology service and was found to have a severely calcified mitral valve. Cardiac catheterization revealed 60% stenosis of the left anterior descending artery. Two days after cardiac catheterization, the patient became hypotensive and was transferred to the intensive care unit. Invasive monitoring and active resuscitation efforts were initiated.

While placing an 8 French Cordis introducer using the Seldinger technique, the vein was cannulated under ultrasound guidance, but dark pulsatile bleeding was noted. The needle was withdrawn and manual pressure held over the puncture site. Cannulation with a needle was attempted a second time and again dark pulsatile bleeding was noted.

With a history of tricuspid regurgitation and pulmonary hypertension, venous cannulation can encounter dark, pulsatile bleeding. Ultrasound-guided confirmation of LIJV guidewire cannulation was obtained and the introducer was advanced into the vessel. Upon transducing the introducer, an arterial waveform and pressures were noted. Vascular surgery was consulted. The patient was deemed too unstable for immediate transport to the operating room for catheter removal and carotid artery repair. Resuscitation efforts were ongoing and ultrasound-guided compression of the arteriotomy was performed by the interventional radiology technician and physician.

The ultrasound technician first performed a diagnostic ultrasound, which included visualization of the path of the catheter into the carotid artery and the arterial insertion site. No active extravasation was noted, nor thrombus formation. The catheter was removed with the ultrasound probe directly over the arteriotomy site, which allowed for pressure to be maintained in a directed fashion over the arteriotomy and allowed confirmation of distal arterial flow. Pressure was maintained for 45 minutes. Completion ultrasound showed no evidence of pseudoaneurysm or arteriovenous fistula and confirmed a patent subclavian artery. The patient ultimately developed acute renal failure and refused hemodialysis. He passed away 6 days after his cardiac catheterization procedure.

DISCUSSION

The occurrence of cannulation of the carotid artery when placing a CVC has significantly decreased with utilization of real-time point-of-care ultrasound. In 2006, a study by Karakitsos et al demonstrated the incidence of carotid cannulation by landmark method was 10.6% vs 1.1% in the ultrasound group.[8] The standard of care now is to place CVCs with ultrasound guidance. In this case series, one CVC was placed by a staff physician assistant and a cardiology fellow, both with attending direct supervision. Both operators had received formal ultrasound training. We advocate that all staff, residents, and allied health professionals performing CVC have formal ultrasound training. If the operator questions whether the CVC has been inadvertently placed in the artery, there are several ways to troubleshoot: manometry, pressure transduction, and blood gas analysis (sent with a guidewire remaining in the vessel held by the operator, with further cannulation proceeding if analysis shows venous blood). The operator should abort the line if there is concern or there is verification that the line has been placed in the arterial system prior to dilatation. When a complication does occur, there are generally 2 possible methods of removing the catheter: "pull-and-pressure" or vascular surgical repair. The "pull-and-pressure" method carries a high rate of complications. In 2008, Guilbert et al retrospectively reviewed the literature of cases with catheter-related cervical-thoracic arterial injury.[7] Complications were experienced by 47% who had the cannula initially removed via pull-and-pressure method, whereas none of the patients with catheters removed by initial vascular surgical approach suffered complications. In a retrospective analysis of 3 large institutions in Canada involving 13 patients, five had the catheter removed via the pull-and-pressure method, and all suffered major complications.[7] Complications include development of a hematoma, airway obstruction, stroke, and false aneurysm, especially when the site of arterial trauma cannot be effectively compressed. However, use of ultrasound to enable pull-and-pressure while direct visualization of the arterial injury site has not been described previously.

A multidisciplinary team approach to management of complications is vital in order to maximize clinical effectiveness. In both cases, extensive discussions were held among the intensive care unit, vascular surgery, and ultrasound radiology teams. Risks and potential of failure were assessed in detail. Due to high risk of operative intervention with hemodynamic and respiratory instability, the teams agreed upon ultrasound-enabled compression of the arteriotomy site under direct visualization. The phased array probe was used in a longitudinal direction without compromising distal arterial flow. Of note, the ultrasound-enabled compression was held for at least 45 minutes in both cases while visualizing the interior jugular and carotid vessels simultaneously. In the majority of the literature, compression was held from anywhere between 15 and 30 minutes. Immediate follow-up color Duplex was obtained to evaluate for hematoma or arteriovenous (AV) fistula. We also obtained a follow-up duplex 24 hours later to confirm the absence of vascular pathology (eg, development of an AV fistula). It is important to remember that complications can occur later, and

repeat imaging should be considered in any symptomatic patient who suffers an inadvertent arterial cannulation on follow-up. Iatrogenic carotid-jugular fistulas can cause systemic embolization, infection and, with time, high output cardiac failure. The duration of follow-up is not clearly known, and cases of AV fistula have been described over several months or even years.[9,10]

Given the nature of patients who generally receive CVC, most who are hemodynamically unstable, we propose an ultrasound enabled "pull-and-pressure" method for removal of venous cannula placed in the carotid artery inadvertently. The proposed method is time-intensive, staff-intensive, and operator-dependent for acquisition of images. Yet in the critical care setting, ultrasound is the standard of care with any procedure and initial assessment of most patients, making it rapidly available. The ultrasound-guided method of pulling an inadvertent carotid cannulation during CVC placement could sufficiently and effectively reduce not only the complications related to the pull and press method, but also avoid operating room exploration and the costs and staff associated with such procedure. Good communication between the operative team, vascular surgery and radiology is vital. Endovascular or surgical treatment should still be the first line approach in inadvertent carotid artery cannulation. However, in a restricted group of patients who have hemodynamic instability and high risk of operative intervention, ultrasound-enabled pull-and-pressure technique can be considered. Thorough and serial neurologic evaluation should be done after injury/repair to assess for signs of acute ischemia.

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Rapid Therapeutic Response of Eosinophilic Meningoencephalitis in a Toddler With *Baylisascaris procyonis* Infection

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ABSTRACT

Introduction: Eosinophilic meningitis is an infrequently encountered condition. *Baylisascaris procyonis* (raccoon roundworm) infection, rarely diagnosed in North America, is a known cause of eosinophilic meningitis, often producing death or permanent neurologic damage.

Case Report: We recently encountered a toddler with geophagia and probable exposure to raccoon feces, who presented with eosinophilic meningitis and encephalitis, and was diagnosed with *B procyonis* infection and possible Toxocara co-infection. His marked peripheral eosinophilia and neurologic symptoms rapidly responded to corticosteroid and albendazole therapy.

Discussion: Since *B procyonis* infection is infrequently encountered, its diagnosis in the proper clinical and epidemiologic setting may not always be considered, resulting in a delay of appropriate therapy. Our patient, diagnosed and treated early in his course, demonstrated rapid clinical and laboratory improvement with anti-inflammatory and antiparasitic therapy.

Conclusion: In cases of eosinophilic meningitis, infection with *B procyonis* should be routinely considered to allow timely institution of effective therapy for this unusual but potentially fatal or debilitating infection.

INTRODUCTION

Eosinophilic meningitis is a rarely encountered condition in North American children.[1,2] We recently treated a toddler with eosinophilic meningitis and encephalitis who was diagnosed with infection with the raccoon roundworm *Baylisascaris procyonis (B procyonis). B procyonis* infection often produces death or permanent neurologic damage in affected individuals.[3-7] Because the infection is encountered infrequently, its diagnosis may not be considered and appropriate therapy may be delayed. Our patient, diagnosed and treated early in his course, demonstrated rapid clinical and radiologic improvement.

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CME available. See page 132 for more information.

CASE REPORT

A previously healthy 2-year-old boy presented with hyperacusis, confusion, and headache of 1 week's duration. He became sleepy, difficult to arouse, disoriented, and confused 48 hours prior to admission. He would not answer questions, had episodes of incontinence, and became ataxic. The child lived in a suburban area near Milwaukee, Wisconsin, with travel only in Wisconsin and to Illinois. He did have geophagia and had been observed eating dirt from a flower pot on his home's front porch.

On admission, the patient was afebrile with mild tachypnea. He was listless but could answer simple questions, such as stating his name. He had a normal neurologic exam without meningismus. A noncontrast computed tomography (CT) of his head and neck was normal. His peripheral white blood cell (WBC) was 15,000/μL with 23% eosinophils. Lumbar puncture opening pressure was 14cm. Cerebrospinal fluid (CSF) analysis revealed a glucose of 48mg/dL, protein 25mg/dL, and WBC of 132/μL with 70% eosinophils, 18% monocytes, and 11% lymphocytes.

Brain magnetic resonance imaging (MRI) was performed, demonstrating abnormal mildly enhancing periventricular and deep cerebellar white matter long repetition time (TR) signal hyperintensities bilaterally. Areas of mild nonenhancing long TR hyperintensity also were noted within the anteromedial aspects of the thalamus. Acute infarct, hemorrhage, and mass effect were not present. His ventricles were normal, without leptomeningeal enhancement or restricted diffusion. With the history of CSF eosinophilia, peripheral eosinophilia, and periventricular TR hyperintensity with subtle enhancement of hyperintense white matter, raccoon roundworm infection was strongly considered in a differential diagnosis that also included vasculitis, malignancy, and idiopathic hypereosinophilic syndrome.

Expanded history revealed that the patient's neighbors had seen raccoons in the patient's garage and around his home, including

the front porch where the flower pots were located. The child also had visited family in a more rural area, where he had potentially been exposed to dog and raccoon feces.

Shortly after admission, the child developed a left-sided facial palsy, dysmetria, and lagopthalmos. A dilated ophthalmic exam was normal. On hospital day 15, *B procyonis* serum serology from the Centers for Disease Control and Prevention (CDC) returned as positive. Simultaneously obtained CSF sent to the CDC was nonreactive. *Toxocara spp* serum serology sent to Quest Diagnostics (San Juan Capistrano, CA) also returned positive. Our patient was then treated with enteral albendazole, 200 mg twice daily for 4 weeks. He also received a 5-day course of intravenous methylprednisolone 30 mg/kg, followed by a 5-week oral steroid wean. Within 48 hours of starting therapy, his peripheral eosinophil count fell to 0 eosinophils/μL and his headaches improved.

Following discharge, the patient continued to recover clinically. Repeat serologic testing at 2 and 6 weeks for both *B procyonis* and *Toxocara spp* remained positive. A repeat MRI of the brain revealed persisting mild periventricular long TR hyperintensity, but no longer demonstrated the focal enhancement and tiny cystic foci previously noted. The child's parents reported complete resolution of his left facial palsy, gait abnormality, and speech problems 4 months after infection. A mild tremor with fine motor activities persisted.

DISCUSSION

Eosinophilic meningitis is defined as the presence of greater than 10% eosinophilia in the CSF.[1] Eosinophilic meningitis is a rare complication of a variety of conditions, including fungal, bacterial, viral, and parasitic infections, and can be associated with the presence of foreign bodies, malignancies, and medications.[2] Parasitic infections are particularly likely in the presence of concomitant peripheral eosinophilia.[2]

The 4 most common parasitic etiologies of eosinophilic meningitis include infection with *Angiostrongylus cantonensis, Gnathostoma spinigerum, Toxocara canis (T canis)* and *B procyonis*. Human infections with these zoonotic agents are generally restricted to tropical climates except for *T canis* and *B procyonis* infections, which also occur in temperate climates, including the Midwestern United States.[3,5]

During the life cycle of *B procyonis*, adult worms reside in the small intestine of the raccoon host, and eggs laid by female worms are shed in feces. Infected adult raccoons excrete millions of eggs daily in feces deposited in communal sites called latrines.[4] The eggs are resilient and remain viable for many years, even after exposure to harsh environmental conditions.[5,6] The infectious dose of *B procyonis* is low and has been estimated to be fewer than or equal to 5,000 eggs.[4,5]

Despite reports of *B procyonis* encephalitis, *B procyonis* is not considered a neurotropic agent. Only 5% to 7% of the total body burden of larvae migrate to the central nervous system (CNS) and ocular tissues. CNS infection is considered random, the result of nondirected migration of the parasites.[4]

The prevalence of human infection is currently unknown but may be higher than current estimates, given the potential for asymptomatic infection.[4] It is believed that the severity of the clinical manifestations is related to the number of eggs ingested.

Humans and other mammals become infected with *B procyonis* by ingesting contaminated organic materials or raccoon feces containing viable *B procyonis* eggs.[4-6] Young children, especially those 2 years and younger, are at increased risk for infection due to behaviors such as pica, geophagia, and placing contaminated objects in their mouths.[5] It is critical all children be excluded from areas potentially contaminated with raccoon feces such as raccoon latrines, to avoid contamination with and later ingestion of infectious *B procyonis* eggs. Other groups at increased risk for *B procyonis* infection include wildlife and zoo workers, animal damage and control workers, agricultural workers, trappers, hunters, and other individuals with increased exposure to raccoon latrines.[4] The risk of *B procyonis* infection is sufficiently high that after a suspected enteral exposure to raccoon feces, a 10-day "preventive" course of an antihelminthic be considered, even prior to the onset of clinical symptomatology.[4]

B procyonis infection should be suspected in the setting of xanthochromic CSF with eosinophilia. Definitive diagnosis is made through serologic testing of blood or CSF. Fecal examination for ova or adult parasites is not useful. Brain MRI of symptomatic patients typically shows subcortical nodular enhancement hyperintensities in the cerebellar white matter.[7]

T canis (dog roundworm) CNS infection should also be considered in patients with CSF pleocytosis and eosinophilia who demonstrate transient oligoclonal immunoglobulin bands in the CSF and peripheral eosinophilia with positive Toxocara serologies.[3] MRI in such patients typically shows cerebral lesions in cortical and subcortical regions and the centrum semiovale. A head CT may show hyperdense signals indicating calcification.[3] This pattern was not observed in our patient, nor was the typical ocular retinitis of toxocariasis seen.

Both *Toxacara spp* and *B procyonis* infections are most common in rural settings and where there is animal contact (cats and dogs or raccoons, respectively), geophagia, and dementia. Given the similar presentations of *T canis* and *B procyonis* infection, differentiation between these 2 infections formerly required the histologic identification of larva from brain biopsy. The invasive nature and lack of sensitivity of this method has been supplanted by more definitive serologic methods of diagnosis.

Initially, both *B procyonis* and *Toxocara spp* infections were detected using excretory secretor (ES) antigen ELISA. Both these ELISAs showed cross reactivity with one another[8] and *Toxocara spp* ES ELISA demonstrated cross reactivity with a variety of other parasites as well.[9,10] Components of *B procyonis* ES antigens have now been developed that are specific for that agent.[9,11] While the original *B procyonis* ES ELISA cross-reacted with *Toxocara spp* infections at rates as high as 90.6%,[12] recombinant synthesis of a

B procyonis antigen (BpRAG1) has improved specificity such that when used in a Western blot assay, test specificity for *B procyonis* now approaches 100%.[13] Currently, the CDC uses the BpRAG1 Western blot to identify *B procyonis* infection,[13,14] essentially excluding cross-reactivity with Toxocara infection.

Our patient had multiple positive *B procyonis* serologies. Given the extremely high specificity of the CDC assay, the patient's positive *B procyonis* serology indicates a true *B procyonis* infection. Based on the currently available information, this patient appears to be the first confirmed case of *B procyonis* infection in Wisconsin (J. Kazmierczak, Wisconsin State Department of Hygiene, oral communication, May 8, 2017).

Based on the multiple positive Toxocara serologies in our patient, a false positive *Toxocara spp* assay cannot be excluded, as cross reactivity of the current *Toxocara spp* assay against *B procyonis* infection is unknown. Other cases of apparent *B procyonis* encephalitis have been reported in which Toxocara serologies were presumed to be falsely positive.[15] However, co-infection with both parasites is possible, given this child's exposure to both raccoon and dog feces, and the fact that dogs can be co-infected with both *T canis* and *B procyonis*. Our patient lacks the typical MRI pattern seen in cerebral toxocariasis as well as retinal findings typical of toxocariasis. Our patient was treated with albendazole, which is effective for both parasitic infections.

Neural larva migrans (NLM) due to *B procyonis* infection has been frequently associated with severe, often fatal outcome.[5] Serious neurologic manifestations may result from larval migration through the central nervous system.[6] Larvae continue to grow during migration, inducing significant inflammation and increasing the damage.[6] Between 1981 and 2002, there were only 12 reported cases of *B procyonis* encephalitis.[16] Most diagnoses were established in that era by brain biopsy or at autopsy. It was estimated at the time that 46% of confirmed or probable neurologic infections with *B procyonis* were fatal, while the remaining nonfatal infections resulted in permanent, severe neurologic deficits.[6]

With wider availability of serologic testing, greater numbers of milder cases of *B procyonis* infection are being recognized.[5] The overall prevalence of human infections with *B procyonis* has increased and the spectrum of clinical disease has broadened.[4] Our patient had relatively mild clinical disease compared to most of the early cases in the literature, perhaps related to the ingestion of a relatively small number of eggs.

Given the high prevalence of *B procyonis* in the raccoon population and abundance of raccoons living near human dwellings, it seems likely that asymptomatic infections may occur. The prevalence of asymptomatic human infections, long-term consequences of such infections, and investigation into potential individual risk factors for more severe infections are areas for future investigation. The likely wide spectrum of clinical pictures emphasizes the importance of the consideration of *B procyonis* infection in any patient presenting with unexplained eosinophilic meningitis and neurologic symptoms, particularly since potentially effective therapy exists for such infection.

CONCLUSION

In cases of unexplained eosinophilic meningitis, infection with *B procyonis* should be considered to allow timely institution of effective therapy for this potentially fatal or debilitating infection.

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Expanding Our Work: A Multifaceted Approach to Improving Mental Health Access

Jon Lehrmann, MD; David Peterson, MBA, FACMPE; Joseph E. Kerschner, MD; John R. Raymond Sr., MD

There is considerable evidence that Wisconsin is experiencing the effects of a nationwide shortage of psychiatrists and mental health practitioners that directly affects the health of Wisconsin citizens. This "continued crisis" in the delivery of and access to adult, child and adolescent mental health care is caused by resonating factors that include an inadequate supply of providers, inadequate insurance reimbursements, Medicaid reimbursement rates for outpatient behavioral health care that trail other states, professional stigma, and greater recognition and awareness that mental health is an integral component of population health, to name a few. For example:

- A Wisconsin Department of Health Services' Division of Public Health study revealed that 68 of 72 Wisconsin counties have inadequate numbers of psychiatrists to meet population needs.[1]
- According to a study published in *Psychiatric Services in Advance*, the psychiatry workforce in the United States will continue to contract and, by 2024, a minimal shortage of over 14,000 psychiatrists nationwide is projected.[2]
- An industry analysis of 42 million insurance claims between 2013 and 2015 revealed that psychiatrists were paid an average of 20% less than their primary care and medical/surgical peers when the same service was delivered using the same billing codes.[3]
- A *Milwaukee Journal Sentinel* analysis of 2016 workforce data "found that Wisconsin is worse than most states in its per-capita workforce of all types of mental health professionals: nurses, social workers, psychologists and psychiatrists."[4]
- A leading physician search and consulting firm's white paper on the psychiatric shortage revealed that the average age of practicing psychiatrists is third oldest, with 59% of the nation's 30,451 active psychiatrists aged 55 years or older." According to a Kaiser study cited in the white paper, Wisconsin is only meeting 20.8% of the state's mental health needs, ranking it 49th of 50 states.[5]

To address the shortage of primary care providers and psychiatrists across Wisconsin directly, The Medical College of Wisconsin (MCW) has developed two innovative, 3-year community medical schools in central and northeastern Wisconsin, a major goal of which is to increase the number of primary care clinicians and ultimately, psychiatrists. To further address our goal of increasing psychiatrists, MCW created two newly accredited psychiatry residencies near the campuses. This was first described in the *WMJ* Dean's Column:"Working to Increase Access to Mental Health Care in Wisconsin" in December 2016.[6] The new residency programs have the capacity to increase the number psychiatry residents trained in Wisconsin by 41%. This was accomplished with local community, Veteran Administration (VA), State of Wisconsin, and health system support. MCW also created an accredited addiction psychiatry fellowship to help address the shortage of addiction psychiatrists.

Another MCW strategy to improve access to mental health care providers has been to develop other allied health care providers by encouraging nonphysician providers to work at the top of their license, and by integrating

> Integrating behavioral health care into primary care is a very important strategy, which can mitigate stigma by facilitating the provision of mental health care from the primary care provider team. There is developing evidence that demonstrates the downstream cost-effectiveness of these collaborative care models.

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them into interprofessional mental health care teams. Such an approach to mental health care maximizes a health system's ability to care for populations. MCW also developed a new pharmacy school that emphasizes the development of clinical pharmacists. Mental health clinical pharmacists can nicely complement and extend the psychiatrist's ability to prescribe for patients. The Department of Veterans Affairs has been a leader in developing this clinical pharmacist model. In partnership with Froedtert Health, MCW opened a health psychology training program this past year to help further establish inter-professional mental health care. In addition, partnering with local universities that are training advance practice providers (APP), MCW and its affiliate health system partners are providing clinical mental health care training for APPs that enhances this interprofessional model further.

Integrating behavioral health care into primary care is a very important strategy, which can mitigate stigma by facilitating the provision of mental health care from the primary care provider team. There is developing evidence that demonstrates the downstream cost-effectiveness of these collaborative care models. MCW is working with its major health care partners to implement models that expand the mental health care provider team.

Finally, drawing from experience in the Department of Veterans Affairs, MCW has developed a "specialty care access network extension for community healthcare outcomes (SCAN ECHO)" in partnership with the State of Wisconsin, health system partners, generous influential families, and the United Health Foundation. SCAN ECHO incorporates population health-focused consultation programs including the Child Psychiatry Consultation Program (CPCP), and a perinatal psychiatry consultation program (Periscope Project). Please note that the VA's SCAN ECHO program was developed from Dr Sanjeev Arora's innovative thinking at the University of New Mexico, where he developed the ECHO Model in 2003. In addition, MCW worked with state legislators to target funding for the development of an Addiction Medicine Consultation Program. All of those consultation programs have the potential to expand to cover the state and to enhance the ability of primary care providers to provide front line mental/behavioral health care; and hence, refer only more severely ill patients to psychiatrists. This model of care also provides mental health care education to primary care clinicians to maximize the mental health care delivered in primary care clinics. This model also helps to connect patients to other mental health care resources.

MCW is making many efforts to address critical mental health access problems through a multifaceted approach that includes increasing the number of psychiatrists trained in Wisconsin, training psychiatrists in regions that have more extreme shortages, and developing a psychiatry fellowship in addiction psychiatry; developing and implementing population-based consultation programs that enhance primary care clinicians' ability to deliver front-line mental health care; developing clinical mental health-trained pharmacists; training APPs in mental health care and utilizing their expertise to allow them to work at the top of their license as part of an interprofessional team; developing health psychologists; and integrating mental health care into primary care clinics.

The serious shortage of access to mental health care is a complex problem that cannot be resolved easily or without deploying substantial resources. MCW's work to mitigate the shortage has been possible primarily because of a willingness to innovate and because of the support of forward-thinking community partners, philanthropists, foundations, health systems, state legislators, and agencies. Any progress made to address this continuing crisis will save lives, minimize suffering, and lead to downstream financial savings. However, despite the multifaceted approach being undertaken in Wisconsin, full resolution of this mental/behavioral health access crisis will not be attainable until there is true national and local parity of funding for mental health care, elimination or diminution of stigma associated with receiving mental health care, and expansion of funding for graduate education of mental health professionals.

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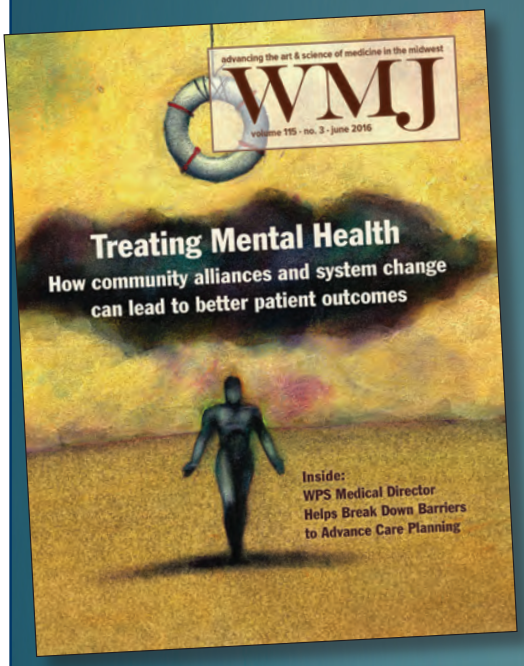

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Wisconsin Health Care Making Progress Toward CMS Quality Strategy Goals

Kristin Westphal, MS, and Jody Rothe, RN, DON-CLTC

Outpatient Antibiotic Stewardship, Motivational Interviewing, and Reduced Admissions and Readmissions Achievements Demonstrate Remarkable Improvements

MetaStar, which represents Wisconsin in the Lake Superior Quality Innovation Network (Lake Superior QIN), has been working alongside Wisconsin health care professionals in many settings to advance the Centers for Medicare & Medicaid Services (CMS) Quality Strategy goals.[1] MetaStar served as Wisconsin's Quality Improvement Organization for 40 years. Following a change by CMS in 2014 to the program's structure, this work became part of a regional partnership, Lake Superior QIN, which serves Michigan, Minnesota, and Wisconsin.

Lake Superior QIN works with partners and stakeholders, including the Wisconsin Medical Society, to positively impact the 1.05 million Medicare beneficiaries in the state. Current initiatives include antibiotic stewardship, behavioral health, cardiac health, coordination of care, diabetes care, medication safety, nursing home quality, the Quality Payment Program, and quality reporting.

To demonstrate how health care in Wisconsin is making progress toward the 6 CMS Quality Strategy goals, we are sharing a recent example or achievement related to each goal. Three examples are featured in this article, and the remaining 3 goals will be discussed in the next issue of *WMJ*.

Goal 1: Make care safer by reducing harm caused in the delivery of care

Each year, more than 2 million Americans develop infections that are not cured by using common antibiotics because the antibiotics are no longer effective against certain germs. Approximately 262.5 million antibiotics are prescribed in outpatient settings each year. Up to 50% of these antibiotics are not necessary and could cause the germs to further develop resistance to other antibiotics.[2]

Lake Superior QIN has been working on antibiotic stewardship to prevent health care associated infections. In Wisconsin, 90 clinics and pharmacies joined our initiative to better understand and receive assistance to achieve all 4 Core Elements of Outpatient Antibiotic Stewardship.

As of May, 99% of participating Wisconsin clinics and pharmacies have achieved all 4 core elements. This marks a significant step toward reducing unnecessary antibiotic prescriptions and helping to prevent antibiotic resistance.

Goal 2: Strengthen person and family engagement as partners in their care

In order to help health care professionals in all settings of care increase the engagement of patients and family members in health care decisions, Lake Superior QIN has been offering Motivational Interviewing workshops across Wisconsin, along with occasional webinars. Motivational Interviewing is a collaborative, person-centered guiding method designed to bring about and strengthen the motivation for positive change. This evidence-based communication style can increase capacity to effectively engage patients in their own care.

As of April, 298 Wisconsin health care professionals have been trained in this approach at workshops hosted by MetaStar and Lake Superior QIN. More workshops are planned throughout summer and fall.

Goal 3: Promote effective communication and coordination of care

This goal is impacted through all the initiatives Lake Superior QIN supports, but the results can be seen most directly in the reduction of hospital admissions and readmissions. Nationwide, nearly 1 in 5 Medicare beneficiaries discharged from the hospital is readmitted within 30 days.[2] In 2016, CMS estimated that readmissions within 30 days cost the Medicare program more than $17 billion annually.[1]

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Kristin Westphal, MS, is the Vice President of Marketing, Communication, and Education at MetaStar. Jody Rothe, RN, DON-CLTC, is Program Manager at MetaStar and also serves as the State Director for Wisconsin for the Quality Innovation Network-Quality Improvement Program work. This material was prepared by the Lake Superior Quality Innovation Network, under contract with the Centers for Medicare and Medicaid Services (CMS), an agency of the US Department of Health and Human Services. The materials do not necessarily reflect CMS policy. 11SOW-WI-A1-18-19 060718

CMS Quality Strategy Goals

1. Make care safer by reducing harm caused in the delivery of care.
2. Strengthen person and family engagement as partners in their care.
3. Promote effective communication and coordination of care.
4. Promote effective prevention and treatment of chronic disease.
5. Work with communities to promote best practices of healthy living.
6. Make care affordable.

In Wisconsin, Lake Superior QIN supports 10 community coalitions focused on reducing hospital admissions and readmissions. Each coalition includes health care and social service partners and stakeholders in a defined geographical area, who work together to address significant barriers for their community. The coalition setting facilitates enhanced relationships between providers and allows for the sharing of and referrals into community-based programs that successfully reduce admissions and readmissions, such as the Patient Adherence and Competency of Therapy pharmacy program in Kenosha.

From August 2014 to December 2017, Wisconsin's relative improvement rates are 5.8% for statewide admissions and 6.2% for statewide readmissions. The goal set by CMS for a relative improvement rate during this time was 2%, so the data suggests Wisconsin is making strong strides toward reducing both admissions and readmissions.

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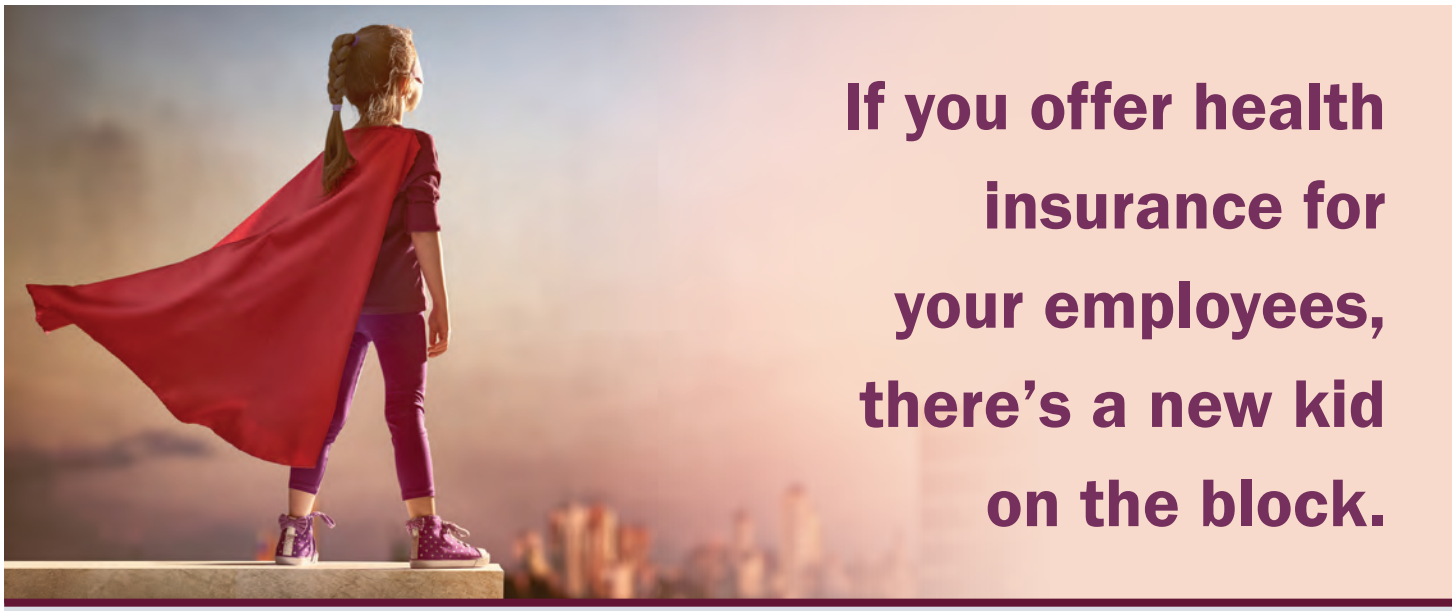

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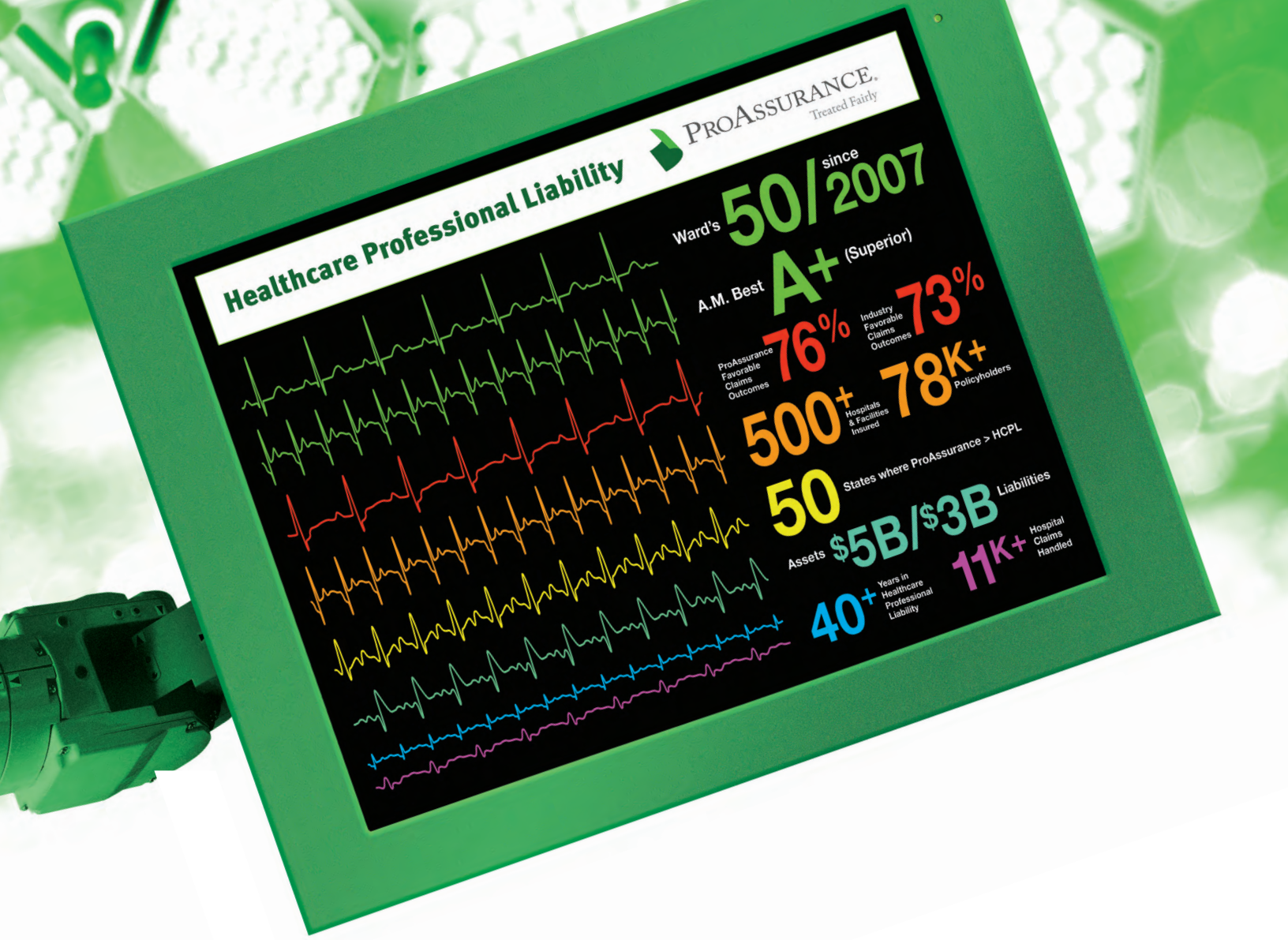

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