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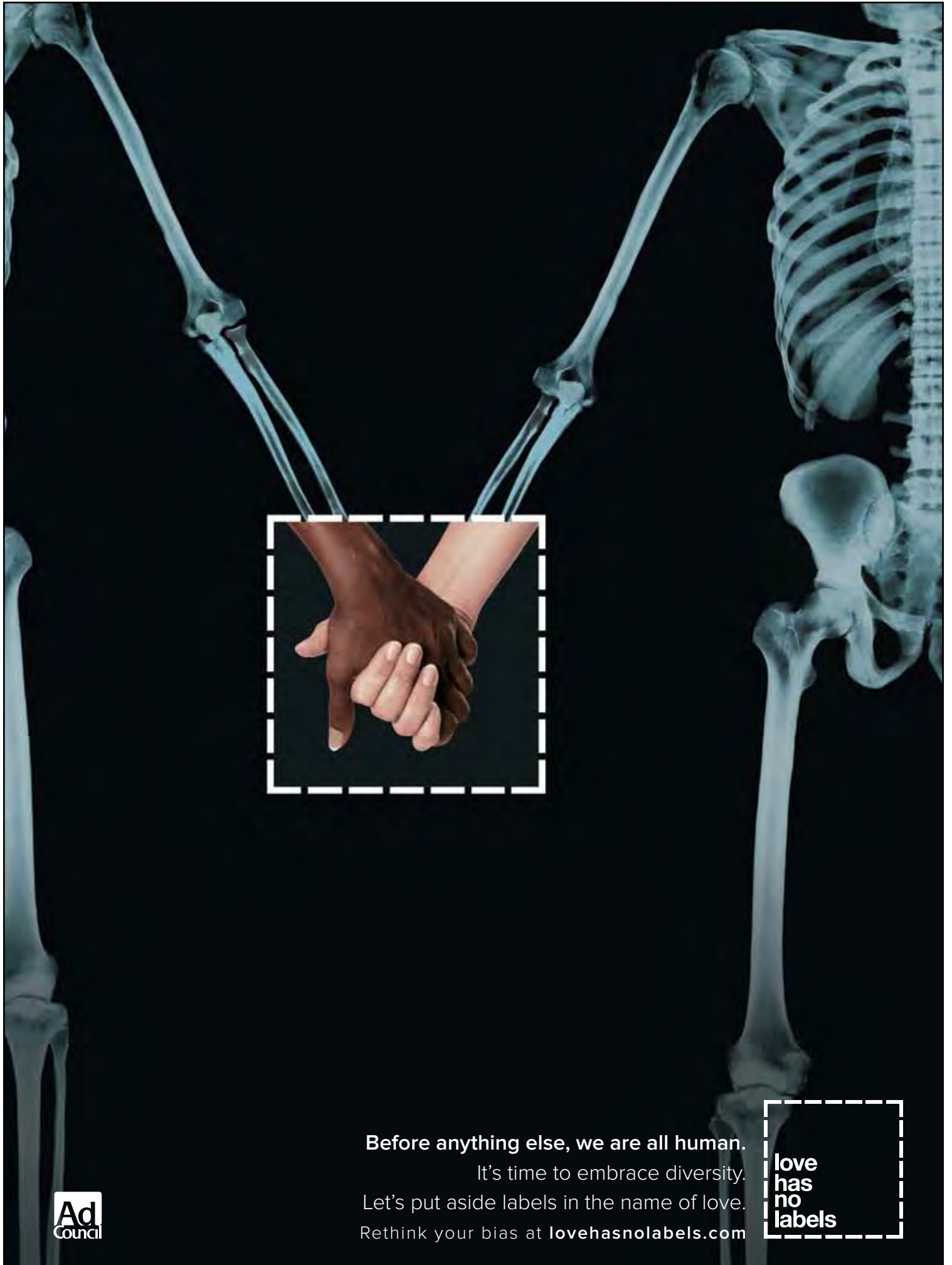
WMMJ

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**DRINKING  
IN COLLEGE:  
What role  
does proximity  
to alcohol  
outlets play?**

Inside: Factors Affecting Physician Satisfaction & Strategies to Drive Change



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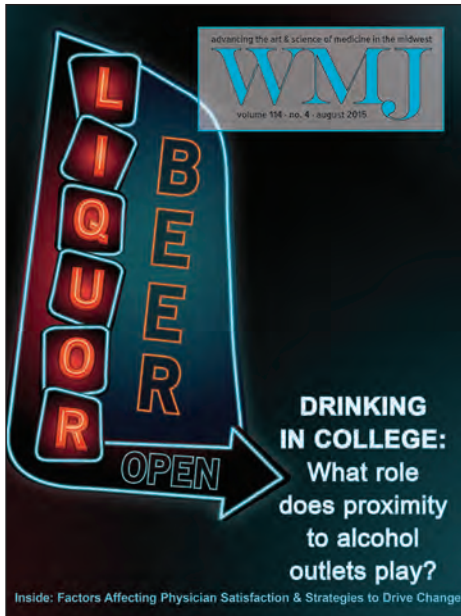


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## COVER THEME

### Drinking in college: What role does proximity to alcohol outlets play?

Excessive alcohol consumption is common on college campuses across the country and is associated with many negative consequences. At the same time, factors associated with the availability of alcohol among this population are not completely understood. A study in this issue of *WMJ* explores how proximity and density of alcohol outlets are associated with drinking at 1 Midwestern university.

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Mary Kay Adams-Edgette

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The mission of *WMJ* is to provide a vehicle for professional communication and continuing education for Midwest physicians and other health professionals. *WMJ* is published by the Wisconsin Medical Society.

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# For the Future

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D.N. Goldstein, MD

*Editor's note: The following editorial was published in WMJ, Volume 64, p. 118, February 1965.*

With good cause for pride, medical scientists can review the accomplishments of 1964—as well as several years preceding it—as being among the most significant in the history of mankind. New techniques, new insights, new discoveries have preserved life, reduced its hazards, and extended its duration. Beginning with new ways to lower the rate of infant mortality, medical science has whittled away at mortality in surgical procedures, controlled certain types of life-changing cancers, and generally enabled people to look forward to a much longer life expectancy.

As a result of the spectacular advance of medical science in the past decade, we can expect more people to live and more people to live longer. But what of the people whose lives are saved and lengthened? Are they being preserved to eke out a miserable existence in conditions of overcrowding, economic uncertainty, and in spiritual and intellectual darkness?

Some of the social problems we face are derived from the fact that we are still working under a system that was developed when our material resources was beyond the limit of our imagination. Many of our laws are reflexes of a time when a man forty-five years of age was a senior citizen, and society's right of control was reinforced and extended by the natural operation of the conditions of life. Now, however, with the conditions of life changed by the advance of science, should there not be another look at the role of our laws affecting the behavior of a population that has changed, if for no other reason than by its sheer numbers?

The tendency to turn back to the "good old days" is always with us. There is a substantial number of citizens in the United States who think that to set the clock back by fifty years would contribute some kind of a solution to a problem they refuse to define. They fail to face the fact that as medical science has changed, so has the reality of daily existence,

and that new solutions must be found for problems that have arisen from the progress that has been made under the successful solutions that were found fifty years ago. If nothing else, the spectacular advance of medical science in the past decade forces us to face to the future and honestly confront the consequences of our progress.

What then, can doctors do about the consequence of our own success? Shall we call a halt to medical progress on the premise that we are interfering with a balance of nature? Shall we return to the theory that he who survives is mysteriously "fit" to survive? Most medical scientists would reject some ideas without discussion, for the rationale of science is progressive, outwardly developing. Science can't be made to regress.

But scientists can take a greater interest in the social affairs of their communities, and it is in the possibility of the scientist becoming socially involved that the salvation of our modern society lies. The logic of scientific method need not be confined to the laboratory, nor is the human condition such that it can't be studied to find a workable truth on which to predicate a satisfactory control.

If the result of medical progress isn't to be poured down a cesspool of social and economic calamity, scientists must look beyond their immediate fields of operation and consider the entire environment that they are creating. As they have a stake in the future, they have a responsibility to speak for a total vision of the good life—not one freed from physician ills but beset with moral and social rot.

Plato wrote that the ideal republic of virtue depended on philosophers becoming kings and kings philosophers. Today more than ever our social salvation depends on scientists becoming statesmen—or politicians, if you like—becoming scientific.

—D.N.G

# The Advantage of a General Journal

John J. Frey, III, MD, Medical Editor

Although physicians, collectively, constitute the profession of medicine, the subcultures that physicians inhabit within that profession are increasingly narrower as technology and science dig deeper into life and its functions. But physicians have an obligation to at least be knowledgeable about the range of problems that affect patients and communities. Physicians may see through a particular specialty lens, but they need to get wider views now and then. Medical school is supposed to be about the general education of physicians, and the national exams emphasize that perspective. But too often, especially in the past few decades, the narrow interests that medical school applicants often express even before they start medical school pre-determine—and quickly narrow—their career choices. Focusing too early allows them—as trained physicians—to claim ignorance where they should show curiosity, even if the subject is not one that will be a major part of their clinical career.

The reading and online habits of physicians also can become more narrow as journals with extremely limited coverage of small areas of medicine proliferate. I serve on a panel for the National Library of Medicine of the National Institutes of Health that reviews journals applying for inclusion in PubMed Central, and over the past 20 years, one would think that the number of new journals would be close to being exhausted. Wrong. There are more new journals every year. Many are online open access journals of variable quality on extremely narrow topics or redundant review journals that offer very little that is new on any subject. Each claims to be occupying a niche

that has not been previously addressed. (Why we might need “The International Journal of Left-Handed, Color Blind Colposcopists” remains a mystery to me.) And reading large numbers of very narrow journals makes me think of how, contrary to what is happening

ple, Kowalski and colleagues demonstrate the spread of Babesiosis to the southwestern part of the state that previously has not seen much of it, and raises issues of how a changing environment and climate could change the profile of vectors for disease.<sup>1</sup>

This issue contains articles that illustrate the value of a general journal. No matter what one’s specialty area, the information herein will make readers better informed about the range of work going on in medicine.

in the world where we are losing ancient languages, medicine has a proliferation journals full of jargon, acronyms, and hypotheses that are unfamiliar to most physicians and are all but unreadable except to a few.

So the need for general journals for general readers remains wide open, but “new” general journals are few and far between because so many physicians and health professionals have become focused on a “field” rather than the profession. All this is to say that *WMJ* remains a general journal in a growing world of specialty publications, and each issue brings together a variety of topics that might have been published in a specialty journal and therefore lost to the readers of *WMJ*.

This issue contains articles that illustrate the value of a general journal. No matter what one’s specialty area, the information herein will make readers better informed about the range of work going on in medicine. For exam-

Also in this issue is Treffert and Rebedew’s article on the development of a worldwide registry for savant syndrome. It builds on the expertise developed in Wisconsin about savants and continues to describe the nature of the disorder, its correlates with the skills possessed by savants, and its distribution across gender and geography.<sup>2</sup>

Pabalan and colleagues used emergency department (ED) visits at a children’s hospital to gauge the severity of food insecurity in families.<sup>3</sup> While many primary care clinicians are including questions about access to and quality of food as part of their social histories with patients, many people use EDs as a primary care source, so interventions and help relating to food insecurity in that environment could be enormously helpful to families.

Tamunihardjo and colleagues use data from college students about drinking behavior and the location of stores where liquor is

available to find a strong association between binge drinkers and proximity to access to alcohol.<sup>4</sup> While there are many ways to interpret what they have found, the location of alcohol access to young and underage drinkers should be a public policy discussion if we are going to seriously address the plague of alcoholism and binge drinking that affects the state.

This issue also contains findings from a Wisconsin Medical Society study on physician satisfaction in the state. It reports differing levels of satisfaction by age, location, and practice size that are worth considering. And, it recognizes that continuing dissatisfaction relating to the mix of direct patient care and administrative responsibilities jeopardizes physicians' commitment to practicing medicine over the long term.<sup>5</sup>

This one issue of *WMJ* contains articles that include perspectives on public health, infectious disease, drug side effects, behavioral health, psychiatry, and professionalism that

could well have ended up scattered to many narrower journals and, likely, been unread by a wider audience. General journals give physicians a chance to remain broadly informed and serve an important purpose in the world of medical journalism. Perhaps that's why *WMJ* has been around since 1903.

#### REFERENCES

1. Kowalski TJ, Jobe DA, Dolan EC, Kessler A, Lovrich SD, Callister SM. The emergence of clinically relevant babesiosis in Southwestern, Wisconsin. *WMJ*. 2015;114(4):152-157.
2. Treffert DA, Rebedew DL. The Savant Syndrome Registry: a preliminary report. *WMJ*. 2015;114(4):158-162.
3. Pabalan L, Dunn R, Gregori K, et al. Assessment of food insecurity in Children's Hospital of Wisconsin's emergency department. *WMJ*. 2015;114(4):148-151.
4. Tanumihardjo J, Shoff SM, Koenings M, Zhang Z, HuiChuan JL. Association between alcohol use among college students and alcohol outlet proximity and densities. *WMJ*. 2015;114(4):143-147.
5. Coleman M, Dexter D, Nankivil, N. Wisconsin Medical Society. Factors affecting physician satisfaction and Wisconsin Medical Society strategies to drive change. *WMJ*. 2015;114(4):135-142.

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# Results From Wisconsin Medical Society’s Physician Satisfaction Survey Are Cause for Concern

Donn Dexter, MD

The Wisconsin Medical Society (Society) represents over 12,800 Wisconsin physicians, with a mission to improve the health of the people of Wisconsin by supporting and strengthening physicians’ ability to practice high-quality patient care in a changing environment. Advocating for the profession is a key focus for our organization; and one of the most poignant areas is physician satisfaction. Overwhelmingly, our physicians are reporting high rates of professional burnout and dissatisfaction. Not only is this detrimental to individual physicians and their career and family, but also to our patients. If our healers themselves are

• • •

Doctor Dexter is chief medical officer of the Wisconsin Medical Society. He can be reached at [donn.dexter@wismed.org](mailto:donn.dexter@wismed.org).

not well, how can we expect them to treat and heal patients?

Research—which is referenced elsewhere in this issue—indicates that when physicians are burned out or dissatisfied, this translates directly to our patient’s health outcomes. Patients are less likely to follow through on treatment plans, and their quality of care suffers. Certain specialties within the field—specifically primary care—are experiencing higher rates of burnout and physicians are leaving their practices for roles in administration or switching careers entirely, adding on to the already existing physician workforce shortage.

Because of these rising concerns, the Society surveyed Wisconsin physicians to determine the source of their satisfaction—and dissatisfaction. The findings from this survey echo and align with findings from similar research nationwide. The study published in this issue

of *WMJ* outlines our survey results, while also presenting a review of the current and emerging literature on physician satisfaction. Also in this issue is a commentary by Christine Sinsky, MD, American Medical Association vice president of professional satisfaction, on the Society’s findings, as well as advocacy for the “Quadruple Aim”—which adds a fourth component of physician satisfaction to the Institute for Healthcare Improvement’s Triple Aim—to bring back the “joy in practice.”

The Society is committed to moving forward the advocacy and professional development recommendations outlined in the study. To that end, a physician satisfaction task force has been launched to begin our efforts. Please feel free to contact me directly with feedback or opportunities for dialogue. We were drawn to the profession of healing as a vocation; it is our duty now to also work to heal the profession.

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# Dissatisfaction Among Wisconsin Physicians Is Part of Serious National Trend

Christine A. Sinsky, MD

The men and women on whom health care is dependent are running out of reserve. This cannot be good for patients. Care from discouraged or demoralized physicians is not optimal. Errors increase, empathy decreases. Costs may rise.

The 2014 Wisconsin Medical Society (Society) survey<sup>1</sup> adds to a growing body of literature pointing to physician dissatisfaction as a serious problem in the US health care system. Forty-seven percent of Wisconsin physicians report being moderately or significantly burned out. This is nearly identical to national norms reported in a 2012 Mayo-AMA study.<sup>2</sup>

How can a career as inherently meaningful and rewarding as medicine have rates of burnout that are significantly higher than those in the general public? The primary issues identified in the Society survey are similar to those identified in a Rand-AMA study<sup>3</sup>: the growing volume of indirect work (documentation, order entry, billing, inbox) and administrative work (prior authorizations, insurance forms, and paperwork), coupled with the impact of the electronic health record (EHR).

Almost a third of Wisconsin physicians report that their EHR has decreased the quality of care they can provide.

EHRs, and the federal and institutional policies around them, often have shifted responsibilities to physicians. Work previously done by receptionists, transcriptionists, medical record clerks, etc, has become the work domain of the physician. As a result, almost half of Wisconsin physicians take EHR work home—many giving up 1 to 2 hours of personal/family time each day to EHR tasks.

• • •

Dr Sinsky is Vice President of Professional Satisfaction for the American Medical Association. She can be reached at [Christine.Sinsky@ama-assn.org](mailto:Christine.Sinsky@ama-assn.org).

## What Is Going On?

In the past 7 years, I have had the opportunity to visit over 50 clinics across the country (including several in Wisconsin), large practices and small, rural and urban, private practices, academic centers, and federally qualified health centers, shadowing primary care physicians and staff as they do their work. The issues are similar in each setting.

I have observed that up to 70% to 80% of nurse and physician work output is waste—not waste from ordering unnecessary tests or treatments, but waste from doing work that doesn't add value for the patient. The degree of waste is often not recognized because it is so finely ingrained in our work that we do not see it.

I believe about half of this waste could be eliminated by re-engineering workflows at the practice level. About half of the waste is nonvalue-added work that arises from the mismatch of policy and technology on the one hand, to the clinical care on the other.

## What Can Be Done?

**Physicians can work smarter.** Improving workflow efficiency is a powerful anecdote to burnout. In a study of primary care clinics in the Upper Midwest and New York,<sup>4</sup> Linzer found that burnout is 6 times more likely to improve with workflow interventions, such as empowering support staff to enter data into EHRs or doing pre-visit planning.

In a study I lead, *In Search of Joy in Practice*,<sup>5</sup> we highlight practices that have re-engineered basic workflows to reduce chaos and waste. For example, several clinics have instituted proactive planned care appointments with pre-visit lab. This involves “flipping the clinic”—doing lab before the visit—rather than the traditional model where the patient is sent for lab after their appointment, and then notified by phone or e-mail about their results. One site found pre-visit lab saved \$25 of organizational costs per visit.<sup>6</sup>

Other innovations include empowering the nurse and/or medical assistant to filter the inbox, with the result that only a minority of the messages are passed on to the physician; and team documentation, allowing the physician to provide his or her undivided attention to the patient. One clinic found that team documentation saves 1.5 hours of physician time for every 4-hour clinic session, while also improving patient satisfaction with the amount of time they spent with their physician.<sup>7</sup>

**Leaders can be bold.** Leaders must recognize that the delivery models of the future cannot be managed with the staffing models of the past. The days of hero medicine, with the doctor doing it all, belong in the past. Higher staffing levels can result in better outcomes in both a fee-for-service payment model, as well as in a global payment model. In addition, Shanafelt<sup>8</sup> found that organizational leadership is a strong predictor of physician satisfaction. Burnout is lower when leaders listen and communicate well, show concern for physicians' professional lives, and empower physicians with the tools and resources to do their best.

**Technology vendors can be humble.** Responsibility for health professional well-being extends beyond the clinic. Technology vendors have an ethical responsibility to create products that reduce the cognitive workload, increase the ease of clinical tasks, and that support advanced team-based models of care. This requires a deep level of respect for the work of clinicians and a responsiveness to their needs for tools that help rather than hinder in carrying out their mission.

**Regulators can take a disciplined approach.** More is not always better. Regulators need to create policy that is evidence-based, and that includes a clear accounting of the time-costs

associated with implementation. For every new time commitment, there should be consideration of what work will no longer be performed to make room for the new task. Likewise, metric developers need to create measures that are meaningful, minimal, and manageable.

There are reasons to be hopeful. The Wisconsin Medical Society has launched a task force comprised of physician leaders to address physician satisfaction. Others are also recognizing the importance of the “Quadruple Aim”<sup>9</sup>—adding the fourth aim of health professional well-being to the Triple Aim of better care for individuals, better health for the population, at lower costs. The Institute for Healthcare Improvement has established “improving joy in work” as one of its focus areas for fiscal year 2016; the American College of Physicians has identified “improving joy in medicine” as an initiative over the past year; and the American Academy of Family Physicians is focusing on improving physician well-being. In addition, the American Medical Association has identified “improving professional satisfaction and practice sustainability” as one of its 3 strategic focus areas

and has created a series of open-access practice transformation resources at [www.stepsforward.org](http://www.stepsforward.org)

A medical education is a terrible thing to waste. Patients need physicians who spend most of their time on work for which they are uniquely qualified. Improving career satisfaction in medicine is a shared responsibility.<sup>8</sup> A single physician or individual clinic cannot solve these problems on their own, but collectively, multiple stakeholders can make a significant impact. Patients deserve to receive care from nurses and physicians who are not running out of reserve, but who instead come to work each day empowered and supported by technology, policy, and effective and efficient teams.

## REFERENCES

1. Coleman M, Dexter D, Nankivil, N. Factors affecting physician satisfaction and Wisconsin Medical Society strategies to drive change: A survey of Wisconsin physicians by the Wisconsin Medical Society. *WMJ*. 2015;114(4):135-142.
2. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Arch Intern Med*. 2012;172(18):1377-1385.
3. Friedberg MW, Chen PG, Van Busum KR, et al. *Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy*. Santa Monica, CA: RAND Corporation; 2013.
4. Linzer M, Poplau S, Grossman E, et al. A cluster randomized trial of interventions to improve work conditions and clinician burnout in primary care: results from the healthy work place study. [published online ahead of print February 28, 2015]. *J Gen Intern Med*. 2015;30(8):1105-1111. doi: 10.1007/s11606-015-3235-4.
5. Sinsky CA, Willard-Grace R, Schutzbank AM, Sinsky TA, Margolius D, Bodenheimer T. In search of joy in practice: A report of 23 high-functioning primary care practices. *Ann Fam Med*. 2013;11(3):272-278.
6. Crocker B, Lewandrowski E, Lewandrowski N, Gregory K, Lewandrowski K. Patient satisfaction with point-of-care laboratory testing: Report of a quality improvement program in an ambulatory practice of an academic medical center. *Clin Chim Acta*. September 2013;424:8-129.
7. Reuben DB, Knudsen J, Senelick W, Glazier E, Koretz BK. The effect of a physician partner program on physician efficiency and patient satisfaction. *JAMA Intern Med*. 2014;174(7):1190-1193.
8. Shanafelt TD, Gorringer G, Menaker R, et al. Impact of organizational leadership on physician burnout and satisfaction. *Mayo Clin Proc*. 2015;90(4):432-440.
9. Bodenheimer T, Sinsky CA. From triple to quadruple aim: Care of the patient requires care of the provider. *Ann Fam Med*. 2014;12(6):573-576.

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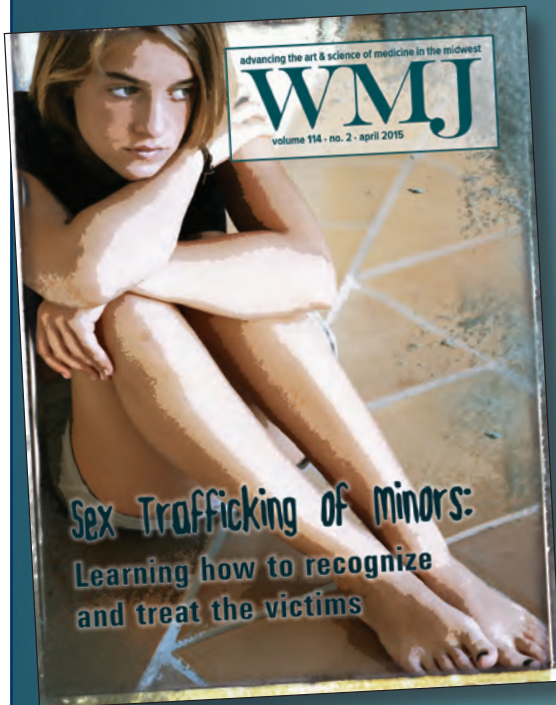
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# Factors Affecting Physician Satisfaction and Wisconsin Medical Society Strategies to Drive Change

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## ABSTRACT

Physicians' dissatisfaction in their work is increasing, which is affecting the stability of health care in America. The Wisconsin Medical Society (Society) surveyed 1016 Wisconsin physicians to determine the source of their dissatisfaction. The survey results indicate Wisconsin physicians are satisfied when it comes to practice environment, work-life balance, and income. In addition, they are extremely satisfied when it comes to rating their ability to provide high quality care, and they have identified some benefits related to the adoption of electronic health records. However, they are feeling burned out, very unsatisfied with the amount of time spent in direct patient care compared to indirect patient care, and that they are spending too much time on administrative and data entry tasks. In terms of future workforce, many physicians are either unsure or would not recommend the profession to a prospective medical student. Electronic health records serve as both a satisfier and dissatisfier and as a potential driver for future physician satisfaction interventions. Changes at the institutional, organizational, and individual levels potentially could address the identified dissatisfiers and build upon the satisfiers. The Society identifies 12 strategies to improve upon the physician experience.

## INTRODUCTION

Physician professional satisfaction is crucial to the stability of the United States health care system, health care reform, and health outcomes, but physician satisfaction rates have experienced a dramatic decline in recent years.<sup>1-5</sup> Negative physician mental health and burnout rates increase when physicians are dissatisfied with their career, and those reporting higher dissatisfaction are more likely to reduce their work hours, leave their current practice, and retire early.<sup>2</sup> Physician burnout and dissatisfaction also are associated with lower patient satisfaction and reduced adherence to treatment plans, and they directly impact the quality of

care patients receive.<sup>5-8</sup> Physician burnout is estimated to be between 25% and 60% across all specialties.<sup>2,9</sup> Moreover, burnout is more common among physicians than any other profession.<sup>3</sup> The importance of improving the physician experience via professional satisfaction is paramount, more so than ever.

A study released in 2010 surveyed 1735 allopathic and osteopathic physicians from the American Medical Association Physician Masterfile regarding their job satisfaction and stress rates and the subsequent implications on their self, their patients, and health care organizations. When physicians perceived higher stress, lower satisfaction rates, and/or burnout, they were more likely to have higher intentions of quitting their job (including early retirement), decreasing their work hours, changing their specialty or practice emphasis, and/or leaving direct patient care (either leave the health care field entirely or switch to a health care administrative role).<sup>10</sup> Other researchers found that middle career physicians were more likely to be planning to leave their current practice out of frustration to pursue a career with no direct patient care or one outside the field of medicine altogether. Such departures are detrimental to health care as middle career physicians tend to be the most productive in terms of the amount of patient care provided. In turn, consequences can include amplification of the physician shortage, increased gaps in access to health care, disruptions in patient care, and added financial burdens on the health system or practices because of the need to replace the physician.<sup>2</sup>

It also has been suggested that younger and older physicians have the most career satisfaction, while mid-career physicians have the least, representing a U-shaped relationship. A study conducted at Mayo Clinic by Dyrbye et al surveyed 7288 physicians from the Medical Association Physician Masterfile in June 2011 regarding their career satisfaction and analyzed responses by age, region, income, and specialty. Early career physicians had more

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**Table 1.** Distribution of Specialties Among Respondents

Specialty	No. of Respondents	% of Respondents n=1016	No. of Society Members	% of Membership n=12,696
Family Med	200	19.69%	2671	21.04%
Internal Med	164	16.14%	1669	13.15%
Emergency Medicine	82	8.07%	764	6.02%
Pediatrics	75	7.38%	1144	9.01%
Anesthesiology	56	5.51%	880	6.93%
Psychiatry	50	4.92%	568	4.47%
Surgery	48	4.73%	590	4.65%
OB/Gyn	47	4.63%	647	5.1%
Orthopedics	44	4.33%	485	3.82%
General Practice/Other	33	3.25%	101	0.01%
Ophthalmology	25	2.46%	343	2.7%
Radiology	23	2.26%	805	6.34%
Dermatology	20	1.97%	205	1.61%
Oncology	20	1.97%	185	1.46%
Otolaryngology	19	1.87%	189	1.49%
Cardiology	18	1.77%	22	0.17%
Neurology	18	1.77%	269	2.12%
Pathology	12	1.18%	320	2.52%
Physical Med & Rehab	12	1.18%	196	1.54%
Allergy/Immunology	11	1.09%	74	0.58%
Endocrinology	8	0.79%	113	0.89%
Preventive Medicine	8	0.79%	71	0.56%
Urology	7	0.69%	164	1.29%
Plastic Surgery	6	0.59%	79	0.62%
Geriatrics	5	0.49%	43	0.34%
Neurological Surgery	4	0.39%	88	0.69%
Medical Genetics	1	0.09%	11	0.09%
<b>Total</b>	<b>1016</b>		<b>12,696</b>	

conflicts with work and home balance. Middle career physicians worked the most hours, took more overnight calls, had the lowest satisfaction, and the highest rates of emotional exhaustion and burnout with their specialty choice. They also were the least likely to recommend medicine as a career option to their children. Late career physicians had the lowest rates of distress and were generally the most satisfied. The cited grievances of middle career physicians existed in both men and women and across all specialties and practice types.<sup>2</sup>

Primary care physicians typically report higher rates of professional dissatisfaction,<sup>4,11</sup> and it has been well documented that they have a higher risk of burnout compared to other specialties.<sup>2,3</sup> One study found that more than half of general internists and family physicians exhibit symptoms of burnout, and physicians on the front line of health care access—including family medicine, general internal medicine, and emergency medicine—have the greatest risk of burnout.<sup>3</sup> About one in six general internal medicine physicians leave the field, possibly due to dissatisfaction, compared to only one in 25 internal medicine subspecialty physicians.<sup>12</sup> Specifically, physicians working in primary care experience high stress due to time constraints, chaotic and stressful work environments, increasing administrative and regulatory burdens, an ever-expanding knowledge base, frag-

mented care delivery, and greater expectations of duties placed on the primary care system.<sup>13</sup> In addition, primary care visits often can be disorganized, rushed, and overbooked, resulting in patients being unable to see their primary care physician when needed, placing more stress on the physician and system.<sup>4</sup>

In part, because of these known pressures and dissatisfaction rates, fewer graduating medical students are choosing to work in primary care.<sup>4,14,15</sup>

A study conducted in 2009 surveyed 16,402 internal medicine residents regarding their perceived time spent on patient documentation compared to face-to-face patient interaction and the importance of the documentation. Over two-thirds of the residents perceived spending more than four hours per day on documentation. The majority felt they received feedback on their documentation less than 50% of the time, and only 58% felt that feedback on documentation was highly important.<sup>14</sup> Fourth-year medical students surveyed at 11 US medical schools indicated the perceived high levels of paper-

work and charting, the need to bring work home, and the appeal of being a primary care physician as reasons why they did not choose an internal medicine career. In addition, the students expressed reservations about internists' quality of life and rewards compared to other fields.<sup>15</sup>

The Wisconsin Medical Society (Society) elected to survey Wisconsin physicians to determine if the concerns arising from these data also are evident in Wisconsin. Findings will be used to help inform the Society's advocacy and education efforts on behalf of physicians, and in dialogue with key stakeholders to bring to light challenges facing the profession.

## SURVEY METHODS

In 2014, the Society conducted a survey to assess physician satisfaction in the state, paralleling a 2009 survey also administered by the Society. To the extent possible, data in this report are evaluated against the 2009 data. The 2014 survey instrument used similar questions to its 2009 predecessor, and exceptions are noted in this analysis where necessary. All surveys were distributed online and returned electronically. There were 40 survey questions across five categories. Each question typically solicited a Likert response to an objective statement. There also were open-field questions for anecdotal analyses.

Invitations to take part in the 2014 survey were e-mailed to 10,380 physicians for whom the Society has current e-mail addresses, including both members and non-members. Only completed surveys were analyzed. There were 1016 completed surveys with a response rate of 9.79%. This is about a half of a percent lower than the 2009 survey, when 10,070 physicians were solicited and 1044 responded, yielding a response rate of 10.37%.

Table 1 shows the rank-ordered distribution of specialties among the respondents and compares the respondents to the composition of the Society membership. Family medicine was the largest subgroup of respondents followed by internal medicine. Together these two groups accounted for 35.8% of the sample and comprise a similar majority in the Society's membership.

Respondents were asked if they work in a health care system with fewer or more than 25 physicians, a medical school, or a hospital.

Table 2 shows that 654 respondents (64%) worked for health care systems with more than 25 physicians. One hundred fifty-seven respondents (15%) worked in systems with fewer than 25 physicians. There were 101 respondents who worked in medical schools (10%); the remaining 73 worked in hospitals (7%).

Table 3 shows that respondents ranged in age from 28 to 83 years, with about 36% between 49 and 58 years. The average range was between 42 and 62 years with a mean of 52. Both the median and mode were 58.

Three hundred thirty-three (33%) respondents identified themselves as female; the remaining 683 (67%) identified themselves as male.

It should be noted that the demographic profile of survey respondents is very similar to the demographic profile of Society members.

## SURVEY FINDINGS AND RELATED LITERATURE

The results of the 2014 survey were organized into two broad categories: factors contributing to physician dissatisfaction or "dissatisfiers" and factors contributing to physician satisfaction or "satisfiers." These were subcategorized based on naturally emerging themes, and the themes were further analyzed based on respondents' age, gender, primary employment affiliation, and specialty. An extensive literature review revealed that the Society survey results parallel and support other national data and research efforts.

### Dissatisfiers

#### *Decrease in Direct Patient Care*

Direct patient care was defined as face-to-face time spent with patients obtaining history, performing exam, and crafting a care plan. One out of every two respondents reported being dissatisfied or very dissatisfied with the number of hours they are able to spend on direct patient care versus administrative tasks. This is a substantial increase compared to the 2009 survey results, when

**Table 2.** Primary Employment Affiliation

	n	n=1016
Health Care System With More Than 25	654	64.37%
Health Care System With Fewer Than 25	157	15.45%
Medical School	101	9.94%
Hospital	73	7.19%

**Table 3.** Age Characteristics of 2015 Respondents

Category	n
<b>No Answer</b>	<b>9</b>
<b>Age Ranges</b>	
28-38	115 ÷ 1007 = 11.42%
39-48	246 ÷ 1007 = 24.43%
49-58	362 ÷ 1007 = 35.95%
59-68	245 ÷ 1007 = 24.33%
69-78	36 ÷ 1007 = 3.57%
79-83	3 ÷ 1007 = 0.29%
<b>Full Range</b>	
28 – 83	1007
Mean	52 (f=39)
Median	58 (f=48)
Mode	58 (f=48)
Standard Deviation	10.06
Average Range	42–62

only one out of every three reported being dissatisfied or very dissatisfied. When asked if time spent in direct patient care has increased, decreased, or remained the same over the past year, 39% reported a decrease, 15% reported an increase, and 46% indicated it remained the same. This is a significant difference from the 2009 results in that more reported a decrease in direct patient care in 2014 compared to 2009 (39% vs 30%) and less reported an increase in direct patient care in 2014 compared to 2009 (15% vs 23%). Furthermore, only 32% of respondents reported feeling that they have significant or total control of the amount of time they spend in direct patient care.

Conversely, when asked about time spent over the past year specifically on indirect patient care, which was defined as electronic health records and other documentation, order entry, test interpretation, referrals and communication with care team, and billing, 74% reported an increase in 2014, whereas 3% reported a decrease, and 23% reported no change. Moreover, when asked about the amount of time spent in the past year on administrative tasks, which was defined as prior authorizations, insurance forms, paperwork, and meeting attendance, 65.5% of respondents reported an increase, 3% reported a decrease, and 31.5% reported no change. Sixty-eight percent of respondents reported feeling like they have no or only some control of the amount of time they spend in indirect patient care. No equivalent questions were asked in the 2009 survey. Respondents reported spending 25.2 hours per week on direct patient care, 11.9 on indirect

patient care, and 7.33 on administrative tasks. Well over 50% of physicians who worked for a health system or a medical school reported being dissatisfied with time spent on direct patient care compared to only 30% of those who worked at a hospital or private/public entity. Moreover, respondents working in the primary care fields of family medicine and internal medicine reported a dissatisfaction rate of 61% compared to 46% reported by all other specialties.

To demonstrate how a physician's workday is spent, one researcher observed and quantified the average physician responsibilities. On any given day, a primary care physician performs 18 in-person visits, 24 phone calls, 12 prescription refills, 17 e-mail messages, 20 lab reports, 11 imaging reports, and 14 consultation reports; all of these activities required the extensive use of an electronic health record.<sup>16</sup> Other researchers have documented the large amounts of time physicians spent outside of the exam room, not interacting directly with patients. Gilchrist et al reported 39% of a physician's day, or three hours and eight minutes, is not in the exam room,<sup>17</sup> whereas Gottschalk and Flocke reported 45%;<sup>18</sup> most of this time is spent on documentation of patient interactions and necessary follow-up.<sup>17,18</sup> Every minute a physician does not spend on direct patient care costs a practice \$4 to \$6 in lost revenue.<sup>11</sup> It has been documented that physicians spend 4.3 hours per week dealing with insurance issues, costing \$23 billion to \$31 billion annually for the time physicians, nurses, and other clerical staff spend on interacting with health plans. This issue has affected the training of physicians as well. Two times as many residents compared to previous reporting indicate they spend four or more hours on documentation work each day.<sup>11</sup>

#### *Electronic Health Records*

More than 56% of respondents reported that their electronic health record (EHR) system has much or moderately worsened the physician-patient interaction, whereas only 21% reported that it much or moderately improved the interaction. Respondents working in primary care or employed at a health system or medical school were more likely to report that EHRs have much or moderately worsened the physician-patient interaction. Moreover, over 68% of respondents reported EHRs have made their overall workload much or moderately worse, and only 17% reported they much or moderately improved the workload. Respondents who were male, age 49 or over, or employed at a health care system or medical school were more likely to indicate that EHRs have much or moderately worsened their workload. Half of the respondents reported not having enough time to complete EHR work during the workday and having to finish it after hours, whereas 22% reported having time during the normal workday. More women, respondents working in primary care, and respondents working at medical schools or health systems reported having to complete EHRs after hours. When asked how much time they spend per week outside of the normal workday to complete

EHRs, 30% reported spending 0 to 2 hours, 22.5% reported 2 to 4 hours, 18% reported 4 to 6 hours, 13.6% reported 6 to 8 hours, and 12% reported more than 8 hours. Three out of four respondents reported feeling they have no to only some control in the amount of time they spend completing EHR work.

Literature suggests the current existence of EHR technology pointedly decreases physician satisfaction via multiple venues. A study completed by the RAND Corporation cited "poor EHR usability, time-consuming data entry, interference with face-to-face patient care, inefficient and less fulfilling work content, inability to exchange health information between EHR products, and degradation of clinical documentation" as major contributing professional dissatisfaction factors.<sup>19</sup> Other research has found the data entry process of patient and billing information can consume up to 2 to 3 hours of a physician's day.<sup>4</sup> It has been documented that up to two-thirds of a patient visit is spent on data entry instead of providing patient care. Quantified, on average each physician spends seven minutes per day refreshing locked computers, 10 minutes on re-signing into a computer, and 13 minutes signing-off on routine documents by clicking through multiple screens and confirming previously entered data. With the transition of electronic billing to the clinician, the creation of one electronic invoice requires 21 mouse clicks, eight mouse scrolls, and five screen changes, totaling at least one minute.<sup>11</sup>

#### *Professional Burnout and Chaotic Work-life*

Professional burnout was defined as the exhaustion of motivation due to prolonged stress or frustration at work. Almost one out of four respondents reported they were either totally or significantly burned out. Approximately 25% more said they were moderately burned out. Over one third said they were somewhat burned out. Together, 82% of respondents reported some level of professional burnout with only 18% reporting no burnout at all. In terms of primary employment, physicians working in health systems or a medical school reported being burned out significantly more than those working in hospitals or private/public entities. Moreover, those working in primary care reported being more burned out than those in all other specialties. When asked to describe the professional work environment in which they currently practice, over half of respondents indicated it to be chaotic or hectic. Chaotic was defined as feeling chronically stressed, impacting their practice and quality of life. Hectic was defined as feeling stressed too often at work, but without it impacting their quality of life. The remainder of respondents reported feeling calm or reasonably busy. More women, primary care physicians, and respondents age 48 and under described their work environment as chaotic. Almost 70% of respondents reporting feeling they have no to only some control in the amount of time they spend on workday interruptions.

Shanafelt et al define professional burnout to be a syndrome characterized by a loss of enthusiasm for work (emotional exhaus-



tion), feelings of cynicism (depersonalization), and a low sense of personal accomplishment.<sup>20</sup> It has been suggested that physician burnout can influence quality of care, medical errors, and early retirement, along with personal damage to relationships, alcohol and drug use, and suicide contemplation.<sup>6,7,20</sup> A sample of physicians from all specialties from the American Medical Association Physician Masterfile were surveyed to understand the factors contributing to satisfaction among US physicians. Taken individually, 37.9% of US physicians reported high emotional exhaustion, 29.4% had high depersonalization, and 12.4% had a low sense of personal accomplishment. In total, almost one out of every two (45.8%) physicians were considered to be experiencing at least one symptom of burnout, and those at the front line of care experienced higher rates of burnout compared to other specialties.<sup>3</sup> Other researchers found the negative contributors to emotional exhaustion and depersonalization to be workload, constraining organizational structure, incivility, conflicts and violence, work-life conflict, low quality and safety standards, and negative work attitudes.<sup>21</sup>

## Satisfiers

### *Practice and Work Environment*

When asked about their current practice and work environment, over 75% of respondents said they were either very satisfied, mostly satisfied, or satisfied. This is similar to 2009 results—the main difference being that in 2014, 2.5% more said they were very satisfied. When examining the data based on primary employment affiliation, those who worked at hospitals had the highest satisfaction rate at 86%, while medical schools had the lowest at 71%. In terms of satisfaction regarding the internal culture and values of their employing organization matching their own, over 70% of physicians reported being very satisfied, mostly satisfied, or satisfied. Compared to 2009, this is a significant decrease from 83.5%. In addition, 30% of physicians in 2014 responded to this question with “dissatisfied” or “very dissatisfied” compared to 17% in 2009. However, due to differences in survey question wording, these results cannot be compared directly.

In terms of primary employment affiliation, respondents who worked at a system with less than 25 physicians were the most satisfied with the internal culture and value of their employing organization (82%), followed by those working at hospitals (80%). Among those employed at health care organizations with more than 25 physicians, medical schools, and private/public entities, the satisfaction rate was 67%.

According to the RAND Corporation study, physicians rate higher levels of satisfaction when the values of management and leadership at their place of work aligned with theirs, specifically in relation to values surrounding clinical care. Effective leadership was especially valued when management had clinical experience themselves and could relate to the needs of the physicians.

Physicians were not satisfied when they perceived poor collegiality, fairness, and respect among their colleagues, leadership, and organization.<sup>19</sup> One systematic review found similar results in that there was a strong relationship between satisfaction and positive collegial support and interaction.<sup>22</sup>

### *Work-life Balance and Compensation*

Sixty-four percent of respondents reported being very satisfied, mostly satisfied, or satisfied with the number of hours per week worked versus their ability to pursue home life and other interests. In 2009, 59% of respondents reported the same. One difference between the two surveys is that there was a 2.6% decline in 2014 in the number of respondents reporting being very dissatisfied. However, when divided into primary employment affiliation and specialty, there is a variation in the responses. The highest satisfaction rates were from the respondents working at a private/public entity, followed by hospital employment at 81% and 72% respectively. Below average satisfaction rates came from those who work at a system with less than 25 physicians (63%), health care systems with more than 25 physicians (62%), and medical schools (52%). Those with specialties outside of primary care also have a higher satisfaction rate compared to those in primary care (68% vs 54%). Every three out of four respondents rated being very satisfied, mostly satisfied, or satisfied with their income relative to the number of hours they work. This is a significant difference from the 2009 survey when only 65% responded feeling similarly. The RAND Corporation study found income to be an important contributor to satisfaction levels based on income stability, fairness, and future payment reform; those with higher incomes also rated themselves as more satisfied.<sup>19</sup> Other research has found similar associations between income level and satisfaction rates.<sup>22</sup>

### *Ability to Provide Quality Care*

When asked about their ability to provide the highest quality of care in their current practice, respondents overwhelmingly reported being able to do so. Seventy-eight percent reported being totally or significantly able to provide the highest quality of care. Adding the 27% that reported being moderately able to provide the highest quality of care brings this total to 95%. Five percent reported somewhat or not at all. Other research demonstrates that those who perceive themselves as providing higher quality care to their patients report higher levels of professional satisfaction. The converse of this is also true. When physicians are able to cite barriers in their practice that hinder their ability to provide quality care, their professional satisfaction decreases. Research also demonstrates that physician satisfaction directly relates to and impacts patient satisfaction.<sup>19,23</sup>

### *Electronic Health Records*

More than 80% of respondents have been using an EHR for three years or more. Half reported that EHRs have much or moderately improved their ability to provide the highest quality of care.

Those who were female, age 48 and under, were a primary care physician, or employed at a health care system with more than 25 employees, a hospital, or medical school were more likely to indicate that the EHR system has much or moderately improved their ability to provide the highest quality of care. Almost a third of the respondents indicated that EHRs have much or moderately worsened their ability to provide the highest quality of care.

Half of the respondents reported that the quality of chart notes in the EHR system has much or moderately improved their ability to communicate with other physicians when referring patients, although 35% reported the quality of the chart notes for this purpose to be much or moderately worse. In addition, almost 70% reported that the availability of chart notes has much or moderately improved their ability to communicate with physicians who refer patients to them.

Physicians often approve of the concept of EHRs in their ability to improve quality of care and access to patient data. Moreover, they are often optimistic that future EHRs will improve.<sup>19</sup>

## DISCUSSION

It is clear from the survey results that Wisconsin physicians have many dissatisfiers to cope with on a daily basis. Almost 40% of respondents reported their retirement plans have changed due to the health care environment, though it was not specified if they would retire earlier or later than previously planned due to professional satisfaction. More respondents age 49 and over indicated their plans have changed compared those age 48 and under. Additionally, 59% of respondents said either they would not recommend or are unsure if they would recommend a career as a physician to prospective students. Women and those 48 and under were less likely to recommend a career as a physician.

However, the survey also highlighted many satisfiers and opportunities to improve professional satisfaction. When respondents were asked to rank the five factors that would most favorably impact their decision to continue working in the field of medicine, the five most-endorsed factors in order of highest rank were: (1) reasonable work-life balance, (2) reasonable income/reimbursement, (3) adequate time and resources in direct patient care, (4) ability to maintain autonomy, and (5) less insurance/administrative hassles. The top two already have been identified as satisfiers in the survey. Efforts can now be made to build upon these satisfiers and lessen the dissatisfiers.

Research and literature dedicated to improving physician satisfaction via evidence-based interventions is still emerging, and what is available can be grouped into three broad solution and action categories: (1) institutional changes, (2) work environment changes, and (3) individual-level changes. Instituting metrics such as known satisfaction predictors of control, time pressure, pace of work, and value alignment, with the correlated outcomes of satisfaction, stress, burnout, and desire to leave the field have been sug-

gested to improve physician satisfaction rates and decrease overall burnout at the macro or institutional level.<sup>24,25</sup> Examining policies at the federal, state, and local levels could promote satisfaction by eliminating unintended barriers from regulations such as current limitations on who can order certain tests, renew prescriptions, and access patient data.<sup>11</sup>

Preserving physician control and autonomy through developing and implementing appropriate practice models, such as expanding primary care teams, was determined to improve physician satisfaction at the organizational level.<sup>25,26</sup> Promoting and utilizing appropriate care models, such as the patient-centered medical home, was found to reduce burnout by instituting participatory decision making and appropriate staffing levels for primary care teams.<sup>27</sup>

The Healthy Work Place Study conducted by Linzer and colleagues hypothesized that workplace changes, discussed and recommended by directly prompted feedback on clinician perceptions and outcomes, would lead to a decrease in clinician stress and improved care for patients. They determined that burnout improved with workflow interventions such as altering current staff assignments in primary care teams and hiring additional staff. In addition, the application of quality improvement projects, such as new medication reconciliation processes, were found to improve burnout rates. Physician satisfaction improved when communication increased between physicians and staff.<sup>24</sup> Sinsky et al surveyed 23 high-performing care practices and found higher physician satisfaction rates due to proactive planned care via pre-visit questionnaires and lab tests, sharing of clerical tasks (eg, collaborative documentation by scribes and expanded data entry by assistants), sharing of clinical work by expanding nurse and medical assistant rooming protocols, expanding team communication through co-location and weekly huddles, and improving work flows and process standardization.<sup>4</sup>

Electronic health records are a large driver in work environment and workflow issues leading to high rates of dissatisfaction. Practices have worked to combat this dissatisfier by expanding data entry responsibilities to scribes or other members of the care team and the employment of work flow managers to guide in helping all staff work to the top of their license.<sup>4,19</sup> Specifically adding inbox managers to filter out requests that do not require a physician, such as normal laboratory results and prescription renewals, and promoting quick in-person question and answering among staff versus e-mail allowed for the 90 minutes a day spent on inbox work to drop to just a few minutes.<sup>4</sup>

At the individual level, there is lack of attention to self-wellness by physicians, including poor attention to physical and mental health. Moreover, there is high stigma in the profession against seeking help, medical or otherwise. Physicians rarely reach out to their impaired colleagues and avoid seeking help for themselves for risk of medical licensing board action.<sup>28</sup> Gazelle et al suggested

that physician personality tendencies of perfectionism, denial of personal vulnerability, and delayed gratification further impact physician dissatisfaction. They propose the technique of coaching to enhance self-awareness, build upon and pull out individual strengths, examine new perspectives, question self-defeating thoughts and beliefs, along with aligning personal values to professional duties. The process of coaching applies mindfulness techniques, which has been found to be a successful method to reduce physician burnout.<sup>29</sup>

Emerging research suggests that motivation for the profession is divided into extrinsic and intrinsic factors and argue that more focus and interventions should be on intrinsic motivation as it relates to professional satisfaction, including increasing self-awareness and structuring their work around their internal motivators to improve satisfaction.<sup>30,31</sup> Moreover, research by Mayo Clinic found when academic researchers have less than 10% to 20% full-time equivalent to do what they care about most, burnout levels dramatically increased. Linzer et al suggested it to be cost-effective to provide at least one half day per week for physicians to dedicate time to what they are most passionate about.<sup>25</sup>

### **Wisconsin Medical Society Strategies**

The Wisconsin Medical Society serves over 12,500 physicians with a mission to improve the health of the people of Wisconsin by supporting and strengthening physicians' ability to practice high-quality patient care in a changing environment. Advocacy and professional satisfaction are at the core of the Society's work. Physician health and well-being is a leading priority of the organization. Informed by the findings of this survey and the current research and literature, the Society will begin to address this critical issue in collaboration with other key stakeholders by implementing the following strategies.

### **Society Advocacy Efforts**

- Work collaboratively with health system leaders and practicing physicians to develop a method and/or process to routinely assess physician satisfaction. This indicator may inform performance, quality, work force, and the health and well-being of physicians and the professional team.
- Heighten awareness among state and national organizations working on models of transforming care delivery, efficiency, and effectiveness to the critical need of adding physician professional satisfaction as a key measure of success.
- Develop a set of "Physician Health and Well-being Principles" through the Society's Council structure. Principles will be used in dialogue with relevant health care stakeholder groups and guide the development of appropriate state and federal legislation and Society educational initiatives.
- Identify requirements in Meaningful Use that are negatively affecting the patient-physician relationship, physician satisfaction, and clinical outcomes and work toward reducing bar-

riers and implementing relevant change.

- Aid in the passage of Wisconsin legislation to reestablish a statewide professional wellness program, which will offer support and assistance to impaired professionals.
- Assess the need to establish a statewide physician reentry program, which will allow physicians who have left practice and are in good standing to retrain and reengage in the workforce.

### **Society Professional Development Efforts**

- Charter a Physician Health and Well-being Task Force to advise Society leadership and staff on advocacy and educational priorities designed to favorably impact physician satisfaction.
- Expand the Society's Leading Healthy Work Systems program through health care system engagement and strategic partnerships. This program is designed to support physicians in transforming their work life to better serve patients, lead interprofessional teams, and enjoy a more balanced and rewarding life as healers.
- Continue to offer and expand Performance Improvement Continuing Medical Education (PI CME) modules to assist physicians in fulfilling their licensure and specialty board requirements, while aligning these efforts with relevant quality improvement and payment incentive programs.
- In conjunction with health system input, develop a toolkit of educational offerings, resources, or services that address areas of dissatisfaction for physicians in clinical documentation, workflow, and/or efficient use of the electronic health record system in their day-to-day practice.
- Partner with entities that have proven expertise and programs supporting the health and well-being of physicians and that focus on intrinsic factors and motivation such as mindfulness techniques.
- Provide opportunities and venues through the Society or within local communities for physicians (and their families) to network and build collegiality across systems, specialties, and geographies.

### **CONCLUSION**

The Wisconsin Medical Society's physician satisfaction survey clearly demonstrates rising dissatisfaction and burnout among Wisconsin's physicians—a trend that has serious implications for patients and the profession, and one that also is evident in the existing literature. As such, the Society has and will continue to use this data to develop and implement strategies to help reverse this growing problem.

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## REFERENCES

1. Okie S. Innovation in primary care-staying one step ahead of burnout. *N Engl J Med*. 2008;359(22):2305-2309.
  2. Dyrbye LN, Varkey P, Boone SL, Satele DV, Sloan J, Shanafelt TD. Physician satisfaction and burnout at different career stages. *Mayo Clin Proc*. 2013;88(12):1358-1367. doi:10.1016/j.mayocp.2013.07.016.
  3. Shanafelt TD, Boone SL, Litjen T, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Arch Intern Med*. 2012;172(18):1377-1385. doi:10.1001/archinternmed.2012.3199.
  4. Sinsky CA, Willard-Grace R, Schutzbank AM, Sinsky TA, Margolius D, Bodenheimer T. In search of joy in practice: a report of 23 high-functioning primary care practices. *Ann Fam Med*. 2013;11(3):272-278. doi:10.1370/afm.1531.
  5. Grol R, Mokkink H, Smits A, et al. Work satisfaction of general practitioners and the quality of patient care. *Fam Pract*. 1985;2(3):128-135.
  6. Haas JS, Cook EF, Puopolo AL, Burstin HR, Cleary PD, Brennan TA. Is the professional satisfaction of general internists associated with patient satisfaction? *J Gen Intern Med*. 2000;15(2):122-128. doi:10.1046/j.1525-1497.2000.02219.x.
  7. DiMatteo MR, Sherbourne CD, Hays RD, et al. Physicians' characteristics influence patients' adherence to medical treatment: results from the Medical Outcomes Study. *Health Psychol*. 1993;12(2):93-102. doi:10.1037/0278-6133.12.2.93.
  8. West CP, Huschka MM, Novotny PJ, et al. Association of perceived medical errors: a prospective longitudinal study. *JAMA*. 2007;296(9):1071-1078.
  9. Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. *Ann Intern Med*. 2002;136(5):358-367; ii. doi:200203050-00008.
  10. Williams ES, Konrad TR, Scheckler WE, et al. Understanding physicians' intentions to withdraw from practice: the role of job satisfaction, job stress, mental and physical health. *Health Care Manage Rev*. 2010;35(2):105-115. doi:10.1097/01.HMR.0000304509.58297.6f.
  11. Shipman SA, Sinsky CA. Expanding primary care capacity by reducing waste and improving the efficiency of care. *Health Aff*. 2013;32(11):1990-1997. doi:10.1377/hlthaff.2013.0539.
  12. Bylsma WH, Arnold GK, Fortna GS, Lipner RS. Where have all the general internists gone? *J Gen Intern Med*. 2010;25(10):1020-1023. doi:10.1007/s11606-010-1349-2.
  13. Grumbach K, Bodenheimer T. A primary care home for Americans: putting the house in order. *JAMA*. 2002;288(7):889-893. doi:10.1001/jama.288.7.889.
  14. Oxentenko AS, West C, Popkave C, Weinberger S, Kolars J. Time Spent on Clinical Documentation. *Arch Intern Med*. 2010;170(4):377-381.
  15. Hauer KE, Durning SJ, Kernan WN, et al. Factors associated with medical students' career choices regarding internal medicine. *JAMA*. 2008;300(10):1154-1164. doi:10.1016/S0084-392X(09)79130-0.
  16. Baron RJ. What's keeping us so busy in primary care? A snapshot from one practice. *N Engl J Med*. 2010;362(17):1632-1636.
  17. Gilchrist V, McCord G, Schrop SL, et al. Physician activities during time out of the examination room. *Ann Fam Med*. 2005;3(6):494-499. doi:10.1370/afm.391.
  18. Gottschalk A, Flocke SA. Time spent in face to face patient care and work outside the examination room. *Ann Fam Med*. 2005;3(6):488-493. doi:10.1370/afm.404.
- INTRODUCTION.
19. Friedberg M, Chen P, Van Busum K, et al. *Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy*. Washington, DC: RAND Corporation; 2013. [http://www.rand.org/pubs/research\\_reports/RR439.html](http://www.rand.org/pubs/research_reports/RR439.html).
  20. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg*. 2010;251(6):995-1000. doi:10.1097/SLA.0b013e3181bfdbab3.
  21. Lee RT, Seo B, Hladkyj S, Lovell BL, Schwartzmann L. Correlates of physician burnout across regions and specialties: a meta-analysis. *Hum Resour Health*. 2013;11(1):48. doi:10.1186/1478-4491-11-48.
  22. Scheurer D, McKean S, Miller J, Wetterneck T. U.S. physician satisfaction: A systematic review. *J Hosp Med*. 2009;4(9):560-568. doi:10.1002/jhm.496.
  23. Shannon D. Physician well-being: A powerful way to improve the patient experience. *Physician Exec*. 2013;39(4):6-12.
  24. Linzer M, Poplau S, Grossman E, et al. A cluster randomized trial of interventions to improve work conditions and clinician burnout in primary care: results from the Healthy Work Place (HWP) Study. *J Gen Intern Med*. 2015;1-7. doi:10.1007/s11606-015-3235-4.
  25. Linzer M, Levine R, Meltzer D, Poplau S, Warde C, West CP. 10 bold steps to prevent burnout in general internal medicine. *J Gen Intern Med*. 2013;1-3. doi:10.1007/s11606-013-2597-8.
  26. Dunn PM, Arnetz BB, Christensen JF, Homer L. Meeting the imperative to improve physician well-being: assessment of an innovative program. *J Gen Intern Med*. 2007;22(11):1544-1552. doi:10.1007/s11606-007-0363-5.
  27. Helfrich CD, Dolan ED, Simonetti J, et al. Elements of team-based care in a patient-centered medical home are associated with lower burnout among VA primary care employees. *J Gen Intern Med*. 2014;29(Suppl 2):S659-666. doi:10.1007/s11606-013-2702-z.
  28. Wallace JE, Lemaire JB, Ghali WA. Physician wellness: a missing quality indicator. *Lancet*. 2009;374(9702):1714-1721. doi:10.1016/S0140-6736(09)61424-0.
  29. Gazelle G, Liebschutz JM, Riess H. Physician burnout: coaching a way out. *J Gen Intern Med*. 2014;508-513. doi:10.1007/s11606-014-3144-y.
  30. Ratanawongsa N, Howell E. What motivates physicians throughout their careers in medicine? *Compr Ther*. 2006;32(4):210-217.
  31. Lambrou P, Kontodimopoulos N, Niakas D. Motivation and job satisfaction among medical and nursing staff in a Cyprus public general hospital. *Hum Resour Health*. 2010;8:26. doi:10.1186/1478-4491-8-26.

# Association Between Alcohol Use Among College Students and Alcohol Outlet Proximity and Densities

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## ABSTRACT

**Background:** Alcohol consumption is common on college campuses and is associated with negative consequences. Factors associated with availability of alcohol are not completely understood.

**Objective:** To describe how proximity and density of alcohol outlets are associated with any drinking and binge drinking in students at the University of Wisconsin-Madison.

**Methods:** Participants were full-time students enrolled in the Young Adults Eating and Active for Health, a multisite, randomized intervention that assessed a variety of health behaviors. Geographic information systems were used to calculate proximity and enumerate alcohol outlet densities. Participants were categorized as “drinkers” or “nondrinkers” based on self-reported alcohol consumption. Binge drinking was categorized as “non-binge drinker,” “frequent binge drinker,” and “excessive binge drinker.” Analysis included regression, *t* tests, and chi-square tests.

**Results.** Among the 166 participants, 126 (76%) were drinkers. Among drinkers, 80 (63%) were either frequent or excessive binge drinkers. Drinkers lived closer to an alcohol outlet than nondrinkers ( $0.18 \pm 0.15$  vs  $0.61 \pm 1.59$  miles, respectively,  $P = 0.005$ ). Within a 1-mile walking radius, there were 47% more establishments for drinkers ( $153 \pm 47$  compared to  $104 \pm 55$  outlets for nondrinkers,  $P < 0.0001$ ). At distances of 0.10-0.25 and 0.25-0.50 miles, twice as many outlets were available to drinkers ( $19 \pm 19$  and  $43 \pm 25$ , respectively) compared to nondrinkers ( $7 \pm 11$  and  $20 \pm 22$ , respectively),  $P < 0.001$ . Proximity and density were not associated with binge drinking frequency.

**Conclusion:** Drinkers lived closer to alcohol outlets and had significantly more outlets available at a distance of up to 1 mile. Municipal and college administrators could consider limiting alcohol license distributions in municipalities with high alcohol consumption.

## INTRODUCTION

Excessive alcohol consumption is prevalent during college years and is associated with unprotected sex, drunk driving, physical

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violence, social abuse, and other unintended consequences on college campuses across the United States.<sup>1-3</sup> The choice to drink operates through complex interactions of individual psychology, familial expectations, and community environment, among other factors. The micro-community of college campuses provides unique opportunities to implement strategies aimed at preventing this detrimental behavior and its consequences.

Physical accessibility of alcohol, as characterized by alcohol outlet density (ie, number of bars and liquor stores within a certain distance), is a critical component in alcohol consumption behavior.<sup>4-6</sup> Previous studies have shown a correlation between high alcohol outlet densities and issues related to excessive drinking.<sup>4-6</sup> For example, Gruenewald et al showed a positive correlation between alcohol beverage sales and alcohol outlet densities.<sup>5</sup> Further, Weitzman et al found significant correlations between outlet density and heavy drinking, frequent drinking, and drinking-

related problems.<sup>5</sup> Wechsler et al's analysis suggested that binge drinking was less prevalent when there was an absence of alcohol outlets within a mile of a college campus.<sup>3</sup> Furthermore, high alcohol outlet densities could be a determining factor in drinking behaviors, norms, and preferences.<sup>6</sup>

An important component of alcohol availability that has received scant attention is proximity (ie, distance to the closest alcohol outlet). This, alone or in combination with density, may be an important factor of drinking behavior. In a study by Young et al, the association between proximity and weekly alcohol use among Scottish adolescents was tested. They found that individuals who were within 200 m (0.12 miles) of an off-sales outlet were nearly twice as likely to drink weekly as those who lived more than 800 m (0.50 miles) away.<sup>7</sup>

The study presented here evaluates associations between drinking behavior and proximity to alcohol outlets in a student residence area characterized by high outlet densities. A geographic information system (GIS) was used to quantify alcohol outlet proximity, which eliminates potential bias associated with self-reports. The purpose of this study was to determine whether proximity and/or density of alcohol outlets is associated with drinking behaviors among college students at a large Midwestern college campus.

## **METHODS**

### **Study Design**

The alcohol study is an ancillary sub-study of Project Young Adults Eating and Active for Health (YEAH).<sup>8,9</sup> Project YEAH was a randomized intervention designed to assess the benefits of an online educational program aimed at preventing excessive weight gain in college students. Students at 13 institutions throughout the United States were enrolled, including those attending the University of Wisconsin-Madison. Participants were randomized to receive or not receive the online educational program after baseline questionnaires were completed. Follow-up was conducted at 3 months and 12 months post-intervention. All questionnaires, including alcohol behavior, were completed online. Physical measurements were obtained in person at each time point. This report is based on findings from subjects enrolled at the University of Wisconsin-Madison ( $n=174$ ). The University of Wisconsin-Madison Institutional Review Board reviewed and approved the research protocol. Prior to online enrollment, all subjects provided online informed consent. Additionally, at the start of the baseline in-person assessment, written informed consent was obtained.

### **Alcohol Behavior Questionnaire**

The ancillary study on alcohol behaviors was conducted to evaluate and measure alcohol consumption behaviors of college students. The alcohol questionnaire was modified from portions of the American College Health Association-National College Health Assessment-II (ACHA-NCHA-II) survey, which is a nationally recognized research survey that collects data about students' health habits, behaviors, and perceptions.<sup>10</sup> Student drinking behaviors that Project YEAH survey evaluated were the percentage of the population who reported any alcohol consumption ("drinkers") and the percentage of drinkers who reported consuming 5 or more drinks in a sitting ("binge drinkers"). Students were provided with standard definitions for alcohol servings at the beginning of the alcohol portion of the survey.

### **Defining Drinking Status**

Nondrinkers were defined by the question "During the last 12 months, when you partied/socialized, how often did you choose not to drink alcohol?"<sup>11</sup> Individuals who answered "Do not

drink/not applicable" were considered nondrinkers. Five subjects who answered "never" were also considered nondrinkers because they did not report any other alcohol consumption behaviors and were believed to have misunderstood the question.

### **Defining Binge Drinking**

Binge drinking was defined by a response of  $\geq 1$  to the following question: "In the last 2 weeks, how many times did you have 5 or more drinks in a sitting?" Although heavy episodic ("binge") drinking is defined as 5 or more drinks in a sitting for men and 4 or more drinks in a sitting for women,<sup>1,12,13</sup> the same question was posed to all subjects; women were not differentiated from men. Binge drinking responses were categorized as follows: 0 occasions (non-binge drinkers), 3 to 4 occasions (frequent binge drinker), and  $\geq 5$  occasions (excessive binge drinker). Non-binge drinkers were individuals who were drinkers but experienced zero occasions of having 5 or more drinks in a sitting in the previous 2 weeks. No subjects reported 1 or 2 occasions in the previous 2 weeks.

### **Proximity and Alcohol Outlet Densities From Geographic Information Systems (GIS)**

Alcohol outlets were defined as on-site (ie, bars) and off-site (ie, liquor stores) establishments that were licensed for the sale of alcohol. Enumeration of alcohol outlets was done using ArcGIS 9.3.1 software (ESRI 2010. ArcGIS Desktop: Release 9.3.1. Environmental Systems Research Institute, Redlands, California) by geocoding each outlet into the software. Each outlet had its location matched with a geographic location (geocode) in the software, with  $>93\%$  being matched. Outlets that could not be matched were removed from the study.

Each participant's proximity (in miles) to the closest alcohol establishment was calculated by the GIS software; this distance was calculated with the Network Analyst feature of the ArcGIS software. This technique differs from previous methods of calculating proximity<sup>7</sup> in that it measures the shortest possible walking route to the establishment; the same method was used by Young et al.<sup>8</sup>

The number of alcohol outlets within specified distance perimeters ("alcohol outlet density" or AOD) also were computed by the GIS software for the following radii around participants' residential addresses: 0 to 0.25 mile, 0 to 0.50 mile, 0 to 1.0 mile, and 0 to 2.0 miles. "Alcohol outlet interval densities" (AOID) were calculated from AOD data. Specifically, distance intervals of  $>0.10$  to 0.25,  $>0.25$  to 0.50,  $>0.50$  to 1.00, and  $>1.00$  to 2.00 miles were calculated by subtracting a smaller perimeter AOD from the next larger one. For example, AOID of  $>1.00$  to 2.00 miles was calculated by subtracting the 0 to 1.0 mile AOD from the 0 to 2.0 mile AOD. These AOIDs were constructed to refine the all-inclusive AODs into smaller intervals. AODs could overestimate the number of outlets visited by a population within a particular perimeter. For example,  $>0.50$  to 1.00 mile AOID

enumerates the number of bars that are between >0.50 mile and 1 mile from the participant's residence while AOD of 0 to 1.00 mile enumerates all of the bars within a mile radius of a subject. Thus, AOIDs represent exclusive subsets of the larger AOD perimeters.

### Statistical Analysis

Statistical analyses compared alcohol environment variables (ie, proximity and density of alcohol outlets) between drinkers and nondrinkers, and among binge drinkers with different frequency of binge drinking. SAS version 9.13 (SAS Institute, Inc, Cary, North Carolina) was used for all analyses. The student's *t* test was used for 2-group comparisons of continuous variables. Fisher's Least Square Difference method was used for multiple-group comparisons of continuous variables. Chi-square or Fisher's exact test was used to compare categorical variables. Multiple regression models were used to examine the associations between proximity and density and alcohol consumption behaviors, adjusting for age, race, and gender. Separate regression models for proximity, and each of the AOD and AOID distances were evaluated. Eight subjects were removed due to missing data: 4 were missing answers to the alcohol survey questions and 4 were missing GIS data. Thus, 166 were included in the analysis.

## RESULTS

### Demographic Results

Table 1 shows population characteristics according to drinking status. Drinkers represented 76% (120/166) of the subjects and were, on average, 19.4 years of age. Age was not associated with drinking status (76% were <21 years old and 78% were ≥21 years, *P*=0.56), however freshman represented a lower percentage of drinkers (65%) compared to sophomores (82%) and juniors (84%), *P*=0.034. Females represented 64% (106/166) of the population; the proportion of women and men drinkers was similar (*P*=0.34). There was a greater prevalence of drinkers among whites (79%) compared to non-whites (57%, *P*=0.02). The percent of drinkers living in on-campus housing (57%) was similar to the percent of drinkers living in off-campus housing (43%, *P*=0.62).

### Proximity and Alcohol Outlet Density in Nondrinkers, Drinkers, and Binge Drinkers

Table 2 shows proximity to, and density of, alcohol outlets in nondrinkers versus drinkers, and compares non-binge, frequent binge, and excessive binge drinkers. On average, nondrinkers lived 0.43 miles further from the nearest alcohol outlet compared to drinkers (mean proximity in nondrinkers: 0.61±1.59 miles compared to drinkers: 0.18±0.15 mile, *P*=0.003). On average, drinkers had more alcohol outlets around their residence than nondrinkers at distances up to 2 miles (all *P*≤0.014). When examining AOID, the mean density of alcohol outlets was sig-

**Table 1.** Demographic Characteristics for Participants (N=166)

	Nondrinker n=40 (24%)	Drinker n=126 (76%)	<i>P</i> -value <sup>a</sup>
<b>Age (years)</b>	19.1 ± 1.0	19.4 ± 1.0	0.07
<b>Age category [n (%)]</b>			
< 21 years of age	34 (24%)	105 (76%)	
≥ 21 years of age	6 (22%)	21 (78%)	0.56
<b>School Year</b>			
Freshman	22 (35%)	41 (65%)	
Sophomore	10 (18%)	47 (82%)	
Junior/Senior	7 (16%)	38 (84%)	0.034
<b>Gender [n (%)]</b>			
Male	11 (20%)	45 (80%)	
Female	29 (26%)	81 (74%)	0.34
<b>Race [n (%)]</b>			
White	26 (21%)	99 (79%)	
Non-white	12 (43%)	16 (57%)	0.02
<b>Housing Type</b>			
On-campus (dorm)	24 (26%)	70 (74%)	
Off-campus	16 (22%)	56 (78%)	0.72

<sup>a</sup> *P*-value from *t* test or chi-square/Fisher's exact test.

nificantly higher in drinkers compared to nondrinkers at >0.10 to 0.25 mile (19 ± 19 vs 7 ± 11, respectively, *P*=0.003), >0.25 to 0.50 mile (43 ± 25 vs 20 ± 22, respectively, *P*<0.0001), and >0.50 to 1.00 mile (87 ± 25 vs 75 ± 30, respectively, *P*=0.002). The highest difference in density is at >0.10 to 0.25 miles, where drinkers had 171% more alcohol outlets available. At >1.00 to 2.00 miles, there were a greater number of alcohol outlets for nondrinkers (127 ± 54) compared to drinkers (97 ± 40, *P*=0.0004). Among drinkers, neither proximity nor density were associated with binge drinking status (ie, non-binge drinker, frequent binge drinker, or excessive binge drinker).

## DISCUSSION

Results from this study show that distance to the nearest alcohol outlet is significantly related to drinking status. Specifically, the nearest alcohol outlet for nondrinkers was almost a half mile farther away compared to the closest one for drinkers (0.61±1.59 miles for nondrinkers compared to 0.18±0.15 for drinkers, *P*=0.003). Furthermore, within defined distance perimeters up to a half mile, more than double the number of alcohol outlets were available to drinkers compared to nondrinkers. Though no significant differences in density or proximity were observed between binge drinking categories, excessive binge drinkers had substantively more outlets in quarter-mile (58% more outlets) and half-mile (40% more outlets) walking distances compared to drinkers who refrained from bingeing. Cause and effect cannot be implied from these cross-sectional results. Nevertheless, the strong associations observed may have important considerations for those invested in preventing any drinking and binge drinking

**Table 2.** Proximity and Density of Alcohol Outlets Among Nondrinkers, Drinkers, and Binge Drinkers (N=166)

	Drinker Status			Binge-Drinking Status			
	Nondrinker	Drinker	P-value <sup>a</sup>	Non-Binge Drinker (0 Occasions)	Frequent Binge Drinker (3-4 Occasions)	Excessive Binge Drinker (5+ Occasions)	P-value <sup>a</sup>
<b>N</b>	40	126		46	50	30	
<b>Proximity<sup>b</sup></b>							
Mean ± SD	0.61 ± 1.59	0.18 ± 0.15	0.005	0.17 ± 0.13	0.21 ± 0.18	0.14 ± 0.11	0.08
Median	0.28	0.14	0.006 <sup>c</sup>	0.15	0.15	0.12	0.47 <sup>c</sup>
Range	0.01-9.33	0-0.67		0.001-0.57	0.0-0.67	0.002-0.54	
<b>Alcohol Outlet Density<sup>d</sup> (AOD)</b>							
0-0.25 mile	9 ± 13	23 ± 23	0.004	19 ± 19	21 ± 25	30 ± 23	0.57
0-0.50 mile	29 ± 31	66 ± 40	<0.0001	60 ± 34	61 ± 44	84 ± 35	0.21
0-1.00 mile	104 ± 55	153 ± 47	<0.0001	155 ± 39	140 ± 56	171 ± 33	0.09
0-2.00 miles	231 ± 62	250 ± 21	0.014	253 ± 5	246 ± 32	253 ± 4	0.10
<b>Alcohol Outlet Interval Density<sup>d</sup> (AOID)</b>							
>0.10-0.25 mile	7 ± 11	19 ± 19	0.003	15 ± 13	18 ± 21	26 ± 19	0.31
>0.25-0.50 mile	20 ± 22	43 ± 25	<0.0001	40 ± 22	39 ± 27	54 ± 23	0.16
>0.50-1.00 mile	75 ± 30	87 ± 25	0.002	95 ± 21	80 ± 27	87 ± 24	0.06
>1.00-2.00 miles	127 ± 54	97 ± 40	0.0004	98 ± 35	105 ± 47	83 ± 30	0.22

<sup>a</sup>P-value from regression models included age, race and gender as covariates.

<sup>b</sup>Walking distance (miles) to closest alcohol outlet.

<sup>c</sup>P-value from non-parametric median test.

<sup>d</sup>Number of outlets.

on college campuses.

The average alcohol outlet density within a 2-mile radius measured in this study was 245 outlets. This is considerably higher than the highest 2-mile densities reported by Weitzman et al<sup>5</sup> (185 outlets), which indicates a higher physical availability of alcohol in our subjects' residential environment (which includes both dormitories and apartments). The high number of outlets is relevant to the troubling observation in this study that 76% of those under age 21 years were drinkers. Our small sample (n = 166) may not be representative of the more than 40,000 students at the University of Wisconsin-Madison, but underage drinking prevalence in Wisconsin was higher than the national average from 2004-2010.<sup>14-17</sup> Wisconsin also ranks high for excessive drinking; in 2010, Wisconsin had the highest intensity (number of drinks per episode) of binge drinking, as well as the highest age-adjusted binge drinking prevalence rate.<sup>18</sup> Thus, an underlying culture of drinking exists that needs to be taken into account when addressing illegal and excessive college drinking.

About 30% of University of Wisconsin-Madison students live on campus, and 60% of dormitory residences are within a 1-mile radius to numerous alcohol outlets. Popular off-campus apartments also are located more closely to the same high-density areas of alcohol establishments. The results are consistent with this housing configuration in that no significant association between residence type (on-campus vs off-campus residence) and drinking status were observed. Thus the on-campus and off-campus housing distinction is not highly relevant in this setting.

In this study, the closest alcohol outlets were, on average, well within normal walking distance. Proximity is a distinctive char-

acteristic of alcohol availability. Consistent with these results are those reported by Young et al, who showed that proximal alcohol outlets within walking distance were linked to adolescent drinking behaviors.<sup>8</sup> Proximity was not associated with binge drinking frequency, but excessive binge drinkers lived in areas with a higher density of alcohol outlets compared to those with non-binge drinkers. Similarly, Scribner's study showed that high-density neighborhoods, not proximity, had a stronger effect on alcohol consumption and norms.<sup>6</sup> Proximity and density are both important in defining physical availability of alcohol. This study's unique calculation of proximity clarifies its role in alcohol availability. Young et al believed that there are 3 contextual effects of proximity and outlet density that could explain discrepancies in associations between drinking behavior and alcohol availability: (1) proximity (how easily one can access alcohol), (2) amenity (how outlets influence the quality and characteristics of the neighborhood), and (3) outlet clusters (locations with multiple outlets in very close proximity).<sup>7</sup> Our study found an association between drinking and outlet proximity but did not account for amenity or outlet cluster effects. Young et al stated that reducing the number of outlets could lead to unintentional creation of new outlet clusters frequented by drinkers.<sup>7</sup> Studying amenity and outlet cluster effects would help understand policy implications when limiting outlet density.

Several limitations are of note. First, the binge drinking question was not gender-specific. Therefore, females were defined as binge drinkers at a level of 5 drinks in a sitting, which is more than the NIAAA definition for women of 4 drinks in a sitting.<sup>19</sup> This may have resulted in an under-estimate of female binge drinkers.



Second, twice the number of participants were female compared to male, which also may contribute to a potential underestimation of binge-drinking on this college campus. Unfortunately, the self-selection of college women into health-related studies is common, and a majority of women participating is similar to other studies or surveys.<sup>2,5,10</sup> Third, because of the small sample size and self-selection into this health-related study, the results cannot be generalized to the entire student population of University of Wisconsin-Madison, which has a more equal gender distribution (52% women). Finally, associations between alcohol outlet data and drinking behaviors are from cross-sectional data. It cannot be determined whether physical access to alcohol leads to consumption or that alcohol consumers choose to live close to the points of sale. However, the results do identify characteristics of a population at high risk of excessive drinking (ie, those living close to alcohol outlets) and factors potentially amenable to prevention strategies at the policy level.

The decision to drink or binge drink in college has multiple deciding factors and influences. Generational alcohol use, family upbringing, peer alcohol use, race, and gender all have been linked to the consumption of alcohol.<sup>20,21</sup> The results presented here equally suggest that close proximity to alcohol may promote consumption, or that alcohol consumers choose to live close to the points of sale. The former scenario identifies factors potentially amenable to prevention strategies at the policy level, and the latter scenario identifies a characteristic of a population at high risk of excessive drinking (ie, choosing to live close to alcohol outlets), which could lend itself to public health strategies to curb drinking. The economic loss due to binge drinking in Wisconsin was estimated to be greater than \$6.8 billion,<sup>13</sup> while the cost of underage drinking was estimated at over \$1 billion.<sup>22</sup> Therefore, there are significant financial benefits to reducing excessive alcohol use. Municipal and college administrators could consider the proximity and density of alcohol outlets in conjunction with other strategies to mitigate the negative economic, personal, and societal impacts of this behavior.

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## REFERENCES

1. Nguyen N, Walters ST, Wyatt TM, Dejong W. Use and correlates of protective drinking behaviors during the transition to college: analysis of a national sample. *Addict Behav.* 2011;36(10):1008-1014.
2. Ray AE, Turrisi R, Abar B, Peters KE. Social-cognitive correlates of protective drinking behaviors and alcohol-related consequences in college students. *Addict Behav.* 2009;34(11):911-917.
3. Wechsler H, Davenport A, Dowdall G, Moeykens B, Castillo S. Health and behavioral consequences of binge drinking in college. A national survey of students at 140 campuses. *JAMA.* 1994;272(21):1672-1677.
4. Gruenewald PJ, Ponicki WR, Holder HD. The relationship of outlet densities to alcohol consumption: a time series cross-sectional analysis. *Alcohol Clin Exp Res.* 1993;17(1):38-47.
5. Weitzman ER, Folkman A, Folkman MP, Wechsler H. The relationship of alcohol outlet density to heavy and frequent drinking and drinking-related problems among college students at eight universities. *Health Place.* 2003;9(1):1-6.
6. Scribner RA, Cohen DA, Fisher W. Evidence of a structural effect for alcohol outlet density: a multilevel analysis. *Alcohol Clin Exp Res.* 2000;24(2):188-195.
7. Young R, Macdonald L, Ellaway A. Associations between proximity and density of local alcohol outlets and alcohol use among Scottish adolescents. *Health Place.* 2013;19:124-130.
8. Kattelman K, White AA, Greene GW, et al. Development of Young Adults Eating and Active for Health (YEAH) Internet-based intervention via a community based participatory research model. *J Nutr Educ Behav.* 2014;46(2):S10-25.
9. Kattelman K, Byrd-Bredbenner C, White AA, et al. The effects of Young adults Eating and Active for Health (YEAH): A Theory-based Web-delivered intervention. *J Nutr Educ Behav.* 2014;46(6):S28-41.
10. American College Health Association-National College Health Assessment (ACHA-NCHA) Website. <http://www.acha-ncha.org/overview.html>. Published 2009. Updated January 2014. Accessed July 16, 2015.
11. Haines MP, Barker G, Rice RM. The personal protective behaviors of college student drinkers: evidence of indigenous protective norms. *J Am Coll Health.* 2006;55(2):69-75.
12. Walters ST, Roudsari BS, Vader AM, Harris TR. Correlates of protective behavior utilization among heavy-drinking college students. *Addict Behav.* 2007;32(11):2633-2644.
13. Black PD, Paltzer JT. The Burden of Excessive Alcohol Use in Wisconsin. University of Wisconsin Population Health Institute, March 2013. <http://uwphi.pophealth.wisc.edu/publications/other/burden-of-excessive-alcohol-use-in-wi.pdf>. Accessed June 29, 2015.
14. Wisconsin Department of Health Services, Division of Public Health and Division of Mental Health and Substance Abuse Services. Wisconsin Epidemiological Profile on Alcohol and Other Drug Use, 2012. September 2012. <https://www.dhs.wisconsin.gov/publications/p4/p45718-12.pdf>. Accessed June 29, 2015.
15. Substance Abuse and Mental Health Services Administration (SAMHSA), US Department of Health and Human Services. State Level Data on Alcohol, Tobacco, and Illegal Drug Use. Appendix B. 2003-2004. <http://oas.samhsa.gov/2k4/State/AppB.htm#TabB.9>. Accessed June 29, 2015.
16. Substance Abuse and Mental Health Services Administration (SAMHSA), US Department of Health and Human Services. State Level Data on Alcohol, Tobacco, and Illegal Drug Use. Appendix B. 2004-2005. <http://oas.samhsa.gov/2k5/State/AppB.htm#TabB.9>. Accessed June 29, 2015.
17. Substance Abuse and Mental Health Services Administration (SAMHSA), US Department of Health and Human Services. State Level Data on Alcohol, Tobacco, and Illegal Drug Use. Appendix B. 2005-2006. <http://oas.samhsa.gov/2k6/State/AppB.htm#TabB.9>. Accessed June 20, 2015.
18. CDC. Vital signs: binge drinking prevalence, frequency, and intensity among adults—United States, 2010. *MMWR Morb Mortal Wkly Rep.* 2012;61(1):14-19.
19. Drinking Levels Defined. Overview of Alcohol Consumption, National Institute on Alcohol Abuse and Alcoholism (NIAAA), November 2014. <http://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking>. Accessed June 29, 2015.
20. Reboussin BA, Song EY, Shrestha A, Lohman KK, Wolfson M. A latent class analysis of underage problem drinking: evidence from a community sample of 16-20 year olds. *Drug Alcohol Depend.* 2006;83(3):199-209.
21. Barnes GM, Farrell MP, Banerjee S. Family influences on alcohol abuse and other problem behaviors among black and white adolescents in a general population sample. *J Res Adolesc.* 1994;4(2):183-201.
22. Underage Drinking in Wisconsin, The Facts. Pacific Institute for Research and Evaluation (PIRE) with funding from the Office of Juvenile Justice and Delinquency Prevention (OJJDP), September 2011. <http://www.udetc.org/factsheets/WI.pdf>. Accessed June 29, 2015.

# Assessment of Food Insecurity in Children's Hospital of Wisconsin's Emergency Department

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## ABSTRACT

**Importance:** Food insecurity is associated with adverse health outcomes and the emergency department may be an ideal location to identify food insecure children and families.

**Objective:** To determine the prevalence of food insecurity in families with children that present to an urban pediatric emergency department (ED) in Milwaukee, Wisconsin.

**Design:** We conducted a cross-sectional survey of caregivers of children 0-18 years between June and August, 2013. The questionnaire included 2 validated statements about food insecurity and demographic and community resource questions. Participant rooms were approached during predefined shifts in an order determined by random number generation.

**Outcomes:** The primary outcome was the prevalence of caregivers who identified as food insecure. A secondary outcome was the percentage of food insecure caregivers who accessed community resources.

**Results:** We enrolled 309 caregivers; 141 (45.6%) reported food insecurity. Nearly 60% (56.8%) of nonwhite caregivers were food insecure compared to 27.4% of non-Hispanic white caregivers ( $P < 0.0001$ ). Among caregivers who identified as food insecure, 82% reported using at least 1 community resource for food.

**Conclusions:** Almost half of caregivers presenting to the ED reported food insecurity. The ED is an excellent location for targeted intervention to identify and link food insecure families with community resources.

## BACKGROUND

The United States Department of Agriculture defines food insecurity as "limited or uncertain availability of nutritionally adequate or safe foods, or limited or uncertain ability to acquire acceptable

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foods in socially acceptable ways."<sup>1</sup> In 2011, 14.7% of households in the United States were considered food insecure.<sup>2</sup> Wisconsin was similar to the national average, with 13.2% of respondents reporting food insecurity between 2008 and 2012.<sup>3</sup>

Milwaukee County, the largest county in Wisconsin, contains 17% of the state's population; 46% of Milwaukee County's population is from communities of color.<sup>4</sup> Between 2008 and 2012, 11.9% of households without children in Milwaukee County were food insecure. Among families with children, 19.3% of households in Milwaukee identified themselves as food insecure.<sup>5</sup> Food insecurity in households with children is associated with numerous adverse outcomes, including poorer health and lower academic performance.<sup>6-7</sup> These disadvantages are accentuated in families with children younger than 3 years, as evidenced by 90% greater odds of being in fair

or poor health, and 76% greater odds of being at increased developmental risk.<sup>8</sup> To prevent these poor outcomes, food insecurity must be identified and addressed. Unfortunately, food insecurity often is not recognized by health care professionals, making intervention difficult.

Emergency department (ED) utilization is higher for children in poverty, on Medicaid, or with lower parental education.<sup>9</sup> Like many states, Wisconsin has high rates of children living in poverty.<sup>10-11</sup> In 2011, 18% of children in Wisconsin and 43% of children in the city of Milwaukee lived in poverty.<sup>12</sup> Despite the association between poverty and ED utilization, there are limited data on the prevalence of food insecurity in pediatric EDs. Currently, the Children's Hospital of Wisconsin (CHW), which serves Wisconsin's largest urban population, has no established protocol for assessing food insecurity during an ED visit. We hypothesized that a large percentage of families seeking care for children at the CHW ED identify as food insecure.

## METHODS

### Study Population/Survey Administration

We conducted a cross-sectional survey of caregivers of children 0-18 years old presenting to the CHW ED, an urban/suburban pediatric ED with an annual volume of 62,000 visits. The ED serves a diverse population, with approximately 40% of visits by children identified as black, 40% non-Hispanic white, and 15% Hispanic; 60% of visits are covered by government insurance.

An 8-item questionnaire, which included demographic information (race, annual income, number of children/seniors in household) and 2 validated statements about food insecurity, was administered to caregivers in the CHW ED. Questionnaires were administered during pre-determined 4-hour periods between 11 AM and 11 PM, weekdays and weekends, during the months of June, July, and August 2013. Rooms to be approached were randomly selected using a random number generator to minimize potential bias in caregiver selection. Randomized rooms with non-English speaking caregivers were not approached. Caregivers who lived in the household of the patient were approached and given a brief explanation of the study. If verbal consent from the caregiver was given, those individuals were asked to complete the questionnaire. If the caregiver refused, the refusal was noted and the next room was entered. An information sheet, including an explanation of food insecurity, information about the study, and resources for food assistance, was provided as part of the survey.

If a caregiver agreed to participate, the research team member left the room while the questionnaire was being completed and returned to collect it 15 minutes later. To ensure the safety of both the research team and the patients, caregivers of children were not approached if the child presented for a complaint of alleged sexual assault, drug overdose, suicide attempt, psychotic behavior, known tuberculosis or Methicillin-resistant *Staphylococcus aureus* infection, or if the child was a trauma patient with unstable vital signs. In addition, only English speaking families were approached in this study.

Caregivers were asked to report their race/ethnicity and then answer 2 screening items that were validated previously by Hager, et al to be sensitive and specific in identifying those with food insecurity: (1) within the past 12 months we worried whether our food would run out before we got money to buy more, and (2) within the past 12 months the food we bought just didn't last and we didn't have money to get more.<sup>13</sup> Further data were collected from those who answered affirmatively to either question regarding food insecurity; these data included annual income level (in increments of \$10,000 to >\$40,000), number of people per household, and use of community and government resources to supplement food supply. Community and government resources included (1) WIC—the federal supplemental nutrition program benefiting women, infants and children; (2) FoodShare Wisconsin—a statewide food stamp program that helps provide

groceries to low-income individuals and families; (3) food pantries—locations that distribute food to those who have difficulty purchasing enough food to avoid hunger; and (4) StockBox—a program that provides free, prepackaged boxes of food for seniors with a limited income.

### Study Outcomes and Analyses

The primary outcome was the percentage of caregivers who reported being food insecure, as measured by an affirmative response to either of the 2 validated screening questions. We also evaluated the percentage of food insecure families already using community resources.

All data were entered into an Excel spreadsheet for analysis. Data were double-entered by 2 separate research assistants to ensure accuracy of recorded data. Race/ethnicity was dichotomized as non-Hispanic white vs other, as all other minority categories were similar with regard to responses to the food insecurity questionnaire. For categorical data, a chi-square test was used. Stepwise logistic regression was used to assess the association between demographic/family factors such as race/ethnicity and household income and use of community resources, including WIC, Food Share, a food pantry, or Stockbox. Analyses were conducted using IBM SPSS Statistics Version 21.0 (IBM Corp, Armonk, New York).

## RESULTS

A total of 320 caregivers were approached. Of those approached, 309 (97%) agreed to participate and completed the race/ethnicity and food insecurity questions. The demographics of the final study population closely mirrored that of the overall ED population, with 37.9% of respondents self-identifying as African American/black, 11% Latino/Hispanic, 37.5% non-Hispanic white, and 13.6% other.

Survey results showed that 141 (45.6%) of the 309 caregivers reported food insecurity (Table 1). Analysis by individual question revealed that 134 (43.4%) reported “within the past 12 months we were worried our food would run out before we got money to buy more,” while 107 (34.6%) reported “within the past 12 months the food we bought just didn't last and we didn't have money to get more.” Analysis of food insecurity by race/ethnicity showed that 27.4% of non-Hispanic white caregivers were food insecure (Table 1) compared to 56.8% of caregivers of all other races/ethnicities ( $P < 0.0001$ ).

We then evaluated the community resources utilized by those caregivers who reported food insecurity. Two of the 141 caregivers who reported food insecurity failed to answer questions related to resources used and were excluded from these analyses. Overall, 114 (82%) of the 139 caregivers reported using at least 1 community resource for food. Fifty-three (37.6%) utilized WIC, 97 (68.8%) utilized Food Share, 22 (15.6%) utilized a food pantry and 3 (2.1%) utilized Stockbox. Use of resources differed by race/

**Table 1.** Study Sample Demographics

	Food insecure n=141 (%)	Not food insecure n=168 <sup>a</sup> (%)
<b>Race</b>		
American Indian	7 (77.8)	2 (22.2)
Asian	4 (50.0)	4 (50.0)
Black/African American	72 (57.1)	54 (42.9)
Hispanic/Latino	23 (56.1)	18 (43.9)
Hawaiian/Pacific Islander	0 (0.0)	1 (100)
Non-Hispanic white	32 (27.4)	85 (72.6)
Other	3 (42.9)	4 (57.1)
<b>Annual Income</b>		
<\$10,000	60 (42.6)	
\$10,000-\$19,000	25 (17.7)	
\$20,000-\$29,000	25 (17.7)	
\$30,000-\$39,000	13 (9.2)	
>\$40,000	11 (7.8)	
Prefer not to answer	7 (5.0)	
<b>Total people in household</b>		
2	20 (14.2)	
3	28 (19.9)	
4	37 (26.2)	
5	25 (17.7)	
6	16 (11.3)	
7+	13 (9.2)	
Not answered	2 (1.4)	

<sup>a</sup>Annual income and total number of people in household were only collected on caregivers identified a food insecure.

ethnicity, with 86.9% of minority caregivers utilizing resources compared to 65.6% of white caregivers ( $P=0.006$ ). In regression analysis assessing use of resources, race/ethnicity was no longer significant, and income remained the only significant variable in the model. The odds of using at least 1 community resource decreased by 0.77 for each additional \$10,000 incremental increase in annual income.

## DISCUSSION

The results of our study show a high prevalence of food insecurity in caregivers presenting with children to the CHW ED. We found almost half of caregivers presenting with children to the ED reported concerns related to food insecurity. This percentage is significantly higher than the prevalence of food insecurity reported nationally (14.7%), statewide (13.2%), for Milwaukee households without children (11.9%), and Milwaukee households with children (19.3%). This disparity is most likely due to the role the ED plays as the safety net provider for those with limited access to care. Given the population it serves, the ED provides a potential location for targeted intervention to identify and improve the knowledge of the community regarding resources available for those with food insecurity.

In our sample, the prevalence of food insecurity across races was disproportionately greater among minorities compared to

non-Hispanic whites; yet, income rather than race was the only significant variable for assessing use of resources. This finding suggests that income, rather than race, may be the best predictor of food insecurity, though additional data about income of families without food insecurity would be required to confirm this finding. Approximately 80% of those caregivers reporting food insecurity were already receiving aid from available community resources. While it is reassuring that the majority have identified resources to help, it is also concerning for 2 reasons. First, these families continued to report food insecurity despite their knowledge of and use of available resources in the community. Second, 1 in 5 food insecure caregivers were not using any community resources to alleviate their concerns about providing food for their families. Targeted interventions might include a standardized ED screen for food insecurity, providing information about additional community resources to families identified as food insecure, and following up with families after their ED visit to ensure they were able to obtain an adequate food supply.

Previous research assessing food insecurity in the ED has shown that 38% of the adult population that presented to an urban ED identified as being food insecure.<sup>14</sup> While there have been data on the adult population, there have been no studies specifically assessing food insecurity in a pediatric ED. Our study reveals that the percentage of patients presenting to our pediatric ED is even greater, and is significantly higher than the general city population. Our study not only shows that food insecurity in the urban pediatric population is prevalent and deserves more attention, but also confirms that the ED is a valuable location to identify those in need of additional resources.

## Limitations

Our study was limited by excluding some presenting complaints. Although a source of potential bias in our estimate, these patients represent a very small proportion of the potential study population, and thus would have minimal impact on our results. Another limitation is the exclusion of non-English speaking families due to a lack of trained personnel to enroll in the ED. It is likely that the exclusion of non-English-speaking families underestimated the actual food insecurity prevalence, given that the Hispanic population experiences more food insecurity than the national average.<sup>15</sup> In addition, our mode of assessment was a written questionnaire. Although the questionnaire was simple and brief, it had the potential to cause confusion for individuals with literacy limitations. Furthermore, we collected income data only from respondents who identified as food-insecure, making it difficult to know the degree to which income, rather than race, drives the likelihood of food insecurity. We also were limited by enrolling in a single ED. Verification of these findings in other settings would increase the generalizability of study findings. Our study, however, is strengthened by the use of random room sampling to ensure an unbiased enrollment of presenting caregivers.

## CONCLUSION

Almost half of families presenting with children to a pediatric ED report food insecurity. Because these patients are at increased risk for adverse health outcomes, it is very important for medical providers to recognize food insecurity. This study demonstrates the potential benefit of implementing a formal screening process for food insecurity in the ED, as the ED is often the only access point to medical care for families most at risk for food insecurity.

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## REFERENCES

1. Anderson S. Core Indicators of Nutritional State for Difficult to Sample Populations. *J Nutrition*. 1990;120:1555-1600.
2. Coleman-Jensen A, Nord M, Andrews M, Carlson S. Household Food Security in the United States in 2011. ERR-141, US Department of Agriculture, Economic Research Service, September 2012.
3. Guerrero N, Walsh MC, Malecki KC, Nieto FJ. Urban-rural and regional variability in the prevalence of food insecurity: the Survey of the Health of Wisconsin. *WMJ*. 2014;113(4):133-138.
4. State and County QuickFacts. US Census Bureau website. <http://quickfacts.census.gov/qfd/states/55/55079.html>. Updated March 27, 2014. Accessed July 2, 2015.
5. Food Hardship 2008-2012: Geography and Household Composition, Data for the Nation, States, Regions and 100 MSAs. Food Research & Action Center website. [http://frac.org/pdf/food\\_hardship\\_geography\\_household\\_composition\\_2008-2012.pdf](http://frac.org/pdf/food_hardship_geography_household_composition_2008-2012.pdf). Published September 2013. Accessed July 2, 2015.
6. Skalicky A, Meyers AF, Adams WG, Yang Z, Cook JT, Frank DA. Child food insecurity and iron deficiency anemia in low-income infants and toddlers in the United States. *Matern Child Health J*. 2006;10.2:177-185.
7. Howard LL. Does food insecurity at home affect non-cognitive performance at school? A longitudinal analysis of elementary student classroom behavior. *Econ of Educ Rev*. 2011;30:157-176.
8. Cook JT, Frank DA. Food Security, Poverty, and Human Development in the United States. *Ann NY Acad Sci*. 2008;1425.001:1-16.
9. Kroner EL, Hoffmann RG, Brousseau DC. Emergency department reliance: a discriminatory measure of frequent emergency department users. *Pediatrics*. 2010;125.1:133-138.
10. Woolf SH, Johnson RE, Geiger J. The rising prevalence of severe poverty in America: a growing threat to public health. *Am J Prevent Med*. 2006;31(4):332-341.
11. Bhattacharya J, Currie J, Haider S. Poverty, food insecurity, and nutritional outcomes in children and adults. *J Health Econ*. 2004;23:839-862.
12. State and County Quick Facts: Milwaukee County. US Census Bureau website. <http://quickfacts.census.gov/qfd/states/55/5553000.html>. Revised March 27, 2014. Accessed July 2, 2015.
13. Hager ER, Quigg AM, Black MM, et al. Development and validity of a 2-item screen to identify families at risk for food insecurity. *Pediatrics*. 2010;126(1):e26-32.
14. Miner JR, Westgard B, Olives TD, Patel R, Biros M. Hunger and food insecurity among patients in an urban emergency department. *West J Emerg Med*. 2013;14(3):253-262.
15. Disparities in Food Insecurity. Food Research & Action Center website. <http://frac.org/reports-and-resources/hunger-and-poverty/disparities-in-food-insecurity/>. Published 2010. Accessed July 2, 2015.

# The Emergence of Clinically Relevant Babesiosis in Southwestern Wisconsin

Todd J. Kowalski, MD; Dean A. Jobe, MS; Emily C. Dolan, BS; Anne Kessler, BS; Steven D. Lovrich, PhD; Steven M. Callister, PhD

## ABSTRACT

**Objective:** To determine the frequency and characteristics of babesiosis cases, and to assess the impact of the introduction of a tick-borne infection diagnostic panel on babesiosis diagnosis in the region surrounding La Crosse, Wisconsin, where babesiosis in non-travelers was previously rare.

**Methods:** In the spring of 2013, we conducted a point-in-time survey of *Ixodes scapularis* ticks for the presence of *Babesia microti*. We also conducted a retrospective study of all babesiosis cases diagnosed in our health system between January 1, 2004, and November 1, 2013. Finally, we compared the number of babesiosis cases diagnosed during the study period before and after the June 1, 2012, introduction of a tick-borne infection diagnostic panel in our organization.

**Results:** *Babesia microti* was present in 5% of ticks surveyed in our region. Twenty-two cases of babesiosis were diagnosed in our organization during the study period—19 since 2010. The tick-borne infection diagnostic panel was used widely by clinicians, with an attendant increase in babesiosis diagnoses.

**Conclusion:** Babesiosis should be considered endemic in southwestern Wisconsin, and testing should be considered for patients with compatible clinical and laboratory features.

## INTRODUCTION

Babesiosis is a protozoan tick-borne infectious disease that infects erythrocytes of humans and other mammals.<sup>1,2</sup> The vector for *Babesia microti*, the causative agent of babesiosis, is the *Ixodes scapularis* tick, which is also the vector for *Borrelia burgdorferi*, the causative agent of Lyme disease, and *Anaplasma phagocytophilum*, the causative agent of human granulocytic anaplasmosis. Babesiosis is usually considered to be a relatively mild infection

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of humans characterized by nonspecific symptoms of fever, myalgia, and headache with accompanying laboratory evidence of hemolytic anemia.<sup>1</sup> However, in patients with immunocompromise, particularly asplenia, and in the very young and in individuals aged 50 years and over, it can be a life-threatening infection.<sup>3,4</sup>

The area around La Crosse, Wisconsin, is known to be highly endemic for Lyme disease.<sup>5</sup> More recently, anaplasmosis has emerged in this region.<sup>6</sup> Historically, most clinical cases of babesiosis in Wisconsin originated in the northwest corner of the state, and clinically recognized cases of babesiosis in the southwest region were very uncommon.<sup>2,7-9</sup> A tick prevalence study from 2006 demonstrated no evidence of *B microti* in 100 ticks collected from this region (Figure

1, Tick Collection Site 1).<sup>10</sup> However, in recent years clinicians in our health system reported cases of severe babesiosis requiring hospitalization in patients who had not left western Wisconsin. Therefore, a polymerase chain reaction (PCR) based assay for the detection of *B microti* was developed and a tick survey performed to evaluate for the theretofore unproven presence of babesiosis in our region. The PCR-based assay was made available to clinicians to facilitate the clinical diagnosis of babesiosis. It also was included in a diagnostic panel developed and made available to clinicians to assist in the diagnosis of tick-borne infections (Lyme disease, anaplasmosis, and babesiosis) in patients who seek care for a systemic febrile illness during the tick season.

The purpose of this study was to test our hypothesis that the number of babesiosis cases was increasing in our service area—especially the number of cases unrelated to travel to areas where *I scapularis* ticks were known to carry *B microti*. We also wanted to determine whether a PCR-based tick-borne infection diagnostic panel introduced in our organization on June 1, 2012, is a sensitive and effective test for identification of *Babesia* infection.

## METHODS

In the spring of 2013, we conducted a point-in-time survey of *I scapularis* ticks for the presence of *B microti*. We also conducted a descriptive retrospective cohort study of patients with a babesiosis diagnosis in our health system from January 1, 2004, through November 1, 2013. We then evaluated the utility of a tick-borne infection diagnostic panel, which was introduced in our organization on June 1, 2012. Protocols were reviewed and approved by the Gundersen Clinic, Ltd Human Subjects Committee/Institutional Review Board prior to the start of the study.

### Tick Collection and Processing

Adult female *I scapularis* ticks were collected from a site in Trempealeau County, Wisconsin, located directly north of La Crosse, by flagging the underbrush (Figure 1, Tick Collection Site 2). Flagging is a common tick collection technique in which a piece of fabric is attached to a dowel, and the investigator sweeps this “flag” through the underbrush. Ticks collected in this manner were transported to the laboratory in 50-ml centrifuge tubes, then stored and processed as described previously.<sup>6</sup> Extracted DNA was stored at  $-20^{\circ}\text{C}$  until tested.

### Study Population and Case Ascertainment

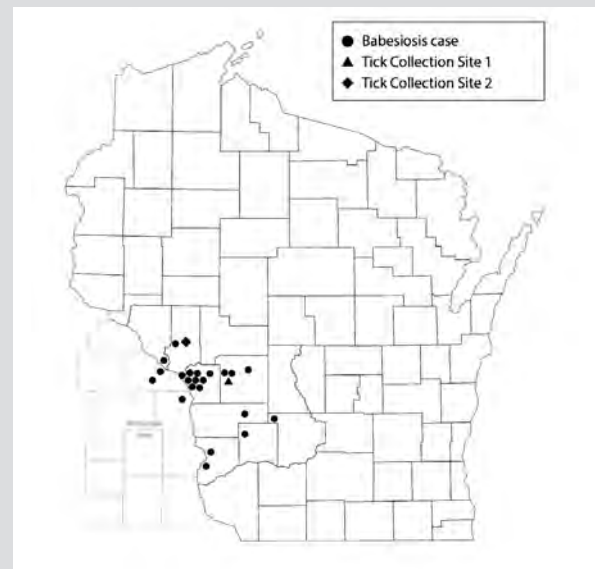
Human cases of babesiosis were identified via multiple methods to ensure complete capture of cases, including searching our medical record database for ICD-9 code 0.88.82 and searching the laboratory database for all blood smears or PCR assays positive for *B microti*. Study inclusion criteria included laboratory confirmation of *Babesia* infection by peripheral smear or buffy coat examination or a PCR assay positive for *B microti* DNA. Patients were excluded from the study if the only laboratory evidence of infection was a positive serologic assay. Medical records were reviewed and pertinent clinical data were recorded. Data collected included demographic data, as well as travel outside the region, known tick bite, and symptoms that might be attributable to a tick-borne infection. Additionally, the results of the tick-borne infection diagnostic panel were tabulated from its implementation on June 1, 2012, through November 1, 2013.

### Patient Samples

From January 1, 2004, until June 1, 2012, a diagnosis of babesiosis was made by identification of parasites on Giemsa-stained blood smears. The laboratory protocol for a complete babesiosis smear included the preparation of 6 thin blood smears that were then examined by 2 separate technicians for at least 300 thin slide fields under  $100\times$  oil immersion. Additionally, a thick blood smear was made by placing 1 to 3 drops of blood onto a slide and spreading manually to an appropriate density, then allowing the slide to air dry overnight prior to staining with Giemsa stain.

Beginning June 1, 2012, a tick-borne infection diagnostic panel was made available in our health system. This panel con-

**Figure 1.** Residence by ZIP Code of 22 Patients Diagnosed With Babesiosis From January 2004 Through November 2013



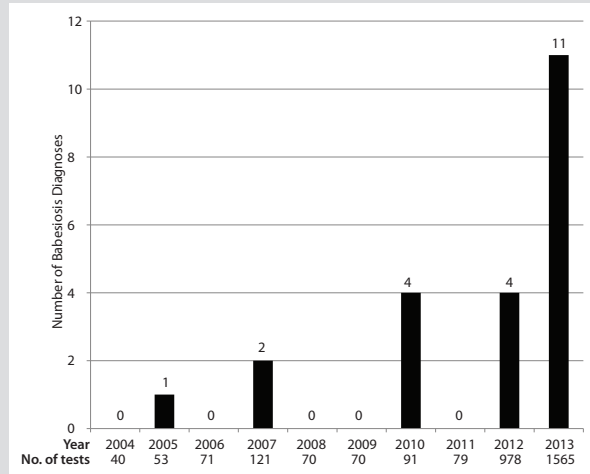
Tick Collection Site 1 represents the location of a study performed in 2006 that did not identify *Babesia microti* in ticks. Site 2 represents the location of a tick prevalence study performed in 2013 that demonstrated 5% prevalence of *B microti*.

sisted of a screening enzyme immunoassay for Lyme disease and a single rapid thin smear analysis for *Anaplasma* and *Babesia* organisms followed by PCR assays for each. More specifically, anaplasmosis and babesiosis diagnostic testing was performed in 2 parts. First blood was collected in an ethylenediaminetetraacetic acid tube, and a smear was created and stained using the SP-1000iHST automatic blood smear. Approximately 300 fields were examined using  $100\times$  oil immersion microscopy for approximately 5 minutes, and the smear was reported as either “no tick-borne organisms seen,” “suspicious for *Anaplasma*,” or “suspicious for *Babesia*.” All samples subsequently underwent *Anaplasma* and *Babesia* PCR testing. The protocol for *B microti* DNA detection is summarized below. The method for *A phagocytophilum* DNA detection by PCR has been described previously.<sup>6</sup> The tick-borne infection diagnostic panel also included the VIDAS IgG and IgM qualitative enzyme-linked fluorescent immunoassay, which was performed according to the laboratory standard operating procedure and interpreted as either negative ( $<0.75$ ), equivocal/indefinite ( $\geq 0.75 - <1.00$ ), or positive ( $\geq 1.00$ ).

### *B microti* DNA Extraction and Amplification

The DNA was recovered using the commercially available DNA Blood Mini Kit (Qiagen, Valencia, California). Briefly, 1 ml of blood was centrifuged at  $2500 \times g$  for 10 minutes to separate the plasma. A 200- $\mu\text{L}$  volume of red blood cell-enriched blood was then removed and combined with 20  $\mu\text{L}$  of protease and 200  $\mu\text{L}$  of buffer AL. After the suspensions were mixed and incubated

**Figure 2.** Number of Diagnostic Tests for Babesiosis Performed and Number of Cases Diagnosed in Health System in the Region Surrounding La Crosse, Wisconsin by Year



**Table 1.** Results of Diagnostic Tests for *Babesia*, Lyme Disease, and *Anaplasma* in the 22 Patients Diagnosed With Babesiosis in the Region Surrounding La Crosse, Wisconsin<sup>a</sup>

Test Performed	Number of Tests	Tests Positive (%)
Rapid smear for <i>Babesia</i> <sup>b</sup>	15	8 <sup>c</sup> (53)
Complete smear for <i>Babesia</i> <sup>b</sup>	7	7 <sup>c</sup> (100)
PCR assay for <i>Babesia</i>	17	17 (100)
Serology for Lyme disease	20	8 (40)
PCR assay for <i>Anaplasma</i>	19	1 (5)

<sup>a</sup>Use of a tick-borne infection diagnostic panel began in our health system on June 1, 2012.

<sup>b</sup>Performed prior to availability of the tick-borne infection diagnostic panel in our health system.

<sup>c</sup>Includes the number suspicious or positive for *Babesia*.

Abbreviation: PCR, polymerase chain reaction.

at 56°C for 10 minutes, 200 µL of absolute ethanol was added to each sample, and the mixed suspension was transferred into individual columns, washed, and the DNA eluted with 50 µL of buffer AE. The extracted DNA samples were then stored at -20°C until tested.

### Real-time PCR

*B. microti* DNA was detected by real-time PCR using a procedure that targeted a unique sequence with the 18S rRNA gene. Briefly, 5 µL of DNA extracted from patient samples was combined with 20 µL of a master mix that contained 12.5 µL of buffer (10X AmpliTaq Gold buffer, 2.5mM MgCl<sub>2</sub>, deoxynucleoside triphosphates), 4.5 µL of a primer/probe mix comprised of Babf (5'-TCGCGTGCGCTTTATTAGAC-3'), Babr (5'-CCGGCAAAGCCATGCGATT-3'), and Babp-FAM (5'-6-carboxyfluorescein[FAM]-AACCAACCCTTCGGGTAATCGGTG[BHQ1a-FAM-3']), 2.5 µL of exogenous control primer and probe (Life Technologies,

Foster City, California), 0.5 µL of exogenous DNA, and 0.5 µL of AmpliTaq Gold DNA polymerase (1.5 U; Life Technologies). The DNA was then amplified using a real-time thermal cycler (Model 3000P, Stratagene, Cedar Creek, Texas) for 1 cycle at 95°C for 10 minutes, 40 cycles at 95°C for 15 seconds, 60°C for 1 minute, and 72°C for 30 seconds, and a final cycle at 25°C for 5 seconds.

### Quality Control

Prior to analyzing the clinical samples, we confirmed the clinical utility of the PCR by amplifying archived DNA extracted from 2 patients with babesiosis diagnoses made by detection of the organisms in blood smears. In addition, we showed that the test could detect as few as 3 DNA copies by resuspending and serially diluting a DNA fragment based on a specific 84-bp sequence within the 18S rRNA gene of *B. microti* isolate Gray (bases 168-185, GenBank accession #AY693840.1) in AE buffer (Qiagen) and testing each dilution. We then used the DNA fragment (50 copies/assay) as a positive control for subsequent runs. In addition, we confirmed that DNA from *Bartonella henselae*, *Plasmodium falciparum*, *A. phagocytophilum*, *B. burgdorferi*, *Borrelia afzelii*, *Borrelia bissetii*, and *Borrelia hermsii* yielded negative findings.

As additional confirmation of our findings, we randomly selected 6 PCR-positive patients and amplified a 425 bp DNA fragment within the *B. microti* 18S rRNA gene as described previously.<sup>1</sup> Briefly, 5 µL of the extracted DNA was combined with a 20.5 µL of master mix that contained 12.5 µL buffer, 1 µL of buffer containing 0.5 µM of primer BJ1 (5'-GTCTTGTAATTGGAATGATGG-3') or BN2 (5'-TAGTTTATGGTTAGGACTACG-3'), 5.5 µL of water, and 0.5 µL AmpliTaq Gold DNA polymerase (1.5 U; Life Technologies). The DNA was amplified under the following conditions: 94°C for 10 minutes followed by 35 cycles of 94°C for 1 minute, 55°C for 1 minute, and 72°C for 2 minutes, followed by a final extension at 72°C for 5 minutes. We then purified the DNA fragment (QIAquick PCR Purification Kit, Qiagen) and forwarded the products for sequencing (Laragen, Culver City, California). Without exception, subsequent basic local alignment search tool (BLAST) searches confirmed that each DNA sequence had high (97%-100%) identity with *B. microti* isolate Gray.

### Statistical Analysis

Descriptive statistics were used to summarize the data. Comparisons of binomial data were made using Fisher exact tests, and continuous data were compared using Mann-Whitney tests. Data analyses were conducted using Excel (Microsoft, Redmond, Washington) and SAS Version 9.3 (SAS Institute, Cary, North Carolina).



## RESULTS

### Detection of *B microti* in Ticks

We collected 171 ticks from the region just north of La Crosse (Figure 1, Tick Collection Site 2) in 2013. By PCR, *B microti* DNA was found in 9 of 171 (5%) ticks.

### Babesiosis Diagnostic Tests

Twenty-two cases of babesiosis were diagnosed in our health system from January 1, 2004, through November 1, 2013 (Figure 2 and Table 1). Of these cases, 15 were diagnosed since the incorporation of PCR testing at our institution in the spring of 2012, including 11 cases in 2013. Prior to 2012, all laboratory diagnoses of babesiosis were based upon a peripheral smear positive for *Babesia*, which in 2 cases was confirmed by a PCR test positive for *B microti* DNA. All cases diagnosed since the tick-borne infection diagnostic panel was made available June 1, 2012, had PCR assays positive for *B microti* DNA, and only 8 of the 15 cases (53%) had a peripheral smear suggestive of babesiosis. From January 1, 2004, until June 1, 2012, 7 of 617 (1.1%) diagnostic blood smears to examine for *Anaplasma* and *Babesia* organisms were positive for *Babesia*, compared with 15 of 2521 (0.6%) PCR tests positive for *B microti* DNA after implementation of the tick-borne infection diagnostic panel. Only 8 of 2521 (0.3%) rapid smears performed in the tick-borne infection diagnostic panel were read as suspicious for *Babesia* parasites. The rapid smear was read as suspicious for *Anaplasma* organisms in 10 of 2521 (0.4%) and subsequent *Anaplasma* PCR was positive in 90 of 2521 (3.6%). All smears positive for *Babesia* or *Anaplasma* organisms were subsequently confirmed by PCR assay. Two hundred seventy-six of 2521 (10.9%) of *B burgdorferi* screens done as part of the panel were positive, and an additional 119 (4.7%) were in the indeterminate range.

### Epidemiology and Clinical Characteristics of Patients With Babesiosis

Figure 1 plots the area of residence of the patients diagnosed with babesiosis. Only 1 patient had traveled outside of the area (to northern Minnesota) in the 30 days prior to diagnosis, and none were known to have had a blood transfusion in the 6 months prior to diagnosis. Only 6 patients (27%) had documentation of a recent tick bite, although 17 patients (72%) recalled outdoor activities likely to have exposed them to ticks.

Demographic and clinical details are shown in Table 2. Only 2 patients were aged younger than 50 years, and only 1 patient had anatomic or functional asplenia. Fever was the most common presenting sign, recorded in 18 patients (82%). The median duration from symptom onset to diagnosis was 5 days (range 1-14). Erythema migrans and/or serologic evidence of co-infection with *B burgdorferi* was noted in 11 of 22 patients (50%), 1 of whom also had infection with *A phagocytophila* based upon a positive PCR.

**Table 2.** Demographic and Clinical Characteristics of the 22 Patients Diagnosed With Babesiosis in the Region Surrounding La Crosse, Wisconsin<sup>a</sup>

Demographic or Clinical Characteristic	Value
Median age, y (IQR)	68 (59-82)
Men	12 (55)
Asplenia	1 (5)
Travel outside the region	1 (5)
Known tick bite	6 (27)
Headache	11 (50)
Fatigue	18 (82)
Myalgias/arthralgias	9 (41)
Nausea/vomiting	6 (27)
Erythema migrans rash	4 (18)
Hospital admission	9 (41)
Median length of stay in days (range)	6 (1-10)

<sup>a</sup>Data are presented as number (percentage) of patients unless otherwise indicated.

Abbreviation: IQR, interquartile range.

**Table 3.** Laboratory Findings in the 22 Patients Diagnosed With Babesiosis in the Region Surrounding La Crosse, Wisconsin<sup>a</sup>

Laboratory test	Observations	Value (IQR)
Hemoglobin, g/dL	21	11.8 (9.3-13.2)
Platelet count, ×10 <sup>9</sup> /L	21	79 (64-120)
White blood cell (WBC) count, ×10 <sup>9</sup> /L	21	5.4 (4.1-6.3)
Alanine transaminase (ALT), U/L	15	61 (37-89)
Aspartate transaminase (AST), U/L	14	72 (50-103)

<sup>a</sup>To convert hemoglobin to g/L, multiply by 10; to convert platelet count to ×10<sup>3</sup>/μL, divide by 1; to convert WBC to /μL, divide by 0.001; to convert ALT or AST to μkat/L, multiply by 0.0167.

Abbreviations: IQR, interquartile range.

Laboratory findings are summarized in Table 3. Thrombocytopenia and liver transaminase elevations were documented in 18 of 21 patients (86%) and 15 of 17 patients (88%) in whom testing was performed, respectively. Anemia, defined as a hemoglobin concentration below the laboratory reference range, was present in 13 of 21 patients (62%).

Clinical and laboratory features suggested a higher acuity of illness in the patients with diagnoses made prior to 2012. Anemia was present in 7 of 7 patients (100%) with diagnoses prior to 2012 and in 6 of 15 patients (40%) with diagnoses since the tick-borne infection diagnostic panel was implemented ( $P=.02$ ). The median hemoglobin prior to 2012 was 9.3 mg/dL, compared with 12.1 mg/dL since implementation of the tick-borne infection diagnostic panel ( $P=.04$ ). All 7 patients with diagnoses prior to 2012 had anemia, thrombocytopenia, and liver transaminase elevations. Of the 7 patients with diagnoses between 2004 and 2011, 6 required hospitalization, while only 3 of 15 with diagnoses since 2012 required hospitalization ( $P=.007$ ). The median length of hospital stay was 6 days (range 1-10 days), and no patient required intensive care unit admission.

Targeted babesiosis treatment consisted of azithromycin and

atovoquone in 18 of 21 patients, clindamycin and quinine in 1 patient, azithromycin monotherapy in 1 patient, and no treatment in 1 patient (the latter 2 patients refused atovoquone treatment due to cost concerns). In all cases, patients improved and demonstrated no ongoing symptoms or signs of infection when seen in follow-up. Both patients who refused atovoquone treatment had resolution of all symptoms 1 month following diagnosis, and a repeat PCR at that time was negative for *B microti*. Additionally, 19 patients were treated with doxycycline, and 1 patient with amoxicillin for confirmed or presumed *B burgdorferi* infection. No patients were treated with exchange transfusion.

## DISCUSSION

This study demonstrates the emergence of clinically relevant cases of babesiosis in the region surrounding La Crosse, Wisconsin, in the last decade. There were 19 confirmed cases of babesiosis in our health system from 2010 through 2013, compared with only 3 cases from 2004 through 2009, and there were as many confirmed cases in 2013 in our health system as reported in the entire state of Wisconsin in 2005.<sup>7</sup> Our results also suggest that a tick-borne infection diagnostic panel consisting of Lyme serology and *Babesia* and *Anaplasma* PCR tests is a useful diagnostic approach in patients with fevers during the tick season who reside in regions endemic for these infections. Increased babesiosis diagnoses correlated with the availability of the tick-borne infection diagnostic panel to clinicians.

Our 19-county service area is largely rural, with a population that is 93.3% white, 2.4% Hispanic, and 1% to 2% black, Asian, and other. No demographic shift has occurred to which the increase in the number of babesiosis diagnoses might be attributed. Likewise, health care delivery in our service area has not changed, with 2 large multispecialty health systems continuing to provide the vast majority of care in the region.

The rise in the number of babesiosis diagnoses is likely multifactorial. First, the geographic area of endemicity seems to have expanded. Evidence for this includes a survey of 100 ticks in our region (Figure 1, Tick Collection Site 1) in 2006 that demonstrated no evidence of *B microti*. However, we demonstrated a tick infection rate of 5% in ticks sampled in 2013 from a nearby site (Figure 1, Tick Collection Site 2). A clinical study conducted in 1997 and 1998 from a region just north of ours demonstrated no cases of babesiosis in 62 patients with a summertime systemic febrile illness seeking urgent care.<sup>8</sup> Previously, clinically relevant cases of babesiosis usually have been linked to residence or travel to northwestern Wisconsin.<sup>2,7,9</sup> In our study, we demonstrated clinically significant cases of babesiosis in patients with no travel history who resided south of La Crosse. These regions have to our knowledge heretofore not been known to be endemic for *B microti*.

Second, the availability of the tick-borne infection diagnostic

panel beginning June 1, 2012, resulted in a substantial increase in the volume of diagnostic testing specifically aimed at detecting *Babesia* infection. This likely increased babesiosis diagnoses that otherwise may have gone clinically unrecognized. It is possible that some patients diagnosed with babesiosis using our new diagnostic approach may have gone on to have resolution of their illness with no adverse outcomes, evidenced by the fact that 1 patient in our cohort was not treated and clinically did well. Further support that our testing identified less severely ill patients is that laboratory abnormalities were more marked and more patients were hospitalized prior to implementation of the tick-borne infection diagnostic panel in 2012. Conversely, and importantly, it is possible that earlier diagnosis and therapy of babesiosis with our tick-borne infection diagnostic panel may have prevented more severe illness.

Finally, the routine use of a highly sensitive and specific PCR assay for diagnosis instead of the more labor-intensive manual review of blood smears, which often requires multiple samples to be reviewed to achieve optimal sensitivity, also may have contributed to increased diagnoses. The PCR was positive for *B microti* in 7 of 15 patients (47%) who had rapid smear results negative for *Babesia* organisms. This is consistent with previously published reports that suggest that a PCR assay demonstrated enhanced diagnostic sensitivity over microscopic examination.<sup>11</sup> Additionally, *B microti* PCR is less labor intensive and can be performed on hemolyzed blood, shortcomings of microscopic examination.

Although the volume of testing and the increased sensitivity of the PCR assay may well have contributed to enhanced diagnostics, our data suggest an evolution of clinically relevant babesiosis in our region. We have newly demonstrated the presence of *B microti* in ticks in our region. Eleven patients had confirmed babesiosis in 2013—as many as in the prior 9 years combined. Hospitalizations for babesiosis in our health system increased from 3 over the years 2004 through 2009 to 6 during the years 2010 through 2013.

In our cohort, the most common abnormal laboratory test results in patients with babesiosis were liver transaminase elevation in 86% and thrombocytopenia in 88% of patients, respectively, while anemia was noted in only 62% of patients. Pfeiffer et al<sup>7</sup> demonstrated similar laboratory findings in patients with documented babesiosis. Therefore, based upon our results and those of prior studies, we conclude that *Babesia* testing in patients with systemic febrile illnesses in a region with babesiosis is best utilized in patients who are immunocompromised, over the age of 50 years, or with laboratory evidence of liver transaminase elevation or anemia. Human granulocytic anaplasmosis commonly presents with a systemic febrile illness and thrombocytopenia, leukopenia, and liver transaminase elevation. It is common practice that patients presenting with these findings

from areas endemic for *A phagocytophila* be treated for presumptive human granulocytic anaplasmosis during the appropriate season. Our study emphasizes the importance of considering babesiosis in febrile patients from endemic regions with elevated liver transaminases or thrombocytopenia because the antimicrobial treatment regimen for babesiosis differs from that for anaplasmosis.

Transfusion-associated babesiosis is a recognized risk for patients receiving blood transfusions, and it occurs most frequently in states endemic for *B microti*.<sup>12</sup> None of the patients in our study had received a blood transfusion in the 6 months prior to diagnosis of babesiosis. Nonetheless, the increase in clinically recognized cases of babesiosis in our region in recent years underscores the importance of considering transfusion-associated babesiosis in appropriate patients, particularly in the very young, old, and immunocompromised patients, in whom it may be a life-threatening infection.<sup>11</sup>

Our study has a number of limitations primarily related to its retrospective nature. We do not have baseline surveillance data of the frequency of *B microti* in ticks in our region prior to 2006 or seroprevalence data from our patient population to gauge the extent to which clinically unrecognized babesiosis may have been present. Previously published seroprevalence studies have suggested up to 10% positivity in *B microti*-endemic areas.<sup>13</sup> Additionally, we did not assess for the presence of other emerging tick-borne pathogens such as *E muris*-like agent or *Borrelia miyamotoi*, which share the same tick vector and could have been present in coinfections in our patient population. Our study also did not evaluate for the presence of another tick-borne pathogen recently identified in our region, Powassan virus. The vector for this virus is also *Ixodes* ticks. Powassan virus can cause severe encephalitis, for which there is no specific treatment.

It should be stressed that although we have demonstrated an increased number of babesiosis diagnoses in our region in recent years, results of the tick-borne infection diagnostic panel were negative for the vast majority of patients tested. Thus, empiric antimicrobial treatment ought to be used judiciously and is best reserved for patients with compelling clinical and laboratory features of a tick-borne illness.

In conclusion, we have demonstrated for the first time the presence of *B microti* in ticks and evidence of the emergence of clinically relevant cases of babesiosis in recent years in our region. Additionally, we have shown that a tick-borne infection diagnostic panel composed of Lyme serology and PCR assays for the detection of *A phagocytophilum* and *B microti* may be an effective means of enhancing diagnostic efforts. Testing for *Babesia* may be best utilized clinically if applied to immunocompromised patients, asplenic patients, patients over 50 years of age, and patients with evidence of either anemia or liver transaminase elevation.

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## REFERENCES

1. Vannier E, Gewurz BE, Krause PJ. Human babesiosis. *Infect Dis Clin North Am*. 2008;22(3):469-488,viii-ix.
2. Herwaldt BL, Montgomery S, Woodhall D, Bosserman EA. Babesiosis surveillance - 18 states, 2011. *Morb Mortal Wkly Rep*. 2012;61(27):505-509.
3. Herwaldt BL, Springs FE, Roberts PP, et al. Babesiosis in Wisconsin: a potentially fatal disease. *Am J Trop Med Hyg*. 1995;53(2):146-151.
4. Iacopino V, Earnhart T. Life-threatening babesiosis in a woman from Wisconsin. *Arch Intern Med*. 1990;150(7):1527-1528.
5. Kowalski TJ, Tata S, Berth W, Mathiason MA, Agger WA. Antibiotic treatment duration and long-term outcomes of patients with early Lyme disease from a Lyme disease-hyperendemic area. *Clin Infect Dis*. 2010;50(4):512-520.
6. Lovrich SD, Jobe DA, Kowalski TJ, Policepatil SM, Callister SM. Expansion of the midwestern focus for human granulocytic anaplasmosis into the region surrounding La Crosse, Wisconsin. *J Clin Microbiol*. 2011;49(11):3855-3859.
7. Pfeiffer CD, Kazmierczak JJ, Davis JP. Epidemiologic features of human babesiosis in Wisconsin, 1996-2005. *WMIJ*. 2007;106(4):191-195.
8. Belongia EA, Reed KD, Mitchell PD, et al. Tickborne infections as a cause of nonspecific febrile illness in Wisconsin. *Clin Infect Dis*. 2001;32(10):1434-1439.
9. Mitchell PD, Reed KD, Hofkes JM. Immunoserologic evidence of coinfection with *Borrelia burgdorferi*, *Babesia microti*, and human granulocytic *Ehrlichia* species in residents of Wisconsin and Minnesota. *J Clin Microbiol*. 1996;34(3):724-727.
10. Steiner FE, Pinger RR, Vann CN, et al. Infection and co-infection rates of *Anaplasma phagocytophilum* variants, *Babesia* spp., *Borrelia burgdorferi*, and the rickettsial endosymbiont in *Ixodes scapularis* (acari: Ixodidae) from sites in Indiana, Maine, Pennsylvania, and Wisconsin. *J Med Entomol*. 2008;45(2):289-297.
11. Teal AE, Habura A, Ennis J, Keithly JS, Madison-Antenucci S. A new real-time PCR assay for improved detection of the parasite *Babesia microti*. *J Clin Microbiol*. 2012;50(3):903-908.
12. Herwaldt BL, Linden JV, Bosserman E, Young C, Olkowska D, Wilson M. Transfusion-associated babesiosis in the United States: a description of cases. *Ann Intern Med*. 2011;155(8):509-519.
13. Leiby DA. Babesiosis and blood transfusion: flying under the radar. *Vox Sang*. 2006;90(3):157-165.

# The Savant Syndrome Registry: A Preliminary Report

Darold A. Treffert, MD; David L. Rebedew, MD

## ABSTRACT

A registry has been established to document certain characteristics on a sizeable worldwide sample of individuals with savant syndrome, a rare but remarkable condition in which persons with developmental disabilities, brain injury, or brain disease have some spectacular “islands” of skill or ability that stand in jarring, marked contrast to overall handicap. Of the 319 savants included in the registry, 90% are congenital savants, while 10% are acquired savants. The registry includes individuals from 33 countries, with 70% from the United States or Canada. Sex distribution was 79% male vs 21% female (4:1).

This report summarizes the findings in the congenital savant syndrome category of the registry. Among the individuals with congenital savant syndrome, the most common underlying disability was Autistic Spectrum Disorder (75%); various other central nervous system (CNS) disorders were present in the other 25%. Fifty-five percent possessed a single special skill, while 45% had multiple skills. Music was the most frequent principal skill followed by art, memory, mathematics, calendar calculating, language, visual-spatial/mechanical, athletic, computer, extrasensory perception, and other skills.

## BACKGROUND

Savant syndrome is a rare but remarkable condition in which persons with developmental disabilities, brain injury, or brain disease have some spectacular “islands” of skill or ability that stand in jarring, marked contrast to overall handicap. The condition can be present from birth or surface in early childhood (congenital) or can surface unexpectedly following head injury, stroke, dementia, or other central nervous system (CNS) disorders (acquired). The special skills occur most commonly in the areas of music, art, calendar calculating, lightning calculating, or mechanical/spatial abilities. Whatever the special skill, it is always accompanied

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by extraordinary memory of a particular type—very narrow but very deep within the area of special ability. It occurs much more frequently in males than females in an approximate 4:1 or 6:1 male to female ratio, depending on the study.<sup>1</sup>

In his lecture and book in 1887, JL Down used the term “idiot savant” for this juxtaposition of ability and disability within the same person.<sup>2</sup> The term had appeared previously in a book by E Seguin.<sup>3</sup> At that time, “idiot” was a scientific classification of people with an IQ below 25, and the term “savant” was derived from the French word *savoir*, meaning “to know or knowledge able person.” Because of the pejorative connotation of the word “idiot,” Treffert suggested in 1988 that the condi-

tion be named savant syndrome,<sup>4</sup> and the term has been in general use since then.

## Previous Reports of Savant Syndrome

Since those earlier descriptions, the vast majority of documented cases of savant syndrome have stemmed from anecdotal reports of individual cases. A survey of the literature between 1898 and 1974 by Hill<sup>5</sup> found 52 individual savant case reports. Savant skills in those cases fell into 7 general areas: calendar calculating, fine sensory discrimination, art, mechanical dexterity, music, mathematics, and memorization of obscure facts—in that order.

In 1977, Hill canvassed 300 public residential facilities for the mentally retarded in the United States<sup>6</sup> asking the superintendents to indicate how many savants had been identified in their programs. There were 111 responses from facilities serving approximately 90,000 residents in 39 states. A total of 54 individuals with savant syndrome were, or had been, residing in 23 facilities, creating a prevalence rate of approximately 0.06% (approximately 1 per 2000 residents).

The following year, Hill reported that of 103 individuals classified as savants in 63 publications, 89 were male and 14 were female—a 6:1 male to female ratio in that group.<sup>7</sup>

Also in 1978, Rimland published findings from a questionnaire given to parents of 5400 children with autism.<sup>8</sup> The responses indicated that 531 children had special savant syndrome abilities in 10 skill areas: music, memory, art, pseudo-verbal (hyperlexia), mathematics, mechanical, coordination, directions, calendar calculating, and extrasensory perception—in that order. The male-to-female ratio was 3.54:1. It is this study that provided the generally accepted figure that 10% of autistic children show some savant abilities.

In a 2000 survey in Finland of 583 inpatient or residential facilities with a total patient population of 31,300, Saloviita and colleagues<sup>9</sup> found 45 individuals with savant abilities—an estimated 1.43 per thousand among people with intellectual disability. That rate is nearly double the rate of the 1977 Hill study noted above. Of the 45 savants, there were 35 men (78%) and 10 women (22%). Calendar calculating ability was particularly common (62%), followed by skills in memory (29%), art (13%), music (7%), mechanics (4%), and mathematics (2%). Multiple skills were present in 16% of that group, most often linking calendar calculation with memory skills.

In 2004, Bolte and Poustka<sup>10</sup> reported 33 persons with savant syndrome out of a group of 254 individuals with “idiopathic autism”—a prevalence of 13%. Howlin et al reported in 2009 that 39 of 137 individuals with autism (28.5%) met their criteria for savant syndrome based on cognitive testing and parental reports.<sup>11</sup>

In contrast to these earlier anecdotal reports and smaller samples, our registry consists of 319 individuals with savant syndrome and provides a detailed analysis of type of disability, type of ability, frequency of particular skills, age, sex, geographic location, and a number of other variables. This report summarizes the findings in the congenital savant syndrome category. Results of the acquired savant syndrome category will be summarized in a later report.

### **Establishing a Savant Syndrome Registry**

After reviewing those earlier single case reports and limited samples, it seemed useful to establish a larger, worldwide savant syndrome registry that would permit analysis of a larger sample of savants on a number of variables for research, education, and information purposes. It also could serve as a resource of cases for other researchers using multidisciplinary imaging, neuropsychological, genetic, and other techniques and carrying out epidemiologic analysis of savant syndrome.

The registry had its beginnings in 1984 when Alonzo Clemons, a savant sculptor, had his world premier exhibition of 30 bronze sculptures in Denver, Colorado. Alonzo was 1 of 3 savants featured in an October 1983 *60 Minutes* program that gave savant syndrome its first worldwide television exposure. A portion of the proceeds of that exhibition went to the Wisconsin Medical Society Foundation to establish an information and education

clearinghouse dedicated to raising awareness of, and education about, savant syndrome for parents, other caregivers, teachers, clinicians, media, and the general public.

Initially the clearinghouse operated using regular mail, printed reports, and press releases.

Simultaneously, reports of various savants from around the world came to the attention of the clearinghouse. Those were simply put into a folder for future reference. In fall 1987, a website—[www.savantsyndrome.com](http://www.savantsyndrome.com)—was established by the Wisconsin Medical Society as a much more efficient, instant, and effective manner of conducting the clearinghouse function. In 1989, the movie *Rain Man* made “autistic savant” household terms and traffic on the website increased dramatically. Currently, the website is ranked highly on many search engines worldwide and receives over 500 hits daily from parents, clinicians, teachers, media, students, and many others.

Web-based recruiting for health research, as used here, as a source of case reports or subjects is growing, including patient self-reports through social networking.<sup>12</sup>

By 2012, the folder of new savants from various sources had grown to nearly 400 cases. In summer 2012, a summer research fellowship was awarded to a medical student (Rebedew) for purposes of organizing and analyzing the data in the case reports. This paper is a preliminary summary of that registry from 1984 to 2012.

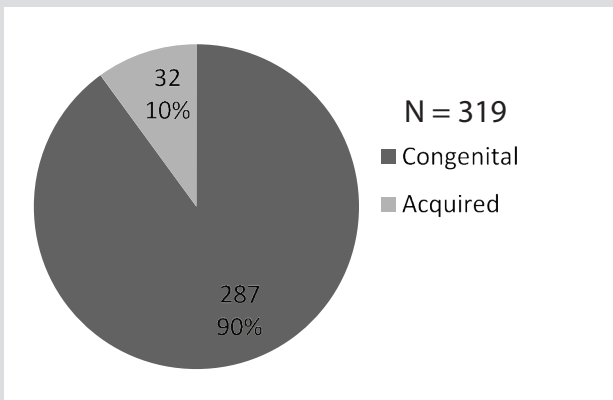
This registry has its limitations. It contains unsolicited cases brought to attention in a non-uniform manner. Therefore, it does not provide an estimate of the prevalence of savant syndrome worldwide, nor the prevalence of savant syndrome within certain disorders such as autism or other developmental disorders, for example.

The cases rely on parental accounts or reports of other caregivers, media accounts or, in some cases, personal observation. They are not formally corroborated, but the reports appeared reliable, often supported by accompanying videos or other documentation. This circumstance is similar to almost all of the earlier reports described in the literature, including Rimland’s sample of 530 savants.<sup>8</sup>

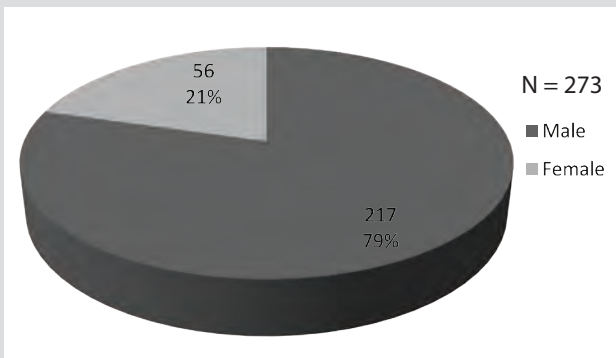
While to some caution is warranted regarding the mention of extrasensory perception, in Rimland’s sample as well as this one, some parents listed such phenomenon. Mentioning that such phenomenon are reported by others in this and other studies of savant syndrome is not the same as corroborating or documenting their validity. Rather, it merely acknowledges that extrasensory perception continues to surface in some studies of savant syndrome. Since extrasensory perception is mentioned quite frequently in the broader autism literature in general, there are studies underway to document or refute such phenomenon.

Finally, this is a preliminary report and identified as such. The next step—already underway—is to ask the sources in this study

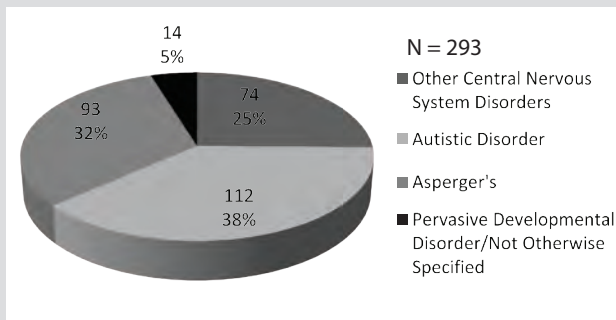
**Figure 1.** Percent of Acquired vs Congenital Savants



**Figure 2.** Sex Distribution in Congenital Savant Syndrome



**Figure 3.** Congenital Savant Autism Prevalence



to complete an especially constructed, detailed, standardized questionnaire administered using SurveyGizmo Online Questionnaire Software. Replies to this 94-question online instrument will provide more detailed, standardized information with a uniform “n” for all the variables being monitored for all the savants. Additionally, discussions are underway to continue and expand the savant syndrome registry by combining it with an already functioning synesthesia registry with the University of Sussex in England.

**METHODS**

Subjects for the current study were chosen based upon existing mail and e-mail inquiries from the savant syndrome website at [www.savantsyndrome.com](http://www.savantsyndrome.com), media articles, and personal contacts (N=367). Variables including name, address, date of birth, sex, ethnicity, type of disability, congenital vs acquired etiology, age of onset of disability, IQ level, type of ability, schooling, occupation (if applicable), treatment, progress, family history, parental education level, and parental occupation, to the extent each of these variables were available from each subject, were entered into Microsoft Excel for analysis. Because some reports did not include all variables (ie educational level), the “n” for some variables differed from the total study population.

If the individual’s sole ability consisted of synesthesia, hyperlexia, or high intelligence, he or she was excluded from the current data set (n=4). If the individual did not have a disability, he or she was excluded from this study since savant syndrome, by definition, includes some underlying disability on to which the special savant skill is grafted or superimposed (n=44). After the exclusion process, data for 319 individuals was categorized and analyzed. Individual handicaps were listed according to reported diagnoses.

Principal ability was a subjective determination based on information contained in the various reports. All abilities were then categorized into music (performance, perfect pitch, composition, memory for music), art (drawing, painting, sculpting), memory (facts, numbers, dates, photographic, hyperthymestic), lightning calculating (ability to do complex multiplication, division, and/or exponentials mentally), calendar calculating (knowing on which day of the week a date in the past or future falls), math truths (having an understanding of complex mathematics at a very early age and knowing multiple digit prime numbers), language (being able to learn a new language fluently and quickly, able to speak multiple languages with no accent, proofreading papers with little effort), visual-spatial (able to take apart and put back together complicated mechanical devices, perfect sense of direction and global positioning system-like recall of directions, being able to measure distances or heights with precision), athletic (a very skilled level of golf, basketball), computer (writing programs, coding, learning new computer languages), and extra-sensory perception (mind reading, telepathy).

**RESULTS**

After the exclusion process detailed above, data on 319 savants was available for analysis. For some variables, data was available on all 319 individuals. For other variables, such as age, educational level, or ethnicity, data was available on less than the entire sample. Therefore the “n” for some variables is less than 319.

**Congenital vs Acquired Savant Syndrome**

Savant syndrome can be *congenital* or *acquired*, and it is not a

stand-alone condition. Rather, the special savant skills are always grafted on to some underlying disability that can include, but is not limited to, autistic spectrum disorder (ASD). For purposes of this study, congenital savant syndrome means savant skills present from birth or emerging in early childhood with conditions such as early onset and late onset ASD, other developmental disorders, intellectual disability, Williams syndrome, agenesis of the corpus callosum, tuberous sclerosis, hypopituitarism, or other brain disorders as the underlying disability. Acquired savant syndrome refers to savant abilities that emerge, sometimes at a prodigious level, in a previously neurotypical child or adult following head injury, stroke, dementia or other CNS incident. Using those definitions, Figure 1 illustrates the congenital/acquired ratio.

### Sex Distribution

Sex distribution among those with congenital savant syndrome is approximately 4:1, male:female. (Figure 2.)

### Primary Disability in Congenital Savant Syndrome

Seventy-five percent of individuals in whom savant syndrome was present in childhood had an autism-related condition as the underlying disorder. Twenty-five percent had other developmental disabilities or other CNS conditions as the underlying disorder, including intellectual disability, Williams syndrome, agenesis of the corpus callosum, tuberous sclerosis, and hypopituitarism. That is not surprising since, as noted above, approximately 1 in 10 children with autism have savant syndrome, whereas that number drops to 1 in 1400 in other CNS disorders. (See Figure 3.)

### Single or Multiple Abilities in Congenital Savants, Principal Skills

Among congenital savants, 55% have a single skill and 45% have multiple skills. Music is the most commonly reported principal skill in congenital savants, whether the savant had single or multiple skills. Art is the second most common. If memory is considered the principal skill (as opposed to only accompanying a skill), it is the third most common skill followed by mathematics. Calendar calculating, while present in many savants along with the principal skill, was reported as the principal skill in only 5% of savants. Other skills, in descending order of frequency were polyglot (language), visual-spatial, athletic, computers, and extrasensory perception. (See Table 1.)

### Geographic Distribution of Savants

Thirty-three countries are represented by savants included in this registry, with 70% from the United States and Canada. Fifteen percent are from Europe; 11% are from Asia (Table 2).

## DISCUSSION

This study of savant syndrome abilities does not measure the frequency of such special abilities in autism or other CNS disorders. Rimland's 1978 questionnaire of parents still provides

**Table 1.** Principal Skill in Congenital Savants (N=281)

Music (performance, composition, perfect pitch, memory)	25%
Art (drawing, painting, sculpting)	19%
Memory (facts, numbers, dates, photographic hyperthymestic)	20%
Mathematics (lightning calculating, exponentials, truths)	11%
Calendar calculating (day of week for past or future dates)	5%
Language (polyglot skills in learning or speaking language)	4%
Visual-spatial/mechanical (maps, directions, how things work)	8%
Athletic (golf, basketball, soccer)	3%
Computer (programming, coding)	2%
Extrasensory perception	1%
Other	2%
	100%

**Table 2.** Geographic Distribution of Savants (N=204)

<b>North America, n = 155</b>	
USA	142
Canada	13
<b>Europe, n = 26</b>	
United Kingdom	18
France	5
Germany	3
<b>Asia, n = 14</b>	
China	2
India	8
Japan	2
Singapore	2
<b>Other, n = 9</b>	
Australia	7
Brazil	2

the largest population sampled (5400 children), of which 531 (approximately 10%) reported such savant abilities.<sup>8</sup> Other studies reported savant syndrome prevalence ranging from 13%<sup>10</sup> to as high as 28%.<sup>11</sup>

Since the early description of savant syndrome over 100 years ago, most of the special skills have been in 5 categories: music, art, calendar calculating, lightning calculating, and visual-spatial/mechanical skills. While it is true that these skill areas still dominate the inventory of abilities, this broad-based review shows that savant skills can include many other skills as well, such as language, computer, athletic, and extrasensory abilities. Some savants have extraordinary memory as their principal skill, but increased memory capacity generally accompanies the principal savant ability.

In this report, the male-to-female ratio was 4:1, which is slightly less than some other earlier reports.

While the movie *Rain Man* left the impression with some that autism and savant syndrome were always linked, the fact is that not all people with autism are savants, and not all savants are autistic. In this study, autistic spectrum disorder was the underlying disability 75% of the time, while other CNS disorders are present 25% of the time. In addition, 10% of the savants were

“acquired” savants with various CNS injury or disease the underlying acquired disability.

The data for this registry was from various sources as opposed to a questionnaire with standardized variables. As the next step in developing the savant syndrome registry, a more uniform, systematic, detailed follow-up questionnaire was created using SurveyGizmo Online Questionnaire Software. This 94-question online survey was sent to the parent, caregiver, or savant. Results will provide much more detailed data for analysis on many more variables than this preliminary report, with a uniform “n” for each variable.

## CONCLUSIONS

An analysis of 319 individuals with savant syndrome drawn from a variety of sources produced the following results:

- 90% were congenital savants; 10% were acquired savants.
- The savants identified were from 33 different countries, 70% were from North America.

Among congenital savants:

- Gender distribution was 4:1, male to female.
- Underlying disability was autistic spectrum disorder in 75% of cases with various other CNS disorders in 25% of cases. Thus, not all persons with autism are savants and not all persons with savant syndrome are autistic.
- Music was the most common savant skill, followed by special skills in art, memory, mathematics, visual/spatial/mechanical, calendar calculating, language (polyglot skills), athletic, computer, and extrasensory perception.
- Single skills were present in 55% of cases; multiple skills were present in 45% of cases

Separate analysis studies will be carried out on the acquired savant, and a comprehensive standardized survey instrument will be sent to each of the 319 individuals included in the registry for a more comprehensive, multifactorial analysis.

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## REFERENCES

1. Treffert DA. *Islands of Genius: The Bountiful Mind of the Autistic, Acquired and Sudden Savant*. London: Jessica Kingsley, Inc.; 2010.
2. Down JL. *On Some of the Mental Affections of Childhood and Youth*. London: Churchill; 1887.
3. Seguin E. Art. XXXIII.-New Facts and Remarks concerning Idiocy: being a Lecture delivered before the New York Medical Journal Association, October 15, 1869. *Am J Med Sci*. 1870;59(129):518-519.
4. Treffert DA. The idiot savant: a review of the syndrome. *Am J Psychiatry*. 1988;145:563-572.
5. Hill AL. Idiot Savants: A categorization of abilities. *Ment Retard*. 1974;12(6):12-18.
6. Hill AL. Idiot savants: Rate of incidence. *Percept Mot Skills*. 1977;44:161-162.
7. Hill AL. Savants: Mentally Retarded Individuals with Special Skills. In N. Ellis (ed.) *International Review of Research in Mental Retardation*. New York: Academic Press; 1978.
8. Rimland, B. Savant Characteristics of Autistic Children and their Cognitive Implications. In G.Serban (ed.) *Cognitive Defects in the Development of Mental Illness*. New York: Brunner/Mazel. 1978.
9. Saloviita T, Ruusila L, Ruusila U. Incidence of savant syndrome in Finland. *Percept Mot Skills*. 2000;91:120-122.
10. Bolte S, Poustka F. Comparing the intelligence profiles of savant and nonsavant individuals with autistic disorder. *Intelligence*. 2004;32:121-131.
11. Howlin P, Goode S, Hutton J, Rutter M. Savant skills in autism: Psychometric approaches and parental reports. *Philos Trans R Soc B*. 2009;364:1359-1369.
12. Fenner YL, Garland SM, Moore EE, et al. Web-based recruiting for health research using a social networking site: an exploratory study. *J Med Internet Res*. 2012;14(1):e20.



# Hypocalcemia Secondary to Zoledronate Therapy in a Patient With Low Vitamin D Level

Narendranath Epperla, MD; Ram Pathak, MD, FACE, FACP

## ABSTRACT

Zoledronate (ZDA) is a bisphosphonate used to treat hypercalcemia that commonly occurs with malignancy, multiple myeloma, and bone metastases from solid tumors. It acts primarily by decreasing osteoclastic activity, thereby slowing the release of skeletal calcium. However, a potential adverse effect of ZDA is hypocalcemia that can be symptomatic, especially in patients with risk factors such as hypomagnesemia, hypoparathyroidism, renal failure, and vitamin D deficiency. We report the case of a patient with extensive stage small cell lung cancer with multiple osseous and visceral metastases who developed symptomatic hypocalcemia following ZDA administration. Significant clinical improvement occurred following administration of calcium and vitamin D, and his calcium levels returned to normal within a few days. Due to the high incidence of vitamin D deficiency and the low accuracy of clinical risk factors to predict vitamin D deficiency, screening for vitamin D deficiency before administration of ZDA may be appropriate.

## INTRODUCTION

Zoledronic acid, also known as zoledronate (ZDA), is a bisphosphonate that decreases skeletal calcium release by inhibiting osteoclastic activity. It has been used for several clinical indications, including hypercalcemia of malignancy, multiple myeloma, and bone metastases from solid tumors, as well as treatment of osteoporosis and Paget's disease.<sup>1-7</sup> Common side effects include bone pain, arthralgias, myalgias, and flu-like symptoms (eg, fever,

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nausea). Dose-dependent nephrotoxicity, osteonecrosis of the jaw, and hypocalcemia are observed less frequently.<sup>8-10</sup> The incidence of symptomatic hypocalcemia requiring treatment is low (based on the data from clinical trials);<sup>11-13</sup> however, in certain clinical settings, the incidence has been shown to be higher (up to ~35%). This is especially true in patients with additional risk factors like pre-existing hypoparathyroidism, vitamin D deficiency, renal failure, or hypomagnesemia.<sup>14,15</sup>

Herein we report a case in which the patient developed symptomatic hypocalcemia following administration of ZDA. He made significant clinical improvement following administration of calcium and vitamin D, with his calcium levels returning to normal within a few days of therapy.

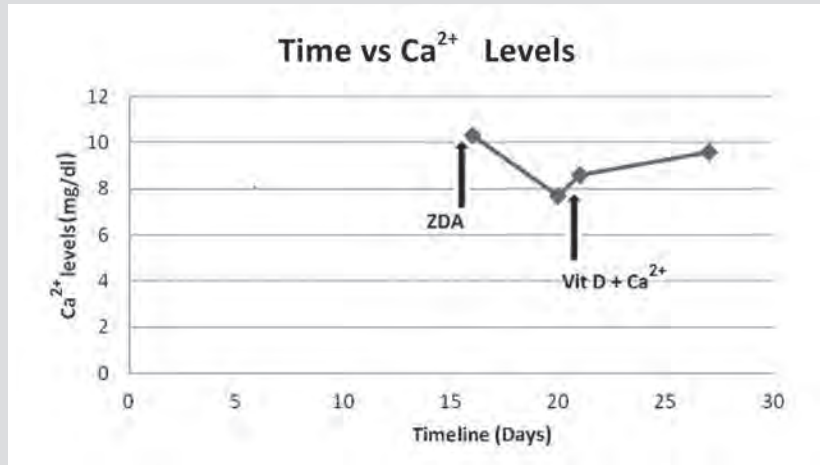
## CASE PRESENTATION

A 54-year-old man with a history of extensive stage small cell lung cancer with multiple osseous and visceral metastases was started on chemotherapy 4 months prior to the presentation. Eight days before presentation, he completed cycle 5 of multiagent chemotherapy (cisplatin and irinotecan). He received intravenous (IV) ZDA (4 mg infused over 15 to 20 minutes) the next day to treat skeletal metastases. He was advised to take calcium and vitamin D (600 mg + 400 IU) supplements. However, the patient forgot to take the advised supplements, and 7 days later presented with complaints of nausea, vomiting, paraesthesias, lightheadedness, and weakness. His total serum calcium ( $\text{Ca}^{2+}$ ) of 10.3 mg/dL before ZDA therapy had decreased to 7.7 mg/dL (normal range 8.5-9.8 mg/dL). The ionized  $\text{Ca}^{2+}$  was 3.9 mg/dL (normal range 4.5-5.3 mg/dL), while creatinine was at his baseline of 1.1 mg/dL (normal range 0.8-1.2 mg/dL). The 25-hydroxy vitamin D (25-OH vitamin D) was low at 24 ng/mL (normal range 30-60 ng/mL), while parathyroid hormone (PTH) was elevated at 104 pg/dL (normal range 12-72 pg/dl). He received IV calcitriol (0.25 mcg) and IV calcium gluconate, and the next day his ionized  $\text{Ca}^{2+}$  was

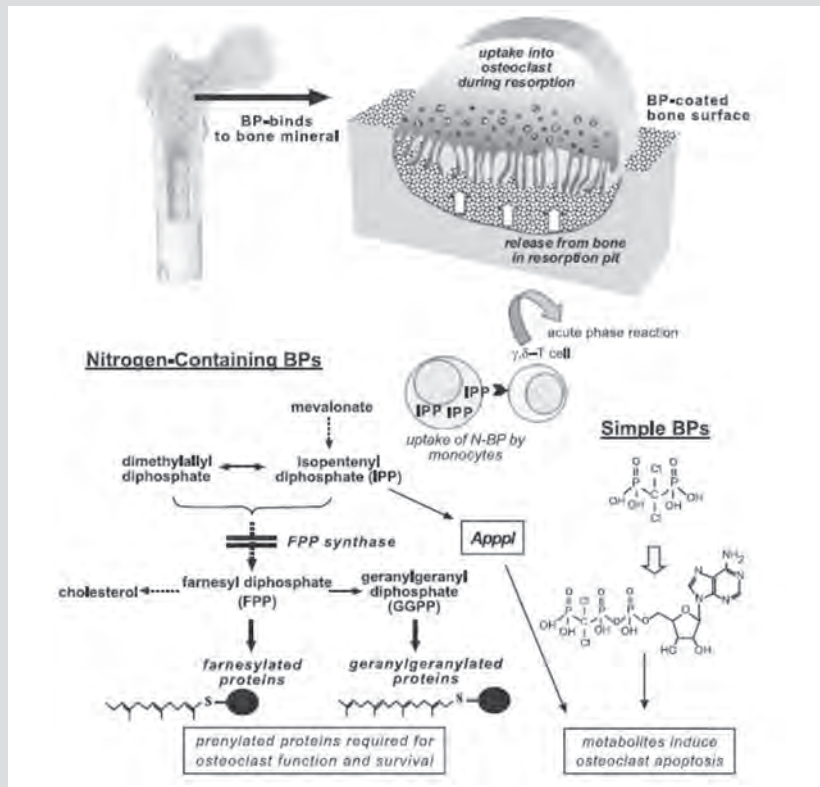
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**Figure 1.** The Patient's Total Serum Calcium ( $\text{Ca}^{2+}$ ) Levels



**Figure 2.** Mechanism of Action of Bisphosphonates on Osteoclasts



(Reprinted with permission from Russell et al, *Osteoporosis Int*, 2008;19:733-759; Fig. 6, p. 740. Springer.)

4.6 mg/dL (total calcium 8.3 mg/dl). He was advised to continue calcitriol and take calcium (1200 mg) and vitamin D (800 U) orally twice daily.

Seven days later, his symptoms had improved, and his PTH levels had normalized to 36 pg/mL. Calcitriol was discontinued, but the calcium and vitamin D were continued. Two weeks later,

he was asymptomatic, and his total serum  $\text{Ca}^{2+}$  was within normal limits (9.4 mg/dL) (Figure 1). Transient hypocalcemia and secondary hyperparathyroidism after ZDA infusion in this patient with inadequate vitamin D levels was successfully treated with vitamin D and calcium supplements with no recurrence of symptoms during subsequent follow-up visits.

## DISCUSSION

Total calcium level lower than 8.5 mg/dL (2.12 mmol/L) in the serum is defined as hypocalcemia. Calcium in the body is mostly present in the bones (99%), with only 1% distributed in the serum. This serum calcium exists in 3 forms:

- Free or ionized calcium (50%)—physiologically active form.
- Calcium bound to plasma proteins (40%)—albumin is the plasma protein to which serum calcium is predominantly bound (approximately 80%).
- Calcium complexed to anions (10%)—the anions include citrate, phosphate, bicarbonate, and lactate.

Thus, serum calcium can be affected by serum albumin, especially when the serum albumin level is high or low. Therefore, it is important to measure serum albumin concentration first and correct serum calcium based on the albumin levels. Alternatively, one can directly measure ionized calcium, which is a true estimate of the individual's calcium level in the body.

ZDA is a third generation amino-bisphosphonate that inhibits farnesyl pyrophosphate synthase, a key enzyme in the mevalonate pathway. This has a few important ramifications: (1) it leads to decreased production of sterols that are required for osteoclast function and survival; (2) it leads to accumulation of an alternative metabolite that induces osteoclast apoptosis.<sup>4,9,16</sup> Thus, ZDA prevents osteoclastic resorption of the bone by decreasing osteoclastic activity and promoting programmed cell death<sup>4,9,16</sup> (Figure 2). ZDA has a high

affinity for bone tissue without any evidence of biotransformation and exhibits rapid elimination from the circulation. Plasma protein binding is low (~22%), indicative of lower likelihood of displacement of other drugs that are highly plasma protein bound. Thus ZDA has a favorable pharmacodynamic and pharmacokinetic profile. It is, in fact, preferred over other bisphos-

phonates available for the treatment of bony metastases, since it is more potent, has a short infusion time (15 minutes), and has the advantage of a shorter length of stay in the ambulatory setting.<sup>5,11-13,17</sup>

ZDA lowers serum calcium in both normocalcemic and hypocalcemic individuals by its effect on osteoclast activity (as detailed above). In most instances, the hypocalcemia that arises is asymptomatic and mild, with normal levels restored rapidly provided the factors involved in calcium homeostasis are intact. However, patients who have additional risk factors like vitamin D deficiency, renal insufficiency, or hypomagnesemia are less likely to counteract the hypocalcemic stimuli when treated with ZDA.

Calcium levels in the blood are maintained within the normal range by vitamin D and PTH. Vitamin D deficient patients have elevated PTH levels, which try to keep calcium within normal limits through osteoclast-mediated bone resorption. However, when ZDA is started in patients with vitamin D deficiency, this defense mechanism is blocked (ie, osteoclast-mediated bone resorption), and the patient is predisposed to developing hypocalcemia. We believe this to be the cause of hypocalcemia in our patient.

At the time of presentation, our patient's vitamin D level was 24 ng/mL. His calcium was kept within normal limits before initiating ZDA therapy by the compensatory increase in PTH. In anticipation of hypocalcemia, he was advised to take calcium and vitamin D supplements once ZDA was initiated. Due to the high incidence (~60%) of vitamin D deficiency in elderly and hospitalized patients,<sup>9,18,19</sup> it would be prudent to screen for 25(OH) D concentration prior to initiating ZDA. It has been stated "to prevent fatal hypocalcemic episodes, administer adequate vitamin D and calcium supplements in patients who have normal to low calcium levels when commencing treatment with bisphosphonates."<sup>20</sup>

Other conditions that predispose to the development of symptomatic hypocalcemia in patients using ZDA are pre-existing hypomagnesemia, renal insufficiency, and hypoparathyroidism. Magnesium is a key element required for the release and action of PTH; hence, patients with low magnesium levels have inappropriately low PTH levels in the presence of hypocalcemia.<sup>21</sup> Some authors have strongly suggested the routine monitoring of magnesium in patients at risk, such as those using diuretics, and to consider prophylactic supplementation in selected cases.<sup>14</sup>

ZDA, like other bisphosphonates, is cleared renally, and if the dose is not adjusted in patients with impaired creatinine clearance, there is a high likelihood of ZDA toxicity. Current guidelines advocate against the use of ZDA in patients with creatinine clearance of less than 30ml/min, and a graded dose reduction is recommended for patients with creatinine clearance of 30ml–60ml/min.<sup>10,22</sup> Therefore, it is considered prudent by many clini-

cians to monitor renal function prior to every dose of ZDA.<sup>8</sup>

Patients with pre-existing hypoparathyroidism are extremely susceptible to symptomatic hypocalcemia when started on bisphosphonates. This is because in addition to losing osteoclast-mediated calcium release from bone resorption, they also typically have renal calcium wasting. Therefore, it is important to screen routinely for hypoparathyroidism in all patients with non-hypercalcemic bone disease before starting bisphosphonates.<sup>23</sup> In a patient with low parathyroid reserve, it is strongly recommended that bisphosphonates be used cautiously and in lower doses, and that one should be prepared to give large doses of calcitriol and calcium to avoid tetany.<sup>24</sup>

Receptor activator of nuclear factor- $\kappa$ B ligand (RANKL) binds to and activates its receptor RANK, a transmembrane protein receptor on the surface of osteoclast precursors and through downstream signals activates nuclear factor  $\kappa$ B and mitogen-activated protein (MAP) kinases. This leads to the differentiation, activation, and increased survival of osteoclasts, leading to enhanced bone resorption.<sup>25</sup> Osteoprotegerin is a natural inhibitor of RANKL, preventing RANKL from binding to its osteoclast receptor. Although other hormones and cytokines participate in osteoclast differentiation and activation, RANKL appears to be an essential factor and the final common regulator of osteoclastogenesis.<sup>26</sup> Denosumab (AMG 162) is a human monoclonal IgG2 antibody that has high affinity for human RANKL and blocks the binding of RANKL to RANK, thereby inhibiting osteoclast differentiation and survival. It is indicated for the prevention of skeletal-related events in patients with bone metastases from solid tumors, osteoporosis, and hypercalcemia of malignancy. Though denosumab is an acceptable alternative to ZDA, it also can cause severe hypocalcemia (similar to ZDA), and caution must be exercised to correct pre-existing hypocalcemia prior to initiating therapy.<sup>27-29</sup>

## CONCLUSION

With more patients being treated with IV bisphosphonates for varying conditions, such as osteoporosis, skeletal metastases, and hypercalcemia of malignancy, the incidence of symptomatic hypocalcemia will probably increase, particularly in patients with undiagnosed calcium and bone metabolism disorders.<sup>30</sup> We advocate routine screening of 25 (OH)D levels for vitamin D deficiency in patients who are being started on ZDA for multiple reasons—high incidence of vitamin D deficiency among the elderly and inpatient population, increasing long-term use of proton pump inhibitors (that limit the absorption of dietary calcium), and the low accuracy of clinical risk factors to predict vitamin D deficiency. We also strongly recommend administration of adequate calcium and vitamin D supplements in patients who have normal to low calcium levels when initiating treatment with bisphosphonates. It might be prudent to incorporate routine

screening for hypoparathyroidism in all patients with non-hypercalcemic bone disease before starting bisphosphonates. These recommendations, along with regular monitoring of calcium, magnesium, and renal function before administration of every dose, could be effective in decreasing the incidence of symptomatic hypocalcemia in patients taking ZDA.

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## REFERENCES

1. Zoledronic acid powder for injection [package insert]. Detroit, MI: Caraco; November 2012.
2. Zometa (zoledronic acid) [prescribing information]. East Hanover, NJ: Novartis Pharmaceuticals Corporation; January 2015.
3. Cohen HE, ed. *2003 Drug Topics Red Book*. 107th ed. Montvale, NJ: Medical Economics, 2003.
4. Russell RGG, Watts NB, Ebetino FH, Rogers MJ. Mechanisms of action of bisphosphonates: similarities and differences and their potential influence on clinical efficacy. *Osteoporos Int*. 2008;19(6):733-759.
5. Rosen LS. Efficacy and safety of zoledronic acid in the treatment of bone metastases associated with lung cancer and other solid tumors. *Semin Oncol*. 2002;29(6 Suppl 21):28-32.
6. Kannan S, Mahadevan S, Sathya A, Sriram U. A tale of three diseases of the bone. *Singapore Med J*. 2008;49(10):e263-e265.
7. Polyzos SA, Anastasilakis AD, Makras P, Terpos E. Paget's disease of bone and calcium homeostasis: focus on bisphosphonate treatment. *Exp Clin Endocrin Diabetes*. 2011;119(9):519-524.
8. Henley D, Kaye J, Walsh J, Cull G. Symptomatic hypocalcemia and renal impairment associated with bisphosphonate treatment in patients with multiple myeloma. *Intern Med J*. 2005;35(12):726-728.
9. Drake MT, Clarke BL, Khosla S. Bisphosphonates: Mechanism of action and role in clinical practice. *Mayo Clin Proceedings*. 2008;83(9):1032-1045.
10. Henry DH, Costa L, Goldwasser F, et al. Randomized, double-blind study of denosumab versus zoledronic acid in the treatment of bone metastases in patients with advanced cancer (excluding breast and prostate cancer) or multiple myeloma. *J Clin Oncology*. 2011;29(9):1125-1132.
11. Saad F, Gleason DM, Murray R, et al; Zoledronic Acid Prostate Cancer Study Group. A randomized, placebo-controlled trial of zoledronic acid in patients with hormone-refractory metastatic prostate carcinoma. *J Natl Cancer Inst*. 2002;94(19):1458-1468.
12. Rosen LS, Gordon D, Kaminski M, et al. Long-term efficacy and safety of zoledronic acid compared with pamidronate disodium in the treatment of skeletal complications in patients with advanced multiple myeloma or breast carcinoma: A randomized, double-blind, multicenter, comparative trial. *Cancer*. 2003;98(8):1735-1744.
13. Rosen LS, Gordon D, Tchekmedyian S, et al. Zoledronic acid versus placebo in the treatment of skeletal metastases in patients with lung cancer and other solid tumors: a phase III, double-blind, randomized trial—the Zoledronic Acid Lung Cancer and Other Solid Tumors Study Group. *J Clin Oncol*. 2003;21(15):3150-3157.
14. Chennuru S, Koduri J, Baumann MA. Risk factors for symptomatic hypocalcemia complicating treatment with zoledronic acid. *Intern Med J*. 2008;38(8):635-637.
15. Zuradelli M, Masci G, Biancafiore G, et al. High incidence of hypocalcemia and serum creatinine increase in patients with bone metastases treated with zoledronic acid. *Oncologist*. 2009;14(5):548-556.
16. Reid IR. Bisphosphonates: new indications and methods of administration. *Curr Opin Rheumatol* 2003;15(4):458-463.
17. Rosen L, Gordon D, Tchekmedyian S, et al. Zoledronic acid (Zol) significantly reduces skeletal-related events (SREs) in patients with bone metastases from solid tumors [abstract]. *Proc Am Soc Clin Oncol*. 2002;21:295a.
18. Thomas MK, Lloyd-Jones DM, Thandhani RI, et al. Hypovitaminosis D in medical inpatients. *N Engl J Med*. 1998;338(12):777-783.
19. Harris SS, Soteriades E, Coolidge JA, Mudgal S, Dawson-Hughes B. Vitamin D insufficiency and hyperparathyroidism in a low income, multiracial, elderly population. *J Clin Endocrinol Metab*. 2000;85(11):4125-4130.
20. Adami S, Zamberlan N. Adverse effects of bisphosphonates. A comparative review. *Drug Safety*. 1996;14(3):158-170.
21. Vetter T, Lohse MJ. Magnesium and the parathyroid. *Curr Opin Nephrol Hypertens*. 2002;11(4):403-410.
22. emc+, Medicines Compendium. Available at <http://emc.medicines.org.uk/>. Accessed July 2, 2015.
23. Comlekci A, Biberoglu S, Hekimsoy Z, et al. Symptomatic hypocalcemia in a patient with latent hypoparathyroidism and breast carcinoma with bone metastasis following administration of pamidronate. *Intern Med*. 1998;37(4):396-397.
24. Stuckey BG, Lim EM, Kent GN, Ward LC, Gutteridge DH. Bisphosphonate therapy for Paget's disease in a patient with hypoparathyroidism: profound hypocalcemia, rapid response, and prolonged remission. *J Bone Miner Res*. 2001;16(9):1719-1723.
25. Boyle WJ, Simonet WS, Lacey DL. Osteoclast differentiation and activation. *Nature*. 2003;423(6937):337-342.
26. Bekker PJ, Holloway D, Nakanishi A, Arrighi M, Leese PT, Dunstan CR. The effect of a single dose of osteoprotegerin in postmenopausal women. *J Bone Miner Res*. 2001;16(2):348-360.
27. Scagliotti GV, Hirsh V, Siena S, et al. Overall survival improvement in patients with lung cancer and bone metastases treated with denosumab versus zoledronic acid: subgroup analysis from a randomized phase 3 study. *J Thorac Oncol*. 2012;7(12):1823-1829.
28. Smith MR, Egerdie B, Hernández Toriz N, et al; Denosumab HALT Prostate Cancer Study Group. Denosumab in men receiving androgen-deprivation therapy for prostate cancer. *N Engl J Med*. 2009; 361(8):745-755.
29. Xgeva (denosumab) [prescribing information]. Thousand Oaks, CA: Amgen Inc; December 2014.



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# Quiz: Hypocalcemia Secondary to Zoledronate Therapy in a Patient With Vitamin D Deficiency

## EDUCATIONAL OBJECTIVES

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

1. Identify the potential risk factors for the development of hypocalcemia in a patient treated with intravenous zoledronate.
2. Describe the mechanism of action of bisphosphonates such as zoledronate.
3. Articulate an appropriate evaluation for a patient prior to receiving zoledronate.

**PUBLICATION DATE:** August 10, 2015

**EXPIRATION DATE:** August 10, 2016

## QUESTIONS

1. Risk factors for the development of hypocalcemia secondary to zoledronate therapy include:
  - Hypomagnesemia, hyperparathyroidism, renal failure, vitamin D deficiency.

• • •

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

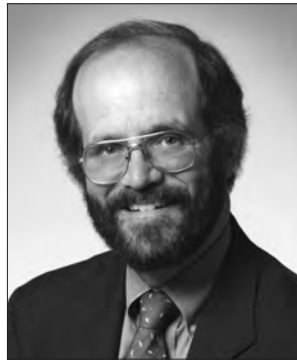
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- Hyponatremia, vitamin D deficiency, hypoparathyroidism, hypomagnesemia.
  - Hypoparathyroidism, hyperkalemia, renal failure, vitamin D deficiency.
  - Hypoparathyroidism, hypomagnesemia, vitamin D deficiency, renal failure.
  - Renal failure, hypomagnesemia, hyperparathyroidism, hyponatremia.
2. Side effects of intravenous zoledronate include nephrotoxicity, osteonecrosis of the jaw, and hypocalcemia.
    - True
    - False
  3. About 10% of serum calcium is ionized and physiologically active.
    - True
    - False
  4. The mechanism of action of zoledronate includes preventing of osteoclastic resorption of bone and promoting osteoclast apoptosis.
    - True
    - False
  5. The authors of this article suggest the following routine screening for patients being treated with IV bisphosphonates such as zoledronate:
    - A. Vitamin D levels, magnesium level, parathyroid level.
    - B. Parathyroid level, renal function, calcium level.
    - C. Calcium level, parathyroid level, renal function.
    - A, B, and C.
    - None of the above.



Carla M. Pugh, MD, PhD



Robert N. Golden, MD

## Medical Training in the Fitbit, Google Glass and Personal Information Era

Carla M. Pugh, MD, PhD; Robert N. Golden, MD

### *Will advanced technologies change the way we learn and practice medicine?*

There's no question that we are in the midst of an ever-expanding journey of information access. While Google and Wikipedia have changed the landscape of searchable, worldwide information on a variety of topics, Facebook, Fitbit, and Google Glass have taken things to the next level—from storage and access of information to up-close-and-personal data.

The medical profession has not been shy about joining the craze of information exchange. Most medical schools and national medical organizations have Facebook and Twitter accounts, and numerous academic medical centers use Google Glass in the

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Doctor Pugh is a professor and vice chair of education and patient safety in the University of Wisconsin School of Medicine and Public Health's (UWSPH) Department of Surgery, and clinical director of the UW Health Simulation Center; Doctor Golden is the dean of the UWSPH, Robert Turell Professor in Medical Leadership, and vice chancellor for medical affairs, UW-Madison.

operating room and training environments. Many of the currently available technologies have the potential to dramatically change the way educators teach and measure learners' expertise. The big question is: How far is the medical profession ready to go?

Recent research published in the *New England Journal of Medicine* (NEJM) noted that clinicians who use less than 10 Newtons of distributed palpation force during a simulated breast examination were 7 times more likely to miss a 2-centimeter lesion. This research project—which calls upon haptics, or the science of touch—involved the use of silicone breast molds combined with layers of simulated breast tissue, skin, and various masses in different locations. The breast molds incorporated sensor technology to capture data regarding where the clinician was palpating and the amount of palpation force he or she applied during the examination. Researchers tested more than 500 surgeons, OB/GYN physicians and family medicine physicians.

While more work is necessary to understand fully how this data relates to real-life clinical breast examinations, the implications are clear: Advanced technologies are available

to provide detailed performance metrics for hands-on clinical skills.

Doctors go through many years of training to become top-notch professionals, but the intensity of their ongoing training and assessment often subsides after the completion of their residency and fellowship years. In contrast, other types of professionals often use performance data to refine their psychomotor skills on a regular basis throughout their careers.

For example, athletes rely heavily on instant replays, video reviews, and cumulative metrics to improve their performance. In some settings, their personal performance records are public knowledge. This information allows individuals to set personal goals. Athletes know where they stand compared to their peers. Coaches use the information to design training programs to maximize performance. These information resources promote continuous quality and performance improvement at the individual and team levels.

In the medical field, specialty board examinations are the most comprehensive competency assessments that are widely available. We don't have an objective test for "hands-on skills," which would be extremely helpful, especially in procedural areas of practice. It's one thing to get feedback about performance from a faculty member or peer, and another thing altogether to receive a detailed computer

readout. To that end, we envision a time when physicians receive daily computerized feedback about their work that will allow them to improve their proficiency in areas such as palpation, instrument selection, operative time, and blood loss. Further, this type of data could be incorporated into recertification and maintenance of certification processes.

However, this scenario raises many questions. How will the data be used? Are medical professionals ready for this type of feedback?

The Achilles heel of the medical profession is that physician performance data often has been used in a punitive fashion—the opposite of how it's used with professional athletics. Many physicians have an understandable fear that performance data could be used against them, thus creating resistance to the idea of collecting such data and dampening our hopes for its availability as a strategic guide through the stages of mastery en route to performance excellence.

While it's unclear what needs to happen to change physicians' culture and outlook about personal performance data, history suggests that eventually we will adopt the technologies and communication venues of the general public. Then, rather than only asking if a physician is board certified, a patient will want to know his or her doctor's haptics scores. After all, that's what matters in the operating room.

Getting the medical profession to take full advantage of technological tools for assessment and performance improvement will require expanding the use of existing technologies for medical purposes; increasing the number of researchers, designers, and innovators who have a passion for health care; and finding a way to address the delicate legal issues that accompany the use of video review and assessment in health care settings. Meanwhile, sensor technology, simulators, and other forms of high-tech training methods have come a long way. Medical and nursing schools around the United States are embracing the concepts, with many investing in multimillion-dollar training programs and simulation centers that employ state-of-the-art technologies.

The UW Health Simulation Center offers educational opportunities for students, faculty, and

staff from the University of Wisconsin School of Medicine and Public Health (UWSMPH), UW Hospital and Clinics, UW Medical Foundation, and many practitioners throughout the state and region. Capable of conducting interdisciplinary health care scenarios, the center was designed to serve myriad health care fields, from surgery and respiratory therapy to environmental services and nursing. It incorporates best practices, integrates Centers for Disease Control and Prevention protocols, and provides critical feedback.

We have taken steps to make sure the Simulation Center's policies and personnel are sensitive to everybody's fears and concerns.

For those who question whether objective assessments of psychomotor performance are related to clinical outcomes, a well-designed study has addressed that issue. In 2013, a *NEJM* article showed that a simple Likert scale rating of surgeons' operative skills correlated significantly with patient outcomes. Using blinded ratings, surgeons who scored the lowest on psychomotor skills had higher patient readmission and re-operation rates.

Examples of technology in action at the UWSMPH include:

- A US Department of Defense-funded project is using motion-tracking technology to model and understand skills decay among physicians who rarely perform certain procedures or who endure prolonged absences from practice—such as those who become ill or take maternity or paternity leave. Its goal is to understand ways in which military doctors can more smoothly make the transition back into practice after deployment.
- A National Institutes of Health-funded study is examining surgeons' decision-making skills during critical intra-operative moments. For example, as a surgical trainee performs a generic task—such as dissecting a pelvic tumor—sensor technology can capture and measure his or her movements, reaction times and decisions.

We have already embarked on the information age. Data exists, it's meaningful, and it will not go away. In fact, we believe our patients will begin to demand it.



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# Implementing Heart Health Strategies With Point-of-Care and Population Management

Jay A. Gold, MD, JD, MPH; Jody Rothe, RN, DON-CLTC

## *MetaStar connects practices with AHRQ research on cardiac health interventions*

As part of a newly launched 3-state consortium called Healthy Hearts in the Heartland (H3), MetaStar will work with independent primary care practices in southeastern Wisconsin to implement evidence-based strategies to address heart health issues.

In May, H3 was awarded a \$15 million grant from the Agency for Healthcare Research Quality (AHRQ) to support 300 independent clinics and health care centers in Illinois, Indiana, and Wisconsin as they adopt new strategies to improve cardiovascular health in the population. As part of a national set of similar research projects called EvidenceNOW, H3 will identify best practices and investigate the effectiveness of various quality improvement tools and tactics.

H3's approach will build on research that saw marked increases in the use of aspirin

• • •

Doctor Gold is senior vice president and chief medical officer for MetaStar, Inc. Jody Rothe is Quality Manager at MetaStar and serves as MetaStar's program manager for H3. The H3 consortium includes Northwestern University, CHITREC, Purdue University, PurdueREC, Northern Illinois University, IL-HITREC, local and State Departments of Public Health, American Medical Association, Alliance of Chicago, University of Chicago, Telligen and MetaStar.

and lipid-lowering medication in patients whose providers received electronic reminders prior to their visits as well as providers who performed additional outreach targeted to patients not receiving recommended medications. However, such clinical decision support has not consistently improved blood pressure control, and other strategies are needed to address such issues as improving accuracy of blood pressure measurement in the office, home blood pressure monitoring, and use of community pharmacists for medication management.

All of the strategies H3 will use are advocated by the Million Hearts®, a national initiative to prevent 1 million heart attacks and strokes by 2017. The project focuses on strategies feasible for small primary care practices in a fiscal environment that is dominated by volume-based, fee-for-service payments. H3 will examine 2 distinct but complementary approaches to improving quality of care and performance for the "ABCS" group of interventions (Table 1). Specifically, using point-of-care (POC) or population management (PM) strategies that have been shown to be successful for each of the individual ABCS strategies, H3 will coach eligible (Table 2) practices as they:

- *Optimize electronic health record (EHR) clinical decision support functionality.* Studies have shown increases in aspirin prescribing between 25.8% and 54.3%

**Table 1.** ABCS

- Aspirin therapy for those who need it.
- Blood pressure control.
- Cholesterol management.
- Smoking cessation.

**Table 2.** Is your practice eligible for H3 coaching?

The H3 consortium will select independent providers in Southeast Wisconsin, Northeast Illinois, and Northern Indiana (including Indianapolis). Clinics are eligible to participate if they:

- Have ≤ 10 providers.
- Are focused on adult primary care.
- Have a certified electronic health record system.
- Do not currently receive significant quality improvement support.
- Practice in Sheboygan, Washington, Ozaukee, Jefferson, Waukesha, Milwaukee, Walworth, Racine, or Kenosha counties.

through the use of clinical reminders at the point of care.

- *Implement and modify office-based protocols.* Coaching will incorporate practices advocated by the Million Hearts initiative.
- *Engage in community efforts to encourage team-based approaches.* For example, studies have shown that providing care in collaboration with pharmacists has greatly reduced systolic blood pressure in hypertensive patients.
- *Collect and analyze clinical quality measures.* This approach aligns with many pay-for-performance models and helps providers to effectively target patient populations.

If your practice is interested in learning more about this program, please contact us at H3@metastar.com.

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# Innovative Leadership Leading Healthy Work Systems

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**How is your medical practice impacted by your colleagues and the system in which you work?**

**What can you do to influence and lead in a more productive, healthier work environment?**

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**Katherine Sanders** has a BS, MS and PhD in Industrial & Systems Engineering from UW-Madison. She specializes in human factors and sociotechnical systems engineering, essentially the health and productivity of people at work. Her academic work as an occupational stress researcher gave rise to a commitment to design programs to support professionals in high burnout occupations. She's one of a small number of PhD systems engineers focused on occupational health, and has a specific interest in the well-being of healers.

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**Where**

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