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WMJ

volume 114 • no. 6 • december 2015

Money & Medicine

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- essential benefits plans

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- advance care planning
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KEY DATES

Abstract Deadline

January 11, 2016

Authors Notified of Acceptance

February 5, 2016

Innovations in Health Care

April 2, 2016

Wisconsin Medical Society

Annual Meeting

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QUESTIONS?

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COVER THEME Money & Medicine

Since the beginning of Medicare and Medicaid in the mid-1960s, the money in health care has risen continuously with only a few plateaus, and now represents over 17% of the US gross domestic product. A number of articles in this issue of *WMJ* take a closer look at the issue of money in medicine today, from costs of care to the Affordable Care Act and the effect of preventive medicine on health care costs.

Cover design by
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Treating Patients as Customers—Whom Does it Help?

October 2015 marked the third year since 30% of the Medicare/Medicaid withhold was based on “customer satisfaction.” To get the money back, hospitals must get a near perfect score based on patient surveys of the patient’s experience, including things like ambiance, timeliness of response to their demands (I mean needs) and the people who came in contact with them, including nurses and physicians. But does treating patients as “consumers” to be “satisfied” make a difference? And what do those scores mean?

Now, in the spirit of transparency, I must admit I never got that perfect score. And for those patients who complain, I do try to see if their complaints are valid (eg, I spend too much time looking at my computer instead of the patient). But then again, what am I to make of a report when only 11 reply out of almost 900 patients I

have seen over a 3-month period?

According to studies, the most satisfied patients are the ones that cost the most. They spend more on drugs. They also are more likely to die.¹ Among vulnerable adults, they have received better communication, but that did not correspond to the technical quality of their care.²

It could be hoped that more satisfied patients are more compliant patients. But that is not the case, either. Instead, adherence is more related to patient demographics.³ And, let’s face it, patients don’t always like what we have to tell them—that antibiotics don’t work for viral infections, that they are obese, shouldn’t smoke cigarettes, or should try other ways of relieving pain instead of taking narcotics—and keep telling them every time they come in. Sometimes we have to break the news that they or a loved one are going to die.

But patients are not customers. After all, when is the last time you saw a fast food restaurant refuse to serve an obese patient a double quarter-pound burger with bacon and cheese, large order of fries and 32-ounce soda on the grounds that it isn’t good for his or her health? Or

a convenience store operator tell a smoker when he or she tries to buy a carton of cigarettes to stop smoking instead?

Yes, we all know or have known doctors who are jerks, whose people skills would benefit from a little smoothing around the edges. Everyone deserves to be treated with respect. But ultimately, what is most important is patient outcomes. Did we do what was best for the patient? That is not necessarily what the patient thinks is best.

Cynthia Jones-Nosacek, MD, Milwaukee, Wisconsin

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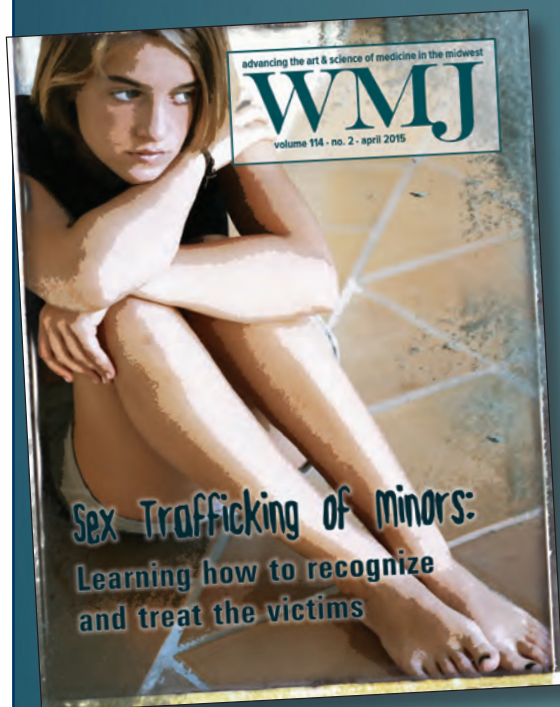
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Published six times a year, *WMJ* is a peer-reviewed, indexed scientific journal available via printed subscription and in full text online at www.wmjonline.org and PubMed through the National Library of Medicine.

WMJ invites original research, case reports, review articles, essays and “health innovations”—short reports that showcase the results of initiatives being tested to improve quality, patient safety and satisfaction, cost efficiency and more in clinics and communities throughout the Midwest.

WMJ also seeks health care professionals who can be objective and insightful to add to our list of highly qualified reviewers.

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This Business of Medicine

Editor's Note: The following editorial originally was published in WMJ, Volume 34, No. 12, p.922, December 1935.

We occasionally hear it said that physicians as a class are notoriously poor business men. Authorities in the field of credit will tell us that physicians fall far below any other group in the collection of accounts. Journals that devote themselves to the field of medical economics urge us to emulate the physician who has adopted the methods of a commercial world. Propagandists for compulsory sickness insurance point to the number of physicians whose income lies under certain levels asserting that the adoption of a socialized medicine would fix all that.

Sometime during this month of December most of us find time to make an audit of our worldly goods. And most of us, like those in every walk of life, shake our heads a bit over the results and mentally make a note that we must do better than that if we hope to retire on a sufficiency when the retirement day comes.

In connection with our audits this year we would like to suggest, however, a new column or two. We must have an income sufficient to support our families and to enable us to keep up-to-date in medicine. That is true. By and large, we physicians do reasonably well in this respect. All of us would like to see each year something saved towards retirement. None of us do as well as we would wish in this respect and a certain amount of discontent with our margin between income and expense of immediate needs is healthy thing. It is the spur to further achievements.

But let us not count all our life work in terms of income tax reports. They may say we are poor in business but there are few indeed who say we are poor in scientific learning and the ability to apply our knowledge.

It may be said that we are not very good collectors. But on the other hand neither do we urge our patient to pay eighteen per cent and more to secure money with which to pay us cash on delivery.

We have not adopted the commercial outlook. No, we do not exist on the advertising of non-accepted drugs. We do not patent our discoveries for revenue. We do not wait with our improvements for an annual show

but adopt them as fast as they are proven good. We do not advertise our abilities for many as our recoveries may be, they are never as many as we would like. We have not adopted mass production methods because the ills of man are peculiarly his own and susceptible to no mimeographed methods of procedure—no belt-line methods of readjustment.

Finally, it is said that our incomes are low. If by that it is meant to suggest that we earn more than we collect, most certainly we will agree. If by that statement it is meant to suggest that by and large our efforts bring us incomes that are lower than men in comparable walks of life, those who make the statement know not whereof they speak.

And when we physicians make our audits this year let us not forget our accomplishments that are other than financial. That shattered limb that promises to give such a fine functional result; that problem in family maladjustment that has been solved; that child that was saved and that mother who, thanks to our acquired and inherited knowledge, did not die but lives to care for her family. We may be accused of sentimentalism but are not these the true standards of our value in the world? Not in a business world perhaps, but surely in ours.

Our wills, collectively speaking, may produce no relatives quarreling in court as to our mental capacities. But that is hardly a sign of achievement. We entered upon the profession of medicine because we wanted to alleviate human suffering and pain. In our calculations this month let us judge ourselves on that basis too. Of course we did not accomplish all we wanted to accomplish. But are we not proud of that which we did accomplish? And is that look of anxiety of the family replaced by the smile of confidence not a compensation? Of course it is! It is the richest compensation that exists. Let us never forget it and particularly in these trying times.

The name of the humblest among us will one day be enshrined in the hearts of many—for what he gave.



Thank You to Our Reviewers

The *WMJ* would like to thank everyone who served as manuscript reviewers in 2015. Manuscript review is an important collegial act and is essential to the integrity of *WMJ*. We are grateful for the assistance of these individuals in ensuring authors receive objective and insightful feedback on their work.

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Rustproofing People: Beans or Beef?

Darold A. Treffert, MD

I don't see many ads anymore for "rustproofing" your car. Perhaps that occurs automatically on the assembly line now.

But that's the term I use—"rustproofing people"—to describe preventative steps we might take to keep ourselves looking better and lasting longer. I prefer it to "wellness."

There is an emphasis on prevention these days, and that's a good thing. But a caution. To be overly concerned at a fad or fetish level with health, germs, dirt, cholesterol, cardiac output, resting pulse, high- and low-density lipids, plaques arterial or dental, teeth whiteness, or running when walking would do has its hazards too.

It can create a sanitary, sterile, prophylactic, almost Spartan lifestyle devoid of all spontaneity and joy or any risk at all.

So my plea is for simple, common sense moderation in both directions.

It is difficult to know exactly what "healthy" is because the rules keep changing. One week caffeine is bad for you, the next week it is good for you. One month dark chocolate clogs arteries, the next month it clears arteries. Remember the cranberry scare? And the supermarkets are 75% gluten free when less

• • •

Doctor Treffert, a psychiatrist, is a member of the WMJ Editorial Board and a recognized authority on savant syndrome. E-mail: daroldt@charter.net.

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than 1% of the population has celiac disease. What are they going to do with all that food when next month's one-minute medical report on the evening news says gluten is good for you and without it you will be gluten deficient?

The morbid obsession of eating nothing but "healthy food" has become more common and even has a name—orthorexia nervosa—with dangerous consequences. Diets proliferate. There is one now called the Paleolithic diet (Paleo for short). It suggests we eat as our long-distant primitive ancestors did. One problem though. As I recall, our ancestors didn't live that long. Life expectancy at the turn of this century was 45 years.

What I favor is moderation in both directions, between beans and beef, stress and distress, fun and fatigue, seriousness and silliness, wearing boots and going barefoot, living and making a living. Watching our collective risks must never replace, in its entirety, watching sunsets (maybe even sometimes without a hat or sun screen).

Without being reckless, taking some risks can add a bit of spice to life.

My mother was in a nursing home for the last several years of her 99¾-year life span. One day the local Harley motorcycle group offered a ride to any resident who wanted to take one. My mom was first in line. One of the fellows drove up with a sidecar. "Sidecar, heck," Mom said, "I want to ride on the back of a Harley." Another fellow obliged. "Where to, Grandma?" he asked. "Anywhere we can get a Manhattan," came the quick reply.

Imagine that. Both the nursing home and

my mom taking that risk. It is a highlight of her life story she told everyone and it has provided a precious memory for all of us.

It reminds me of the "If I had my life to live over again" piece in which the person says she would "start barefooted earlier in the spring, and stay that way later in the fall. I would go to more dances. I would ride merry-go-rounds. I'd pick more daisies."

As for me, if I had it to do over again I would take flying lessons and also buy a boat. I would actually use a sick day rather than always showing up. I would take more family vacations and attend fewer professional conventions. I'd sit by the waterfall more and at my computer less. In reality, though, I would change very little. It's been a wonderful trip especially because of the people I have been privileged to live with and love.

So my advice for rustproofing ourselves is to balance reasonable concerns and interventions regarding symptoms and disease with sensible prevention efforts based on proven results and reliable data rather than rumor, hearsay, slogans, the evening news, or advertising lest we substitute new wives' tales for old wives' tales. Pick a good, conservative doctor. Eat wisely but tastefully with portion control. Fasten your seatbelts. Stay active physically (sometimes the yard is as good as the gym) and stay active mentally (maybe crosswords rather than the tube).

That way one can combine a mellow—"relaxed, at ease, and pleasantly convivial"—lifestyle with a healthy one and enjoy some beans, some beef, and many sunsets.

Money

John J. Frey III, MD, Medical Editor

“Money makes the world go around.”

—from “Cabaret” by Kander and Ebb

The amount of money in medicine has exploded since the beginning of Medicare and Medicaid in the mid 1960s. With only a few plateaus during the HMO years, the money in health care has risen continuously and now represents over 17% of the US gross domestic product (GDP), putting us in the same league as Tavalu (population 9600) and the Marshall Islands (population 52,000) and greater than 50% higher than most developed countries.¹ Of course the US GDP is over \$16 trillion, while Tuvalu is \$39 million. The staggering amount of money in health care is the greatest obstacle to substantive reform—some current “winners” will have to lose and that is enough to make those with money and power mobilize their opposition, even to something as obvious as an unsustainable growth in costs. What also should be obvious is that—in the era of health reform—what is seen as revenue will certainly be reframed as costs. Clinicians are already being asked on one hand to increase “production,” while on the other hand to cut costs. If that seems like an impossible task, it is.

Physicians historically have had comfortable incomes but as income disparity has grown in the US, unlike many of our patients, the average physician income has risen consistently since the 1960s. Currently, physician salaries average in the top 5% of US incomes, with the procedural disciplines averaging close to the top 1%.^{2,3} I spent some time in November at the Center for the History of Family Medicine looking through physician daily log books, and as recently as the 1950s, GPs were charging \$2 to \$3 for an office visit, and a day’s worth of seeing patients would generate about \$90 in charges. That was an era

when physicians were solidly middle class—when there was a middle class—and expectations were to live comfortably, but not extravagantly.

While physician income is a relatively small part of a very big business, what physicians do and how they do it is the significant driver for everything else in the world of medicine, from hospital charges to Pharma to the technology industry. The education of physicians has very little in it that makes us aware of our responsibility for the costs of health care in the United States. I had an insight into this at a retirement seminar for physicians I attended some years ago, where I thought that I could disguise my ignorance in a roomful of physicians and came to find out that almost none of us knew even how or when to sign up for Medicare, much less what it covered, even though we had been billing Medicare for most of our lives.

Every fall will see discussions in the press about both the complexities of choosing health insurance and the new cost equations imbedded in various plans, which often include copays, deductibles, and varying charges depending on where and from whom patients get their care. But reading the instructions and guidelines in the thick book of health plans I receive every year invokes for me the clarity of the “no parking” sign I remember from my *Mad Magazine* days 60 years ago, which read “No Parking Mondays, Wednesdays, and Fridays, except on other days.” While the Affordable Care Act may have expanded the number of covered lives in the United States and helped millions avoid catastrophic costs and destitution from unanticipated illness, nothing is ever easy, particularly where issues of money are at stake. All this is to say

that—as Sally Bowles did in *Cabaret*—money does, indeed, make the world go around; and the more money there is, the more the potential for mischief and corruption. The Centers for Medicare and Medicaid Services had to create a Center for Program Integrity to deal with billions of dollars of fraud and abuse in public health care funding.⁴ That certainly was not necessary when physicians were charging \$3 for an office visit and hospitals were \$40 per day.

Hospital Costs and Medical Education

This issue of *WMJ* contains a number of articles about money. Hsu and Brazelton describe the costs of care in pediatric intensive care units and found that medical patients had longer lengths of stay, higher severity, and higher costs compared to surgical patients, but that surgical patients had a higher cost per day.⁵ At some level this is intuitive, but finding and presenting these data was challenging for the authors. Hospitals made it hard to describe actual costs broken down by categories, so any effort by clinicians to trim costs would be hard to manage. Imagine trying to manage your monthly budget without any data on how you spend your money. This is often the state of US hospital “budgets” and leaves clinicians confused even if they wanted to control costs.⁶

An encouraging article by Meurer and colleagues describes the opinions and understanding of medical students in Wisconsin about the Affordable Care Act and its role in their future careers.⁷ Students expressed optimism that the ACA is benefitting their communities, but the majority also expressed the need to amend the Act over time. They had personal experiences that made them support the need for affordable universal coverage, and 85% of students expressed their belief that physicians are responsible for helping decrease costs. The problem,

of course, is that students are not taught much about costs, perhaps because their teachers don't know much about costs, and the figures they see are global, large scale, and don't trans-

aging and wobbly boomer generation, is a well-described and crucial component to both preserving quality of life and avoiding unnecessary costs. Falls are so often the precipitating factor

to be creative about addressing negative trends. But trends should be about directionality, as the authors point out, not overall grades.

Finally, we are republishing two pieces that seem especially pertinent as 2015 comes to a close, and many of us take time to reflect. The first is an essay by Darold Treffert, MD, a member of our editorial board and an internationally known scientist, and—as importantly—a wise essayist who, in the spirit of the Oracle of Delphi, suggests all things in moderation as an approach to “rustproofing” our lives.¹³ The second is another interesting editorial originally published in *WMJ* 1935 that relates very much to the economics of health care today.¹⁴

The staggering amount of money in health care is the greatest obstacle to substantive reform—some current “winners” will have to lose and that is enough to make those with money and power mobilize their opposition, even to something as obvious as an unsustainable growth in costs.

late easily to day-to-day care. The authors give suggestions about bringing the costs of care into medical student curriculum at all levels but, again, lack of specifics will stymie efforts to show where individual action can make a difference. Just as patient health literacy is a crucial component for achieving clinical outcomes, financial literacy on the part of clinicians is essential for managing the cost component of the Triple Aim.

Prevention and the Cost of Care

Turning to the upstream factors contributing to health care costs, Knox and Remington compress smoking-attributable diseases into a single measure that can be applied to counties and regions to calculate the burden from smoking, the factors that are involved in that burden, and how county-level health policies might have an effect on decreasing costs to individuals and communities.⁸ The value of a single measure is that it can be used as an overall measure of improving health outcomes with a focus on the single most important health behavior—smoking—that affects morbidity and mortality. The review article on Hepatitis C by Schrager and colleagues raises a cost issue that has gotten a tremendous amount of attention lately with the approval of new direct antiviral agents that offer high cure rates at very high costs.⁹ The costs of prevention, in this case, are very low if one looks at behaviors that create risk for Hepatitis C, while the costs of treatment carries the risk of a financial burden that would break the backs of many insurance programs.

Preventing falls, particularly as we look at an

in what Stein and Mold called the “clinical cascade”¹⁰ that adds cost and suffering to a patient's life that anything that can be done to decrease their incidence is worth the effort. But the study by Deprey and colleagues in this issue shows that the rate of fatal falls, which was high initially in a rapidly aging Wisconsin county, has only fallen slowly and remains a challenge despite community efforts to improve outcomes.¹¹ Some things are very hard to budge.

Health trends are always interesting in what they say about changes over time—and in the case of Timberlake and colleagues,¹² what they say about the “what” of the Wisconsin state of health. Building on the very successful example of the country report cards, developed by the Population Health Institute at the University of Wisconsin-Madison and now an important contributor to national policy through the Robert Wood Johnson Foundation, the state health trends report synthesizes a number of contributors that focus on behaviors—like smoking—and outcomes, such as cancer and greater-than-expected death rates, to help citizens understand the policy issues about health that they face in the coming years. Unfortunately, as the old saying goes, “Success has many parents, while failure is an orphan,” and scorecards don't explain the “why” behind the “what,” leaving us to speculate about the reasons behind positive and negative trends in very complex systems. Using state health trends will require counties and municipalities to look at where need is the greatest but often resources are the worst, leaving counties

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A Comparison of Costs Between Medical and Surgical Patients in an Academic Pediatric Intensive Care Unit

Benson S. Hsu, MD, MBA; Thomas B. Brazelton III, MD, MPH

ABSTRACT

Objective: To estimate the impact of patient type on costs incurred during a pediatric intensive care unit (PICU) hospitalization.

Patients and Methods: Retrospective cohort study at an academic PICU located in the United States that examined 850 patients admitted to the PICU from January 1 to December 31, 2009. Forty-eight patients were excluded due to lack of financial data. Primary service was defined by the attending physician of record. Outcome measures were total and daily pediatric intensive care costs (2009 US dollars).

Results: Of 802 patients in the sample, there were 361 medical and 441 surgical patients. Comparing medical to surgical patients, severity of illness as defined by Pediatric Risk of Mortality (PRISM) III scores was 4.53 vs 2.08 ($P < 0.001$), length of stay was 7.37 vs 5.00 days ($P < 0.001$), total pediatric intensive care hospital costs were \$34,786 vs \$30,598 ($P < 0.001$), and mean daily pediatric intensive care hospital costs were \$3985 vs \$6616 ($P < 0.001$).

Conclusions: Medical patients had higher severity of illness and length of stay resulting in higher total pediatric intensive care costs when compared to surgical patients. Interestingly, when accounting the length of stay, surgical patients had higher daily pediatric intensive care costs despite lower severity of illness.

INTRODUCTION

Per capita national health expenditure in the United States has grown at an annual rate of 4.5% from 1965 to 2010, with total health care expenditure reaching \$2.7 trillion in 2011 or 17.9% of gross domestic product.^{1,2} In 2005, over 13% of hospital costs within the United States were attributed to critical care medicine.³ Given the high proportion of the rapidly growing US health care expenditure attributed to critical illness, understanding the impact of patient type on resource utilization and costs within the pediatric intensive care setting may have policy implications

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in the current climate of cost control.

Preliminary studies have shown that health care costs and resource utilization vary based on the types of patients.⁴ However, a thorough exploration of existing literature regarding hospital costs segmented by patient type revealed a gap in the research. Specifically, there have been no studies examining the difference between medical vs surgical patients within the pediatric intensive care setting. Our study aimed to address this gap.

METHODS

Population

The study site was a 21-bed university-based closed pediatric intensive care unit (PICU) within a 61-bed children's hospital attached to a 500-bed adult hospital in the Midwest. Data was collected on all patients admitted to the PICU (including direct admissions, transfers, and postoperative admissions) between January 1, 2009 and December 31, 2009. Patients admitted before January 1, 2009 but hospitalized past January 1, 2009 were excluded. Patients admitted before December 31, 2009 but hospitalized past December 31, 2009 were included. A critical care team consisting of a pediatric critical care attending physician, pediatric critical care fellows, pediatric residents, nurses, respiratory therapists, and pharmacy staff cared for all patients. A subset of patients also received care from consultants across various pediatric medical and surgical specialties. Patients can be admitted under a surgical attending physician if the reason for admission was surgical in nature. Approval was obtained from the University of Wisconsin Institutional Review Board prior to data collection.

Exclusions

The study panel was cross-referenced with the financial database from hospital decision support. Forty-eight patients with incomplete financial data were excluded. The data set was unclear as

to why financial data were unavailable. One possibility was that those excluded represent patients who were physically in the PICU but not cared for by the pediatric intensive care team. No other exclusion criteria were applied.

Clinical and Demographic Data

A pediatric critical care division administrator collected patient data daily for all patients in the PICU. Data specific to our study included the age of the patient on admission to the PICU, gender, length of stay within the PICU (based on date of admission to the intensive care unit and date of transfer or discharge from the intensive care unit), discharge disposition (survival with discharge from hospital, transfer from the PICU, or death), admission service to the PICU (medical vs surgical based on primary attending physician of record), and Pediatric Risk of Mortality (PRISM) III score captured 24 hours after admission to the PICU.

PRISM III scoring is a validated mortality risk score based on physiologic status.^{5,6} PRISM III scores were captured within the first 24 hours of admission and used physiologic and laboratory factors in predicting mortality. This scoring system has been used nationally and internationally for both quality and cost research.⁷⁻⁹

Financial Data

Patient-level data were obtained from the hospital decision support system that identified costs during the PICU hospitalization. PICU hospitalization was defined as having a pediatric critical care provider as part of the care team. Thus, patients under intermediate care status with pediatric critical care physician involvement were included in the study. In comparison, costs incurred during the hospitalization not specific to the PICU were excluded. For instance, supplies used during the intensive care stay were included, whereas similar supplies used during the hospitalization on the pediatric ward were excluded.

Costs were compiled as a combination of direct and indirect costs. Direct costs were those related to direct patient care, such as medications and central line kits. Indirect costs were those used to support patient care not specific to direct patient care, such as building maintenance and administrative costs.

Statistical Analysis

Medical vs surgical patient types were identified based on primary attending physician of record. Descriptive statistics of mean and 95% confidence intervals were determined for age, gender, mortality, length of stay, PRISM III scores, and hospital costs. All costs were in 2009 US dollars. Mean values were used for determination of statistical significance. Due to the nonparametric characteristic of the dependent variables, Mann-Whitney tests were used to identify *P*-value for interval variables. Similarly, chi-square tests were used to identify

Table 1. Included Patients vs Excluded Patients

	Included	Excluded	<i>P</i> -value
No. of Patients	802	48	
PRISM III Score (95% CI)	3.18 (2.82-3.54)	0.94 (0.45-1.42)	<0.001
Age, years (95% CI)	8.02 (7.58-8.46)	8.22 (6.46-9.98)	0.70
Gender, % female (95% CI)	47.4% (43.9%-50.8%)	47.9% (33.3%-62.6%)	0.94
Length of stay, days (95% CI)	6.06 (5.31-6.81)	1.50 (1.23-1.77)	<0.001
Mortality, % (95% CI)	1.9% (0.9%-2.8%)	0.0% (0.0%-0.0%)	<0.001
Primary service medical, % (95% CI)	45.01% (41.56%-48.46%)	60.42% (46.07%-74.77%)	0.04

Abbreviation: PRISM, pediatric risk of mortality; CI, confidence interval

P-values for categorical variables. Statistical significance was set at *P*<0.05. Statistical analyses were conducted using STATA/IC 12.1 (StataCorp LP, College Station, Texas).

RESULTS

Our study population included a total of 850 patients with 802 (94.4%) patients included in the study and 48 (5.6%) patients excluded due to having incomplete financial data (Table 1). Excluded population was similar in age (8.22 to 8.02 years, *P*=0.70) and gender (47.9%, vs 47.4% females, *P*=0.94) when compared to the included population. However, length of stay (1.50 vs 6.06 days, *P*<0.001), mortality (0.0% vs 1.9% *P*<0.001), and severity score (PRISM III Score of 0.94 vs 3.18, *P*<0.001) were all lower in the excluded population. Patients with incomplete critical care financial data may represent those who were physically in the PICU, but not cared for by the pediatric intensive care team, and therefore they did not incur critical care costs.

Three hundred sixty-one (45%) patients were identified as primarily medical and 441 (55%) patients were identified as primarily surgical (Table 2). Mean age for medical vs surgical patients was 7.21 vs 8.69 years of age (*P*<0.001). Mean distribution for gender for medical vs surgical patients was 49% vs 46% female (*P*=0.21). In examining severity of illness using PRISM III scores, we found medical patients with higher mean severities on admission vs surgical patients (4.53 vs 2.08, *P*<0.001) with mortality rates higher in medical patients but statistically comparable (2.5% vs 1.4%, *P*=0.27). Mean length of stay was higher in medical vs surgical patients (7.37 vs 5.00, *P*<0.001). Total hospital costs for the pediatric intensive care portion were higher in medical patients (\$34,786 vs \$30,598, *P*<0.001). In comparison, daily hospital costs for the pediatric

Table 2. Demographics and Resource Utilization Comparing Medical vs Surgical Inpatients

	All Patients	Medical Patients	Surgical Patients	P-value
No. of Patients	802	361	441	
Age, years (Mean, 95% CI)	8.02 (7.58-8.46)	7.21 (6.55-7.86)	8.69 (8.10-9.27)	< 0.001
Gender, % female (Mean, 95% CI)	47.4% (43.9%-50.8%)	49.0% (43.8%-54.2%)	46.0% (41.4%-50.7%)	0.21
Length of stay, days (Mean, 95% CI)	6.06 (5.31-6.81)	7.37 (5.93-8.81)	5.00 (4.33-5.66)	0.05
PRISM III Score (Mean, 95% CI)	3.18 (2.82-3.54)	4.53 (3.92-5.14)	2.08 (1.68-2.49)	< 0.001
Mortality, % (Mean, 95% CI)	1.9% (0.9%-2.8%)	2.5% (0.9%-4.1%)	1.4% (0.3%-2.4%)	0.27
Total PICU costs, 2009 (Mean, 95% CI)	\$32,483 (\$28,006-\$36,961)	\$34,786 (\$26,701-\$42,872)	\$30,598 (\$25,803-\$35,366)	< 0.001
Daily PICU costs, 2009 (Mean, 95% CI)	\$5432 (\$5122-\$5741)	\$3985 (\$3663-\$4307)	\$6616 (\$6146-\$7087)	< 0.001

Abbreviation: PRISM, Pediatric risk of mortality; PICU, pediatric intensive care unit; CI, confidence interval

intensive care portion were lower in medical patients (\$3985 vs \$6616, $P < 0.001$) (Table 2).

DISCUSSION

We assessed the differences in costs during the pediatric intensive care portion of hospitalization for medical and surgical patients. We discovered that medical patients had longer average lengths of stay by greater than 2 days. These longer lengths of stay were associated with an expected higher PRISM III score.¹⁰ Interestingly, we found that medical patients had 12% higher total costs (\$34,786 to \$30,598, $P < 0.001$) but 66% lower mean daily costs during their PICU hospitalization (\$3985 vs \$6616, $P < 0.001$).

These findings suggest 2 possible conclusions. First, higher total costs of care for medical patients as compared to surgical patients can be attributed to the impact of length of stay as opposed to severity of illness. Second, when holding length of stay constant, the lower severity surgical patients may have consumed more costs per day (based on averages of daily costs) as compared to the higher severity medical patients. However, this data set was only able to describe costs and unable to characterize the specific resource use. In other words, costs are related to the values assigned to the equipment and individuals and not necessarily the amount of resource utilized. A surgical tool may be used in patients with low severity of illness, but be assigned a high cost due to the price of the equipment as compared to a low cost central line kit used on a more severe medical patient. This level of distinction was unclear through our database.

Our extensive literature review revealed no prior studies characterizing the difference in costs between medical vs surgical

patients in pediatric intensive care units. Moreover, there were no studies examining this topic within an academic pediatric intensive care unit setting. Thus, our study took the first step to fill this gap in the literature.

We contend that understanding the difference in costs of care based on patients' service types can help policy-makers and health care providers allocate the limited health care dollars more efficiently given a certain patient mix. This added efficiency might help address the rising health care spending within the United States.

Moreover, the length of stay findings of this study, when combined with understanding of a hospital's patient mix, may help a hospital to define the resource need to care for that population. Although spe-

cific resource use was not characterized by this data set, varying lengths of stay can indicate differences in use of resources such as nursing and rooming. Thus, this study may have supply chain and operational efficiency impacts. If more surgical patients are seen at a hospital, then adjustments can be made to inventory in order to respond to high turnover, short-term consumption of resources.

Future studies may expand on these findings by specifically characterizing health care resource use. Possibility comparisons can be made in examining full-time employee (FTE) time required for patient care, whether it be physicians, nurses, or therapists. Moreover, distinct resource comparisons, such as medications and equipment, also can be made. Given existing health care financial and resource constraints, insights to our consumption can have significant policy impacts.

There are several limitations of the study, including being a single institution study, lack of assessment of other clinical variables, and the use of an administrative data set. Moreover, this study uses the raw PRISM III score for severity of illness. Although this score has been validated for the pediatric intensive care population, the authors know of no study validating the scale specific to surgical vs medical patients. Thus, the scale may not be applicable when comparing the 2 types of patient populations.

CONCLUSION

Understanding the varying levels of costs by service can have policy implications by clarifying health care spending patterns. We found that for those admitted to the PICU, medical patients differed from surgical patients in the severity of illness, length of

stay, and cost of care. This study was an initial step in exploring the effect of patient mix on the potential to improve efficiency in health care finances. Future steps may include identifying specific use of resources to assess the relationship between service type and resource utilization.

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A Novel Approach for Measuring and Communicating State Health Trends Over Time

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ABSTRACT

Objective: To develop a method to assess long-term and recent progress for leading health indicators in Wisconsin.

Methods: Data from state and national sources were compiled. Baseline (10-year) trends for 20 health indicators were measured and compared to the Healthy People 2020 improvement standard of 1% per year. Additionally, current rates were assessed by comparing the most recent year of data to the expected rate had the previous 10-year baseline trend continued. Where available, health indicator trends were reported by gender, race/ethnicity, geography, and socioeconomic status.

Results: Wisconsin improved on 10 of the 20 indicators over the past decade, with decreasing mortality rates for all age groups. The largest improvement was a decline of 3.0% per year in deaths among 1 to 24 year olds. The rates of teen births and adult excessive drinking also improved by 2.5% per year and 1.4% per year, respectively. Other indicators worsened. For example, increasing rates of low birthweight (+0.6% per year), adults in fair or poor health (+1.6% per year), and all socioeconomic indicators worsened (high school dropouts [+0.9% per year], unemployment [+5.9% per year], children in poverty [+5.1% per year], and violent crime [+2.3% per year]). Health indicators varied substantially across subgroups within Wisconsin. For example, African Americans were twice as likely to experience low birthweight compared to other racial subgroups, and males experienced death rates higher than females across all ages.

Conclusion: Reporting current estimates and 10-year trends of leading health indicators helps identify areas of progress and opportunities for improvement. Despite progress in reducing death rates and several other health factors, self-reported health status is worsening in Wisconsin. Worsening socioeconomic conditions and health disparities represent significant public health challenges for Wisconsin's future.

BACKGROUND

The development of a national agenda for health improvement began with the 1979 Surgeon General's Report on Health Promotion and Disease Prevention.¹ This agenda was expanded

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by the work of Healthy People 2020 (HP2020). HP2020 is a national initiative to promote longer and healthier lives for all Americans through encouraging collaboration across community sectors, empowerment of individuals, and preventive activities.² In 2010, health achievement objectives for the nation to reach by 2020 were established for numerous health indicators. Although HP2020 will provide an assessment of whether or not the goal was achieved, there is no current national effort to measure annual change or to understand whether current health interventions are resulting in sufficient improvements to meet the goals. Following HP2020, the Wisconsin State Health Plan for 2020 established a goal for everyone to live longer and healthier lives.³ Measuring progress annually and identifying trends can indicate whether or not these goals are likely to be achieved.

Current research is heavily focused on analyzing trends in morbidity and mortality rates.⁴ In addition, nationally, "America's Health Rankings" tracks yearly

changes in health measures with significant changes reported at the $P < 0.05$ level.⁵ States reporting on trends (eg, Connecticut, New Hampshire, Oklahoma, and Utah) use general assessments such as those from America's Health Rankings or focus on reporting specific health outcome data, but do not delve into other measures or describe how these measures differ over time or by subgroup.⁶⁻⁹

One method used to measure cancer trends over time was developed by the Surveillance, Epidemiology, and End Results Program of the National Cancer Institute and has been applied heavily across different subpopulations and cancer types.¹⁰ This method may be used to quantify changes in other health measures over time.

In addition to measuring trends over time, it is important to examine disparities across population subgroups. For example, the Center on Social Disparities in Health compares rate ratios and differences between subgroups to the most advantaged stratum to identify areas of inequality.¹¹ Other methods identified include ratios (by groups or percentiles), correlations and regressions, Gini-like coefficients, population attributable risk, and dissimilarity indices to detect disparities across subgroups.⁴

Building on these efforts, the University of Wisconsin Population Health Institute has developed an approach to measure and assess trends in leading health indicators. This analysis is designed to help researchers and policy makers understand the state's progress in its goal of everyone living, longer healthier lives and where to focus efforts in order to increase the improvement rate of specific health indicators. Results of this analysis have been reported annually since 2011 in a brief, user-friendly non-technical report known as the *Wisconsin Health Trends: Progress Report*.¹² The report assesses progress on 20 health indicators by looking at trends over the past 10 years and comparing data for the current year to those trends. The report is accompanied by additional material available online that assesses the health indicators by subgroup and highlights areas where adequate health for all has not been achieved.¹³

This paper provides more background on the data and methods provided in the report and online, as well as a discussion of the results and implications for Wisconsin. Specifically, it describes how we measured 10-year trends for several health indicators in Wisconsin and performed 2 assessments for 20 health indicators: (1) an assessment of the health indicator's trend over the past 10 years, and (2) an assessment of the most current year of data compared to where it would be expected to be if the previous 10-year trend line had continued through the current year. In addition, trends were broken into subgroups to identify disparities in trends over time.

METHODS

Data

Using the County Health Rankings model of population health, relevant health indicators were identified to be evaluated against the HP2020 goal of a 1% per year improvement rate.¹⁴ Of these, health indicators with at least 11 years of consecutive Wisconsin data were used. A complete list of the data sources and years used are included in the report.^{15(p13)}

Assessment

More descriptive assessment methods can be found in the report itself.¹⁵ Briefly, 10-year trends were measured and the most currently available data were compared to these trends. To assess the magnitude of the 10-year trend, a linear regression line was used to calculate the annual percentage change for each indicator.¹⁰ An increase in the annual percentage change indicated a

worsening health trend, while a decrease indicated improvement. Assessments of the 10-year baseline trend were ascribed based on the magnitude of the annual percent change for each indicator.

Using the 10-year baseline trends, the expected current rate for each indicator was determined. The current observed rate was compared with the expected rate. Current progress was determined by calculating the percent difference between the observed and expected rates. Statistical significance at $P < 0.10$ indicated that a value was "much better" or "much worse" than expected. This value of 0.10 was chosen to provide substantial statistical validity and also variation in assessment among measures.

The same methodology for reporting the annual percent change was repeated for the subgroups of gender, race/ethnicity, geography, and socioeconomic status where the data was available to visually communicate trends by subgroup over time, highlighting important health disparities. These data were from the same sources used in the entire Wisconsin health indicator analysis. Due to small sample sizes, a baseline trend was calculated, but an assessment of this trend line was not provided due to high variability and, thus, lack of statistical significance.

RESULTS

Baseline Trends

The 10-year baseline trend, current observed value, current expected value, and percent difference value for each indicator, along with their assessments, are provided in Table 1. Wisconsin is experiencing improving trends on 10 of 20 health indicators. For health outcomes, death rates are improving for every age group indicating positive trends. However, worsening trends are evident among self-reported health and low birthweight. For health factors, Wisconsin is experiencing improving trends on 3 of 5 health behavior indicators, 1 of 2 clinical care indicators, zero of 4 social and economic factors, and there is no observed change on the physical environment indicator.

Eight of the indicators received a "much better" rating, showing sustained improvement at a rate greater than 1% per year. These indicators are all ages death rate, premature death rate, 1- to 24-year-old death rate, 65+ year-old death rate, smoking, excessive drinking, teen birth rate, and no health insurance (0-17). Seven of the indicators received a "much worse" rating, with rates of self-reported fair or poor health, obesity, chlamydia incidence, adults (18-64) without health insurance, unemployment, children in poverty and violent crime increasing at a rate greater than 1% per year (Table 1).

The largest improvement was among the percentage of children without health insurance, decreasing at a rate of -3.6% per year. The teen birth rate and adult smoking percentage also experienced substantial improvements, both decreasing at a rate of -2.5% per year (Table 1). The indicator worsening the fastest was unemployment rates at an average rate of +5.9% per year. The percentage of children in poverty, and obesity among adults

Table 1. Health Progress Assessment Table From 2014 Progress Report^{15(p5)}

Measure	Current Observed Rate	Expected	Percent Difference	Current Progress	Baseline Trend (% change/year)	10-Year Trend Progress
Health Outcomes						
Premature death rate (YPLL-75 per 100,000)	5714	5548	+3.0	●	-1.2	↓
Low birthweight (%)	7.2	7.1	+0.8	○	+0.6	↑
Self-reported poor or fair health (%) ^a	14.0				+1.6	↑
All ages death rate (per 100,000)	707	692	+2.1	●	-1.1	↓
Infant death rate (per 1,000)	5.7	6.1	-7.2	○	-0.9	↓
1- to 24-year-old death rate (per 100,000)	33.5	31.5	+6.4	○	-3.0	↓
25- to 64-year-old death rate (per 100,000)	283	273	+3.4	●	-0.7	↓
65+ year-old death rate (per 100,000)	4274	4205	+1.6	●	-1.1	↓
Health Factors						
Health Behaviors						
Smoking (%) ^a	20.4				-2.5	↓
Obesity (%) ^a	29.7				+3.1	↑
Excessive drinking (%) ^a	22.8				-1.4	↓
Teen birth rate (per 1,000)	22.1	25.9	-14.7	●	-2.5	↓
Chlamydia incidence rate (per 100,000)	433	405	+6.9	●	+2.8	↑
Clinical Care						
No health insurance (0-17) ^a (%)	7.0				-3.6	↓
No health insurance (18-64) ^a (%)	14.6				+1.8	↑
Social and Economic Factors						
High school dropouts (%)	1.9	2.2	-14.9	●	+0.9	↑
Unemployment (%)	6.7	8.1	-17.0	●	+5.9	↑
Children in poverty (%)	18.3	19.0	-3.8	●	+5.1	↑
Violent crime rate (per 100,000)	280	283	-0.9	○	+2.3	↑
Physical Environment						
Air pollution (µg/m ³)	9.6	10.6	-9.4	●	-0.3	→

Current Observed Rate = Rate or percentage provided for the most current year from the data sources.

Expected = Value expected for the current year using a 10-year linear regression model for the previous 10 years.

Percent Difference = (Observed Value – Expected Value) / Expected Value x 100.

Current Progress = Based on magnitude and significance of the percent difference value. Black dot, better than expected; dark gray dot, worse than expected; white dot, as expected.

Baseline Trend = $(e^{b-1}) \times 100$ where e=exponential function and b=slope of the logarithmic trend-line.

Trend Progress = Based on magnitude of the baseline trend. Up arrow, worse; down arrow, improved; right arrow, no change

^aDue to changes in the methodology by which Behavioral Risk Factor Surveillance System and Family Health Survey collected data, “current progress” was not analyzed for 6 indicators: self-reported fair or poor health, smoking, obesity, excessive drinking, no health insurance (age 0-17) and no health insurance (age 18-64).

Abbreviation: YPLL, years of potential life lost.

also experienced large deteriorations, worsening at rates of +5.1% per year and +3.1% per year respectively (Table 1).

Current Progress

Five indicators received a “better” rating, where the current rate was statistically better than expected ($P < 0.10$). These indicators are teen birth rate, high school dropouts, unemployment, children in poverty, and air pollution. Five indicators received a “worse” rating, where the current rate was statistically worse than expected with $P < 0.10$. These indicators are all ages death rate, premature death rate, 25- to 64-year-old death rate, 65+ year-old death rate, and chlamydia incidence (Table 1).

The best current progress was for unemployment rate at 17.0% better than expected. High school dropouts and teen birth rate also performed better than expected, with percent differences of –14.9% and –14.7%, respectively. The worst current progress was experienced for chlamydia rates, with a percent dif-

ference of +6.9% (Table 1).

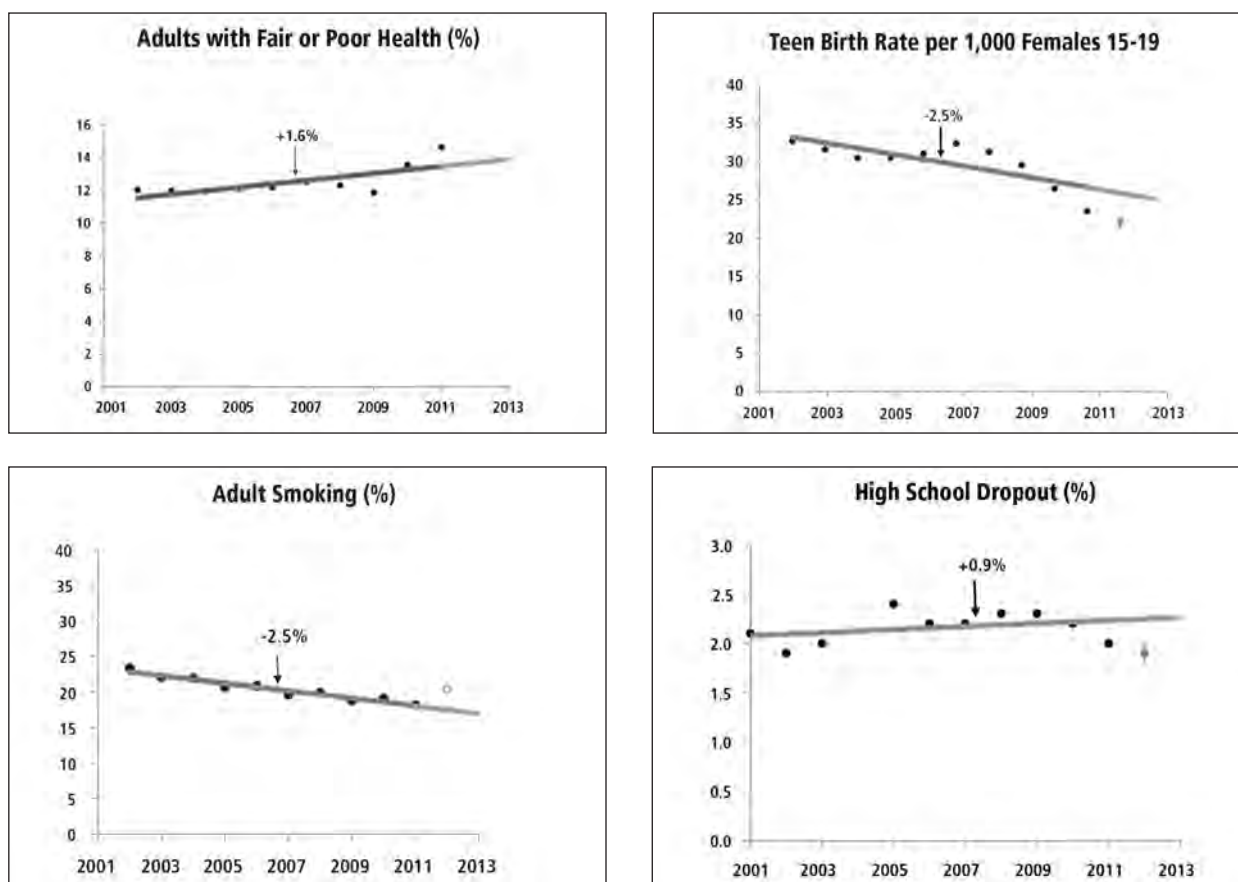
In some cases, current progress and baseline trends were not in agreement. For example, unemployment increased over the past 10 years at an average rate of +5.6% per year, but performed better than expected (–17.0%) for the current year (Table 1). However, in other cases, the 10-year baseline trend and current progress are in complete concordance. For example, over the past 10 years teen birth rate has improved –2.5% per year, and the current rate was –14.7% better than expected (Figure 1).

Disparities

Substantial differences in health status, as well as marked different trends, are seen when indicators are examined by gender, geography, socioeconomic status, or race/ethnicity.¹³ Examples illustrating these disparate trends are provided in Figure 2.

Smoking rates differ by socioeconomic factors. For example, in Wisconsin, those with less than a high school education have

Figure 1. Trend Graphs for 4 Leading Health Indicators From the 2014 Progress Report



an almost 6 times higher rate of smoking (42.7%) compared with those with a college degree (7.7%) (Figure 2). Looking at 10-year trend data by socioeconomic status further reveals that smoking rates are declining twice as quickly for those with a college degree (-3.7% vs -1.6% per year).

Disparities also exist by race. Blacks and American Indians fare worse on all health indicators compared to whites, Hispanics, and Asians. The current rate of infant deaths among blacks is 13.2 deaths per 1000 live births and among American Indians is 10.9 deaths per 1000 live births, compared with all other racial groups at 6.3 deaths per 1000 live births or better (Figure 2). Looking at trends over a decade, the infant death rate is improving for blacks at rates 3 times as high as the HP2020 standard.

Geographic disparities in health continue to persist in Wisconsin as well. Those living in suburban and nonurban areas are healthiest for all indicators where geography disparity data was available. The teen birth rate was almost 3 times higher in urban counties compared with suburban counties (40.0 vs 15.4 births per girls ages 15-19) in 2012. The trend is improving for all geographic groups, but improving more than 4 times as fast

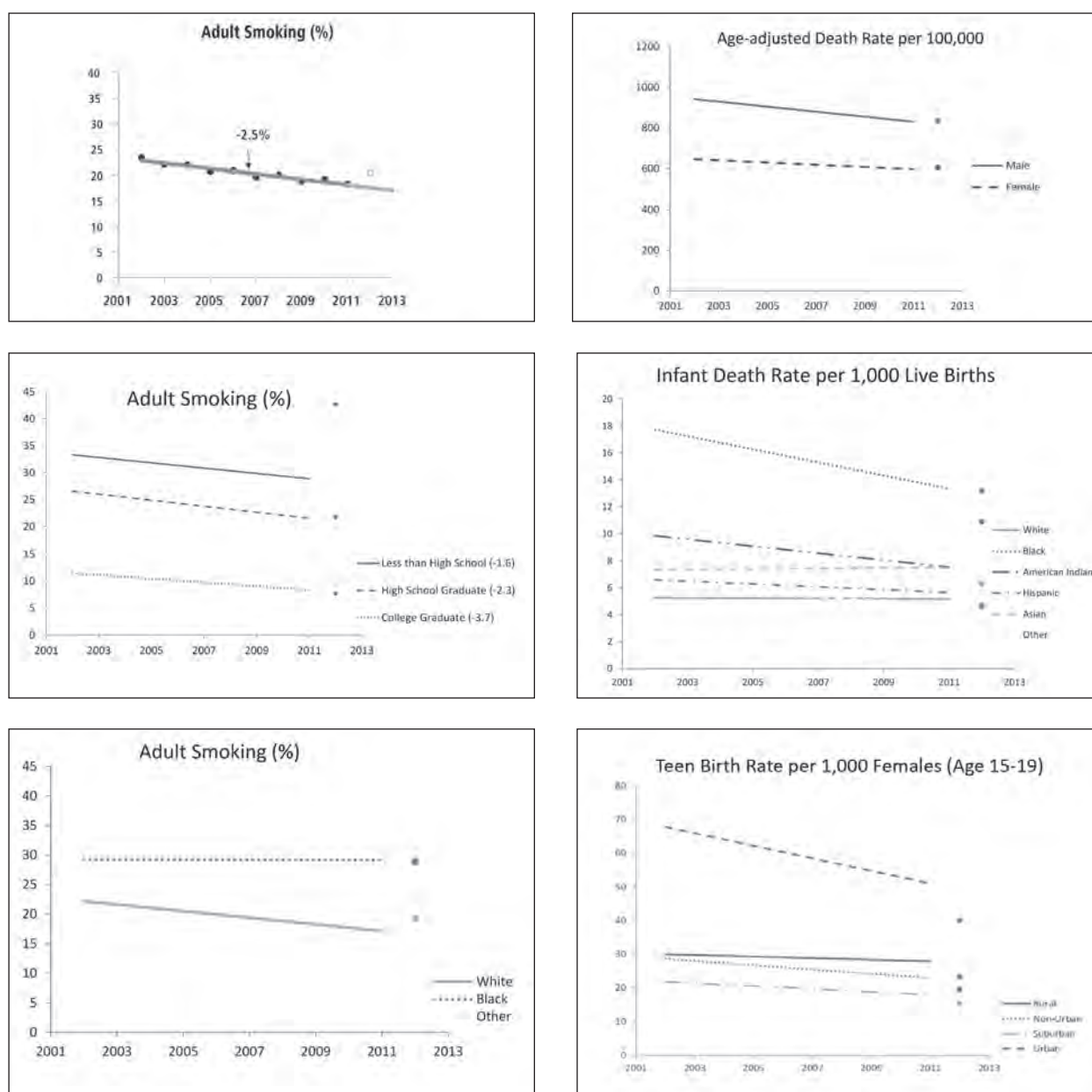
for urban areas compared with rural areas (-3.4 vs -0.8) (Figure 2).

DISCUSSION

It's been said that "what gets measured, matters." Measuring health trends is an important—but underutilized—way to evaluate overall progress toward the goal of improving the length and quality of life for all. *The Wisconsin Health Trends: Progress Report* is unique in providing 2 assessments of health: (1) the health indicator's baseline trend over the past 10 years, and (2) the most current year of data compared to its expected value, a short-term trend. Together, these assessments provide a clearer picture of Wisconsin's health, allowing researchers, policymakers and others interested in the health of Wisconsin to assess where improvements are occurring and what indicators require more attention.

This report shows that the health of Wisconsin is mixed, with improvements in some indicators and declines in others. The improvements in age-specific death rates are encouraging, as they reflect progress in 1 of the key health goals for Wisconsin and the nation—longer lives. The progress in other areas, such as a signifi-

Figure 2. Example of Health Disparity Trend Graphs by Subgroup for 4 Leading Health Indicators



cant improvement in teen birth rates, suggests that evidence-based programs and policies are leading to measurable improvements in health outcomes. Unfortunately, not all trends are improving. The increasing rates of low birthweight and self-reported quality of life among adults suggests that we are not making progress toward the goal of “living better.” Further exacerbating this concern are the worsening trends in all of the socioeconomic indicators, with increasing rates of high school dropouts, children in poverty, and violent crime—suggesting even more challenges for the public’s

health in the future. Even more troubling are the differences in health trends that are apparent by subgroups with regard to gender, race/ethnicity, socioeconomic status, or geography.

Assessing trends each year allows us to detect the impact of major economic or policy changes, as well as identify instances where effects take longer to materialize. For example, we can see a large spike in the unemployment and child poverty rates in 2009 consistent with the national recession. This measurement technique can be used to identify when changes occurred and allow

researchers to further investigate what might be contributing to that change in a particular year. This method also can be used to measure current policy changes to assess whether or not they are having an impact on the health of the states' population overall or among specific subgroups. For example, in 2010, Wisconsin instituted a statewide smoking ban in public places.¹⁶ Although the impact of the ban is not obvious in any single year, adult smoking continues to decrease annually in Wisconsin. We know that change does not happen overnight, but we expect to see the magnitude of the decrease to improve in coming years. Another example to place a spotlight on reductions in disparity is the efforts of the many partners who have worked to reduce African American infant mortality in Milwaukee and other southeastern Wisconsin communities. Their work may be having an impact: the rate of infant mortality in Milwaukee County, Wisconsin's only urban county, is decreasing faster than all other geographical areas (Figure 2).¹⁷ Finally, with the implementation of health insurance reforms and purchasing strategies under the Affordable Care Act (ACA) in 2014, we anticipate detecting decreases in uninsured rates in the coming years.

Disparities

The Health of Wisconsin Report Card highlights significant disparities in health outcomes.¹⁸ The *Wisconsin Health Trends: Progress Report* takes this analysis a step further by providing data on the leading health indicators by gender, race/ethnicity, geography, and socioeconomic status.^{12,15,19} This analysis vividly illustrates the need to look beyond averages. In the case of adult smoking, for example, the overall 10-year baseline trend is positive, with an average rate of decline of 2.5% annually (Figure 1). Looking at smoking rates by educational attainment, however, we see that adults with less than a high school education report smoking at rates about 5 times higher than those having a college degree (Figure 2) suggesting that without intervention, disparities in smoking rates among populations with different levels of educational attainment will continue to grow. Similarly, while smoking rates are declining for members of all other racial and ethnic groups, smoking rates for blacks have been flat for a decade (Figure 2). Researchers and policymakers need to choose interventions that have been demonstrated to reduce these kinds of disparities. For example, choosing to implement a technology-based intervention might worsen disparities, while increasing funding for a comprehensive statewide tobacco program might reduce disparities and still improve the health of the entire population.²⁰ This analysis illustrates the need to better understand differences in health outcomes and health factors by subgroups within the population, and to better tailor policies, programs, and other interventions to realize faster improvements for those groups whose health continues to lag that of the population as a whole. Work should center on the need to close these evident racial, gender, socioeconomic, and geographic disparities.

Strengths and Limitations

This report of the long-term and recent health trends in Wisconsin used a consistent approach to assess progress and challenges for the state, across 20 leading health indicators. Current progress was assessed annually by comparing how the current value compared to the expected value for that year given the 10-year baseline trend line. Because the current progress assessment is based only on 1 year of data, it is much more susceptible to annual variation. Teen birth rates, for example, have improved over the last 10 years, but in the 2013 report (using 2010 data), the rates improved to a lesser degree than in the 2014 report (using 2011 data), 9.4% compared to 14.7%.^{12,19} On the other hand, violent crime has increased since the 2011 report. In the 2013 report, the increase was larger in magnitude than in the 2011 report, showing cause for concern (12.6% better than expected for 2011 compared to 0.9% for 2012).^{12,19} These volatile annual changes indicate the need to measure both current progress and long-term trends, and also demonstrate the limited understanding that can be gained from any single year's results.

Linear trends are used in this report in order to have a standard method for assessing progress across different indicators. The use of linear regression minimizes the impact of year-to-year variation during the time period.²¹ However, there are limitations of using 10-year linear trends for several indicators. Not all trends fit best into a linear model. For example, a parametric model may fit violent crime and unemployment data better.

Interpreting the data with arrows facilitates communication about the trends in Wisconsin. In addition, providing an assessment of the trend for the most recent year's data offers a glimpse at how the trend may shift in the future. Due to lag time in data, however, "current" is not always as current as people expect it to be.

The use of graphs for statewide and subgroup trends allows for visualization and easy understanding of large quantities of data. Ten years of data are summarized onto a single graph for easy understanding. Additionally, the use of trend lines and current values helps communicate positive or negative trends. Using data from large-scale national and statewide surveillance systems allows for the comparison of data over time. A standard methodology allows for comparison of slopes across indicators. Providing graphs by subgroup allows for disparities to be easily represented and communicated to public health and nonpublic health professionals. We encourage other states to measure health trends using this methodology to be able to effectively communicate health trends to a variety of audiences.

CONCLUSIONS

The Wisconsin Health Trends: Progress Report provides a picture for the health of Wisconsin as a whole and of subgroups in Wisconsin.^{12,15,19} Wisconsin shows continuous reductions in

death rates at all ages, as well as many health behavior indicators. However, Wisconsin's trends are worsening on all socioeconomic and quality of life indicators. If these trends persist, it is likely the costs of medical care will grow, as people living longer yet less healthy lives will require additional medical care. Additionally, current trends in health indicators are markedly disparate across subgroups. Many health disparities exist across gender, racial, geographic, and socioeconomic status domains. Presenting the data is only the first step—the question now is how this data will be translated into appropriately tailored actions to promote longer and healthier lives for all.

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Medical Student Views of the Affordable Care Act

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ABSTRACT

Introduction: With new insurance coverage under the Affordable Care Act (ACA) beginning in 2014 and the ever-changing practice of medicine, it is important to understand medical students' recent perspectives on health policy and reform.

Objective: This study describes the opinions, perceptions, and comprehension of the ACA and health care reform by a cross-section of medical students in Wisconsin.

Methods: A total of 578 students (35%) completed an original survey developed from previous surveys.

Results: Of those sampled, one-half identified as liberal or very liberal and 20% as conservative or very conservative. Respondents were split equally in their opinions of whether the United States or other nations had the highest quality care. One-half felt that faculty physicians and the media influenced their opinion of the ACA, while two-thirds felt that coursework and peers had no influence on their views. The vast majority sampled thought everyone is entitled to adequate medical care regardless of ability to pay and that physicians have a major responsibility to help reduce health care costs. A majority of liberal students and a minority of conservative students, supported the ACA. Personal and family experience as a patient influenced most liberals to support and most conservatives to oppose the ACA. One-half felt that medical school spent adequate time on health care policy education.

Conclusions: The results were used in curriculum development; these approaches may be useful to medical educators nationally.

INTRODUCTION

For more than 30 years, medical students have been surveyed about their opinions regarding health care policy and access to care. In 1980-1981, 417 first- and second-year medical students at 1 institution were surveyed; the majority perceived that gov-

ernment was responsible for ensuring access to medical care for all.¹ In 2002, a survey of 770 US medical students showed that the vast majority believed that everyone is entitled to adequate medical care regardless of ability to pay, and two-thirds favored health care reform that would achieve universal coverage.² A 2011 survey of Minnesota medical students showed that most were uninformed and undecided about the Affordable Care Act (ACA).³ In a 2011 survey of medical students at 10 schools, 80% indicated support for the Patient Protection and ACA and two-thirds believed it would increase access.⁴ With the new insurance coverage under the ACA beginning in 2014 and the ever-changing practice of medicine, it is important to understand medical students' have recent perspectives on health policy and reform.

This paper describes current opinions, perceptions, and comprehension of the ACA and health care reform by medical

students. The purpose is to understand student knowledge and attitudes about the ACA and to use this information to guide health policy education curricula at medical schools across the nation.

METHODS

The study was a cross-sectional, anonymous survey of medical students at Medical College of Wisconsin (MCW) and University of Wisconsin School of Medicine and Public Health (UWSMPH), and was deemed exempt by the institutional review boards of the MCW/Froedtert Hospital and the UWSMPH.

Surveys from 7 publications on physician and medical student knowledge and perceptions about the ACA were reviewed.¹⁻⁷ The research team vetted 42 survey constructs on opinions, 27 on perception, 16 on understanding, 4 on responsibility, and 13 on demographics. In order to minimize the survey burden, the team

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Table 1. Demographic Characteristics of Wisconsin Medical Student Survey Respondents

Characteristics	Number of Respondents	Percent
Political Identification		
Very liberal	62	11
Liberal	224	39
Centrist	91	16
Conservative	109	19
Very conservative	8	1
Independent	59	10
Apolitical	26	4
Current Specialty Interest and Anticipated Field		
Undecided	65	11
Internal medicine	92	16
Family medicine	86	15
Pediatrics subspecialty	54	9
Emergency medicine	49	9
General surgery	36	6
General pediatrics	29	5
Anesthesiology	27	5
Orthopedic surgery	26	5
Other	109	19
Current Year in Medical School		
M1	147	25
M2	157	27
M3	122	21
M4	152	26
Gender		
Male	301	52
Medical School		
Medical College of Wisconsin	291	50
University of Wisconsin School of Medicine and Public Health	287	50

used multiple voting to select the most important items in each domain resulting in 2 opinion, 3 perception, 4 understanding, 1 responsibility, and 2 demographic items for the final survey.

The medical student affairs offices e-mailed a flyer and survey invitation to all 820 medical students at MCW and 811 at UWSMPH during a 20-day period in April and May 2014. A printed flyer was posted in medical school areas frequented by students. All students also were sent 1 reminder e-mail.

No grant or contract funded this study. A faculty member donated \$200 as \$25 random lottery incentives to increase the response rate. The offices of student affairs distributed the \$25 gift cards to 4 randomly selected respondents at each medical school. Their e-mail addresses were separated from survey responses.

Survey responses were collected using the SurveyMonkey web-based tool (www.surveymonkey.com). Responses were imported into SAS version 9.4 for analysis (SAS Institute Inc, Cary, North Carolina). Frequencies and percentages were calculated using the FREQ procedure. Pearson chi-square analyses were performed to show the association of political affiliation with various questions related to attitude, influences, and beliefs.

RESULTS

A total of 578 of 1631 students completed the survey, yielding a 35% response rate. Table 1 shows demographic characteristics of the respondents. One-half identified as liberal or very liberal and 20% as conservative or very conservative. More than one-third were interested in a primary care specialty (internal medicine, family medicine, or general pediatrics) and 11% were undecided about a specialty. Respondents were distributed equally across 4 years of medical school, gender, and participating schools.

Opinions and knowledge about the ACA are depicted in Table 2. Two-thirds of respondents supported the ACA but thought “more reform is needed” while 20% did not support the ACA because “it went too far.” Most believed the ACA made access to health care better. More than 40% thought a single-payer system of universal health insurance offers the best health care to the greatest number of people for a given amount of money, while one-quarter didn’t know whether universal coverage or market approaches are best. One-quarter incorrectly thought that the ACA cut benefits to Medicare recipients and 12% were unaware of the individual mandate to buy health insurance.

Table 3 shows the students’ views of how the US health care system compares with other industrialized nations. The vast majority thought other nations had lower patient out-of-pocket costs, lower medical student debt, and better access to care. Respondents were split equally in their opinions of whether the United States or other nations had the highest quality care. Two-thirds thought the United States had superior technology development and nearly one-half felt US patients had more freedom of choice of physicians.

Influences on respondents’ opinions of the ACA are shown in Table 4. Seventy percent had a personal or family experience as a patient that influenced their support of the ACA. Slightly more than half felt that faculty physicians and the media influenced their opinion, while two-thirds felt that required and elective coursework and their medical school peers had no influence on their view of the ACA.

Table 5 shows students’ agreement with health policy positions and experiences. The vast majority thought everyone is entitled to adequate medical care regardless of ability to pay, and that physicians have a major responsibility to help reduce health care costs. More than 40% felt their medical schools spent an inadequate amount of time on health care policy education.

Variations in responses based on political identification are depicted in Table 6. Tables 6 and 7 only analyze responses for reported liberals and conservatives; centrist, apolitical, and independent views are excluded, so the denominator differs from the other tables. Approximately one-third of liberals and conservatives were interested in primary care and the vast majority agreed that physicians have a responsibility to reduce health

care costs. A majority of liberal students, and a minority of conservative students supported the ACA and thought it made access better. Most liberals thought more reform is needed. Most liberals preferred a single-payer/universal coverage system. A higher percentage of conservatives than liberals incorrectly believed the ACA cut Medicare benefits. Fifty percent of conservatives and 20% of liberals felt other nations had worse quality care than the United States. Approximately two-thirds of conservatives and one-third of liberals thought patients in other nations had less freedom of choice of physicians. Nearly all liberals and slightly more than two-thirds of conservatives agreed that everyone is entitled to adequate medical care regardless of ability to pay. Nearly half of both conservatives and liberals felt that medical school spent adequate time on health care policy education.

The sources of influences based on political affiliation are noted in Table 7. Personal/family experience as a patient influenced most liberals to support and most conservatives to oppose the ACA. Media and faculty/attending physicians also moderately affected these liberal and conservative positions. Coursework had a lesser influence on liberals and minimal impact on conservatives.

DISCUSSION

This survey of Wisconsin medical students provided new information on their political identification, knowledge and opinions of the ACA, views of the US health care system compared with other nations, and positions on health policy.

The major limitation of this survey was the 35% response rate. Equal distribution by gender and across the M1-M4 classes suggest minimal bias for these variables. However, the high number of statistically significant tests may increase the risk of type 1 errors or false positives. Moreover, the distribution of 50% liberal or very liberal respondents compared with 20% conservative or very conservative respondents may bias the overall results toward more liberal perspectives.

Similar to the 2002 survey of US medical students,² our 2014 survey of a sample of Wisconsin medical students showed that the vast majority believed that everyone is entitled to ade-

Table 2. Opinions and Knowledge of Wisconsin Medical Students About the Affordable Care Act (ACA)

Questions and Answers	Number of Respondents	Percent
Which statement best describes your attitude toward recent health care reform legislation?		
I support the ACA but think more reform is needed.	376	65
I support the ACA and think that it went far enough.	36	6
I support the ACA and think that it went too far.	29	5
I do not support the ACA because it did not go far enough.	21	4
I do not support the ACA because it went too far.	119	20
Regarding access to health care for everyone, the ACA made things...		
Better	354	61
The same	68	12
Worse	62	11
I don't know	101	17
Which of the following would offer the best health care to the greatest number of people for a given amount of money?		
Single-payer/universal	243	42
Multi-payer/universal	85	15
Fee for service/market	53	9
Managed care/market	45	8
Don't know	158	27
Answered "true" to the following statements		
The ACA prohibits insurers from denying coverage because of health status.	553	95
The ACA gives states the option to expand the Medicaid program to cover low-income, uninsured adults regardless of whether they have children.	549	94
The ACA requires all to buy insurance coverage (individual mandate).	513	88
The ACA cuts benefits that were previously provided to all people on Medicare.	139	24

Table 3. Wisconsin Medical Students' Views of "How Does the US Health Care System Compare to Other Industrialized Nations' Systems Regarding the Following"

Topic	Other Nations Better than US		Other Nations Same as US		Other Nations Worse Than US		Don't Know	
	No.	%	No.	%	No.	%	No.	%
Patients' out-of-pocket costs	519	89	21	4	14	2	30	5
Medical student debt	495	84	10	2	13	2	68	12
Access to care for everyone	515	88	30	5	27	5	15	5
High quality care	174	30	212	36	173	30	26	4
Freedom of choice of physician	120	20	101	17	267	45	99	17
Development of technologies	45	8	111	19	394	67	34	6

quate medical care regardless of ability to pay. Two-thirds of US medical student respondents in 2002, and most in Wisconsin in 2014 believed universal coverage is needed. In a 1994 survey of 631 first-year medical students in California, 72% felt that practicing physicians had a major responsibility to help reduce health care costs.⁷ In our survey of Wisconsin students, 85% believed physicians have this responsibility.

Nationally, approximately 40% of the public favor the ACA.⁸ Among responding Wisconsin medical students, two-thirds support the ACA, but the national partisan divide on the law was also evident among these students.

In a survey of 20,088 US physicians in 2014, 46% gave the ACA a D or F grade, while 25% gave it an A or B. Younger,

Table 4. Wisconsin Medical Students' Views of "Overall, How Did the Following Influence Your Opinion of the ACA"

	Influenced Support		No Influence		Influenced Opposition	
	No.	%	No.	%	No.	%
Personal/family experience as a patient	257	44	178	30	150	26
Faculty/attending physicians	200	34	281	48	103	18
Media	174	30	270	46	140	24
Required coursework	173	30	397	68	15	3
Peers in medical school	153	26	394	67	37	6
Elective coursework	126	22	440	68	16	3

Table 5. Wisconsin Medical Students' Agreement With Policy Positions/Experiences

Statement	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	No.	%	No.	%	No.	%	No.	%	No.	%
Everyone is entitled to adequate medical care regardless of ability to pay.	301	51	196	33	53	9	20	3	15	3
Practicing physicians have a major responsibility to help reduce health care costs.	226	39	271	46	55	9	28	5	4	1
My medical school spent an adequate amount of time on health care policy education.	61	10	137	23	135	23	168	29	85	15

female, employed, and primary care physicians were somewhat more positive about the current medical practice environment than were older, male, practice-owning, and specialist physicians.⁹ Two-thirds of sampled Wisconsin students, especially with liberal political identification, supported the ACA and 80% thought the ACA made access better. One-half of Minnesota students identified as liberal responded similarly to Wisconsin respondents when asked about the ACA. Nationally, one-quarter of the public are unaware of the individual mandate for coverage⁸ compared with 12% of sampled Wisconsin medical students.

According to the Commonwealth Fund, the United States underperforms relative to other nations on most dimensions of performance. Relative to 10 other developed countries, the United States ranks fifth in quality, ninth in access, and 11th in costs.¹⁰ The vast majority of surveyed students recognized cost and access challenges while half of conservative students and 20% of liberal students believed that the United States has higher overall quality than other nations. In international comparative questions where there was a correct answer (eg, about quality of care), responses correlated with political views. This pattern, together with curriculum having little influence on student views, might be a motivation for curricular improvements.

The results of this study were reflected in curriculum development at the 2 surveyed medical schools.¹¹ These recommended approaches may be useful to medical educators nationally:

- *Require a health policy course as a foundation, or ensure that a thread of policy issues is included throughout the curricu-*

lum. MCW offers an elective course in health policy for fourth-year students. UWSMPH expanded its existing health policy curriculum in a required event for first-year students.

- *In addition to the required curriculum, offer deeper health policy learning opportunities later in the curriculum.* MCW offers a pathway in health system management and policy for interested first- and second-year students and an option for third-year students. UWSMPH has 2 fourth-year electives on health systems and health advocacy.

- *Support medical student presentations of their experiences working on policy issues within health care delivery, through advocacy with medical associations and societies, and in community services.* MCW students in the health system management and policy pathway may present a scholarly project on policy or advocacy at the end of their course. UWSMPH enhanced a required

2.5 day experiential learning event for second-year students focused on advocacy skill building. UW offers an elective to learn effective presentation skills for advocacy as well as a fourth-year elective that focuses on mental health advocacy.

- *Provide symposia with panelists and small group discussions about controversial and complex topics such as international comparisons of health care system quality.* MCW students organized a faculty panel and group discussions of international health care systems in 2015.
- *Integrate the topics of quality of care, health outcomes, and costs of services in clinical case discussions throughout the medical school curriculum.* These Triple Aim topics are increasingly examined in clinical settings. UWSMPH has expanded a 2-day learning event called "Cost of Care" for second-year students that uses clinical cases to examine drivers of health care costs.

CONCLUSION

The surveyed sample of medical students reflected differing partisan opinions of the ACA, and their views were especially influenced by personal or family experiences. Regardless of political identification, most agreed that everyone is entitled to adequate medical care regardless of ability to pay. Only one-half felt that medical school spent adequate time on health care policy education. Educators should explore methods for helping students and teachers to recognize their own potential ideology bias in aspects of policy and the need to learn how to be open to evidence that may be in conflict with that bias. Integration of a

Table 6. Variations in Selected Responses Based on Political Identification^a

Item	Very Liberal or Liberal		Very Conservative or Conservative		P-value
	No.	%	No.	%	
Gender male	120	42	68	59	0.003
Gender female	163	57	48	41	
Specialty interest internal medicine, family medicine or general pediatrics	115	40	36	31	0.08
Support the Affordable Care Act (ACA) but think more reform is needed	253	89	25	21	0.0001
ACA made access to healthcare better	229	80	36	31	0.0001
Single-payer/universal offers best health care to the greatest number for a given amount of money	164	58	16	14	0.0001
Fee for service/market offers best health care to the greatest number for a given amount of money	4	1	28	24	
Believe the ACA cuts benefits that were previously provided to all people on Medicare	46	16	48	41	0.0001
Other Nations Better					
Patient's out-of-pocket costs	268	94	99	85	0.002
Medical student debt	259	91	86	74	0.0001
Access to care for everyone	275	96	87	74	0.0001
Other Nations Worse					
High quality care	57	20	58	50	0.0001
Freedom of choice of physician	105	37	76	65	0.0001
Development of technologies	184	65	92	79	0.004
Strongly agree or agree physicians have a major responsibility to help reduce health care costs	254	89	96	82	0.04
Strongly agree or agree everyone is entitled to adequate medical care regardless of ability to pay	273	96	82	70	0.0001
Disagree or strongly disagree that medical school spent an adequate amount of time on health care policy education	118	41	58	50	0.13

^aCentrist, apolitical, and independent views are excluded from this table.**Table 7.** Sources of Influences Based on Political Affiliation^a

Item	Very Liberal or Liberal		Very Conservative or Conservative		P-value
	No.	%	No.	%	
Personal/Family Experience as a Patient					0.0001
Influenced support	174	61	19	16	
No influence	87	30	27	23	
Influenced opposition	25	9	71	61	
Peers in Medical School					0.0001
Influenced support	90	32	23	20	
No influence	188	66	78	67	
Influenced opposition	7	2	16	14	
Media					0.0001
Influenced support	119	42	14	12	
No influence	125	44	52	44	
Influenced opposition	41	14	51	44	
Faculty/Attending Physicians					0.0001
Influenced support	125	44	31	27	
No influence	132	46	49	42	
Influenced opposition	28	10	37	32	
Required Coursework					0.0001
Influenced support	104	36	20	17	
No influence	182	64	89	76	
Influenced opposition	0	0	8	7	
Elective Coursework					0.0001
Influenced support	83	29	9	8	
No influence	202	71	96	83	
Influenced opposition	0	0	10	9	

^aCentrist, apolitical, and independent views are excluded from this table.

variety of health policy learning opportunities longitudinally throughout the required and elective 4-year curriculum may help future physicians better understand the complexities of the political environment in which they will practice.

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One Wisconsin County's Experience With Fall-Related Mortality

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ABSTRACT

Background: Falls in Wisconsin account for 74.1% of all injury-related deaths for persons 65 years and older. This study describes the rate, demographics, and characteristics of fall-related mortality in one Wisconsin county over an 8-year period from 2005 to 2012.

Methods: Retrospective review of 841 death investigation records of Waukesha County residents 65 years and older who died from a fall during the years 2005 to 2012. Data were collected at the Waukesha County Medical Examiner's office.

Results: No significant differences in individual demographics, activity, or injury characteristics ($P > 0.05$) in fall-related deaths over an 8-year period.

Conclusion: Fall-related mortality in Waukesha County over the past 8 years has demonstrated consistent demographics, fall, and injury characteristics.

65 years,^{6,7} the team wanted to identify the demographics and characteristics of why certain falls lead to mortality. Preliminary data collection was initiated in 2005, when there was improved coding of fall-related deaths,^{3,4} and expanded to a longitudinal investigation of fall-related mortality in the county.

The purpose of this brief report is to describe the rate, demographics, and characteristics of residents in one Wisconsin county who experienced a fall-related death over an 8-year period.

BACKGROUND

Fall-related mortality among people 65 years and over has increased significantly over the past decade. Falls are the leading cause of unintentional injury-related deaths in the United States and explain 52.9% of all deaths due to injury.¹ In Wisconsin, falls account for 74.1% of all injury-related deaths for persons 65 years and older, with 904 deaths occurring in the state in 2011.² It has been suggested that recent reporting of fall-related deaths is more inconclusive and may better reflect the actual sequel of falls, which may account for some of the increases in fall death rates.³⁻⁵

The interdisciplinary Elder Care Review Team of Waukesha County has met quarterly to review elderly deaths in the county for the past 15 years and has identified falls as a frequent cause of injury-related deaths among those age 65 and over. Concern for the number of deaths due to falls was the impetus for this investigation. Given that falls occur in 25% to 33% of all adults over

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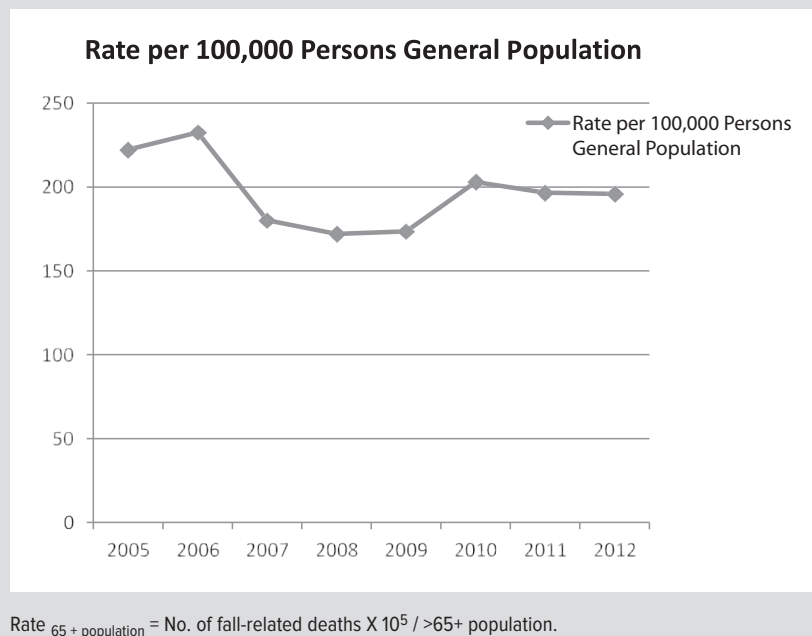
METHODS

This report is a retrospective review of death investigation records of Waukesha County residents 65 years and older who died from a fall during the years 2005-2012. The data were collected at the Waukesha County Medical Examiner's office. Investigation records reviewed were those residents whose death certificate listed a fall as the underlying cause of death. We followed Public Health Service Act (42 USC 242m[d]) for data use restrictions in which data will be used for health statistical reporting and analysis only and no attempt will be made to learn the identity of any person or establishment included in these data. This retrospective review (IRB #13-016) received Institutional Review Board (IRB) exemption status.

The objective of the records review was to capture the demographics of residents at the time of their fall (not at the time of their death). Records reviewed included medical examiner's investigation and examination records, hospital records, and communication with significant others (health practitioners, paramedics, family members, caregivers, and/or others involved in the safety of the faller).

Data extracted from investigation records included gender, age at time of death, body mass index, residence at time of fall, date and place of fall, date of death, cause of death, select comorbidities correlated with falls, and number of medications prescribed at the time of the fall.

Figure 1. Rate of Fatal Falls in County's 65+ Population



Data Analysis

Descriptive statistics were used for continuous variables, and frequencies were used for categorical data. Independent samples *t*-test or one-way between groups analysis of variance (ANOVA) was used to compare continuous variables. Chi-square was used to explore relationships and proportions between categorical variables ($P < 0.05$). SPSS version 21 (SPSS; Chicago, Illinois) and Microsoft Excel 2010 were used for statistics and graphing. A *P*-value of < 0.05 was considered statistically significant.

RESULTS

According to the latest 2012 census, Waukesha County has a population estimate of 392,477 residents, with 15.3% (60,049) of the residents 65 years and older.¹ There were a total of 842 fall deaths from 2005 to 2012. One subject's fall occurred 18 years prior to the person's death and accurate records of fall events could not be ascertained. Therefore, this person was excluded from further data analysis. Thus, 841 records were analyzed for characteristics and trends in this study.

County Population and Prevalence of Fall-related deaths

The older adult population in Waukesha County has increased 31% over the last 8 years.^{1,8} Using yearly county census data and number of fall-related mortalities, we were able to calculate the rate of death from falls in the county.¹ In 2005 the county fall mortality rate for persons 65 years and older was 222.2 cases per 100,000 persons per year, and in 2012 the rate was 195.9 cases per 100,000 per year (Figure 1).

Demographics

The average age at death after a fall was 86.02 years (SD 7.23, range 65-104); 61.2% were female. There were no statistical differences ($P = .639$) between the age of subjects during the years 2005 through 2012, $F_{8,833} = 0.738$. An independent sample *t* test was used to compare ages between men and women. Men were statistically younger at death after a fall, mean = 84.48 years (SD = 7.31), than women, mean = 86.99 years (SD = 7.02), $t(839) = -4.94$, $P = .00$.

The overall average post fall survival time (number of days between the date of the initial fall to the date of death) was 36.17 days (SD 112.58, range 0-2565). There were no statistical differences between survival time after a fall for each of the 8 years, $F_{0,726} P = 0.65$. However, due to the large standard deviation, we excluded 2 cases whose survival days were greater than 4 standard deviations from the mean.

The new calculated mean for survival time is 31.24 (SD = 44.83, range 0-389). Mean body mass index (height and weight taken at death) was 23.46 kg/m² (SD 5.83, range 8.90-58.58) (Table 1).

Persons on average were prescribed 6.23 medications (SD 3.60, 0-21). Over each of the 8 years, more than two-thirds of all residents were diagnosed and/or treated for hypertension. Less than one-third was diagnosed with osteoporosis, and over half of the residents had a neurological diagnosis such as stroke, Parkinson's disease, dementia, or neuropathy, that may have put them at risk for falls.

Fall Characteristics

Consistently each year more than half (55.6%) of the people who experienced a fall-related death lived in their own home, 22.8% resided in an assisted living facility, 19.5% resided in a nursing home, and 2% of falls occurred while a person was a patient in a hospital or hospice.

In each of the 8 years, walking (including slips and trips) was the most common activity during which a fall occurred. Transfers were the next most frequent activity every year in which a fatal fall occurred, with 53% of the fall-related mortality due to transfers occurring in nursing homes (63 of 119 falls due to transfers occurred in nursing homes) (Table 2).

One's residence was the most common place a fall-related mortality occurred, with the bedroom and bathroom consistently the 2 most common rooms at home (24.5% and 22.1% respectively) in which a fall resulting in death occurred each year (Table 2). Of

Table 1. Annual County Resident Demographics of Those Who Sustained a Fall-Related Death

Year	2005	2006	2007	2008	2009	2010	2011	2012
Population 65+	45,897	49,461	51,065	52,883	55,326	55,688	57,968	60,237
Number of falls	102	115	92	91	96	113	114	118
Age (years) mean	85.48	85.61	86.72	85.55	85.89	86.15	87.11	85.64
SD	6.54	6.65	7.42	7.43	6.89	7.98	7.026	7.78
Range	70-97	66-97	67-103	69-101	66-101	65-104	69-99	66-101
Gender								
Males (%)	35.3	39.1	40.2	34.1	46.9	41.6	32.5	40.7
Females (%)	64.7	60.9	58.8	65.9	53.1	58.4	67.5	59.3
Survival time^{a,b} mean	31.12	28.64	34.46	29.52	29.2	33.65	36.83	26.57
SD	40.76	34.86	51.1	52.61	42.5	49.76	48.72	37.86
Range	0-220	0-261	0-389	0-381	0-231	0-356	0-228	0-278
BMI (kg/m²) mean	23.42	24.48	23.43	22.69	23.81	24.02	22.31	23.4
SD	5.29	6.62	5.13	4.59	5.75	7.27	5.39	5.56
Range	12.89-40.71	13.56-58.58	8.90-41.22	12.81-33.84	12.23-40.76	11.42-58.15	11.77-36.59	12.5-36.44
No. medications mean	5.37	6.27	6.53	6.3	6.85	6.43	6	6.24
SD	3.85	3.8	3.5	3.66	3.54	3.64	3.2	3.3
Range	0-18	0-16	0-16	01-21	0-15	01-18	0-18	0-17
Comorbidities								
Hypertension (%)	74.3	67.3	78.1	78.8	78.4	90.6	76	73.9
Osteoporosis (%)	25	20.4	27.2	24.7	23.6	28	21	19.8
Neurological disorder (%)	56	43.4	62.7	63.5	59.8	67	55.7	54.3

^a Survival time = number of days from the time of fall to death.

^b Two cases were excluded as outliers as their mean was greater than 4 standard deviations from the overall mean.

Abbreviation: BMI, body mass index.

people who resided in their own home, 58.2% (201) of the fall-related deaths occurred at home, 32.8% (113) of the falls occurred outside of the home (ie, driveway, yard, or garage) and 9% (31) occurred in the community.

Fall Outcome

Hip fractures were consistently the most frequent (54.6%) injury incurred from a fall that led to a fatality each of the 8 years. Head injuries were the second most common injury from a fall each year, occurring in 21.6% of all fall-related deaths (Table 2). We also assessed the potential for a seasonal effect for head injuries and hip fractures. A chi-square test for independence showed no relationships between the season that a hip fracture ($\chi^2=1.276$, $P=0.74$) or head injury ($\chi^2=0.364$, $P=0.95$) occurred in Wisconsin. In addition, there was no significant difference in the season in which a fall occurred in each of the 8 years ($\chi^2=17.3$, $P=0.69$).

DISCUSSION

We have described and analyzed fall-related mortality in one Wisconsin county over an 8-year period. The rate of fall-related deaths in this county is currently 196.0 per 100,000 persons 65 years and older, which is 74% higher than the state and more than 200% higher than national rates; 113.83 and 55.35 per 100,000 people 65+ respectively.¹ Falls as the underlying cause of death are under recognized in other areas of the state and country.^{3,9} The high rate in Waukesha County may have to do with education

and appropriate reporting of injury-related deaths. The Waukesha County Medical Examiner's office individually contacts all medical facilities and funeral homes providing presentations to doctors and health care staff to communicate that a preceding injury makes a death reportable for investigation. Thus, the investigations reviewed for this report reveal the relationship between the injury and death and identify the unbroken chain of events from injury to death. We were fortunate to have access to all records associated with a fall injury and not rely solely on death certificates or ICD-10 codes, as others have done,^{4,9} which could limit the exact underlying cause of death in other areas of the state. In addition, the consistency and reliability of the county medical examiner's office may have led to better detailed description of fall-related deaths for this report.

Over the past 8 years, the 65 years and older population has increased by 31% in Waukesha County; however, fall-related deaths have not mirrored this increase. Though fall-related mortality in the county has not declined steadily, and given that previous state and national reports have shown increases in fall-related death rates,^{3,9,10} this report identified Waukesha County's rate of fall-mortality trending downward over the 8-year investigational period. This is consistent with what Gagne et al⁴ found when analyzing fall-related mortality in Quebec.⁴

Demographics, activity, and injury characteristics of those persons who suffer a fall-related death are very consistent from year to year. Many of the same characteristics that are consistent for

Table 2. Characteristics of Falls that Lead to Mortality

Activity of Fall % (n=839)	2005 N=100	2006 N=115	2007 N=92	2008 N=91	2009 N=96	2010 N=113	2011 N=114	2012 N=118
Walking	43	27	45.7	45	38.5	46.9	49.1	45.8
Trip/slip	6	16.5	14.1	14.3	15.6	11.5	5.3	8.5
Transfer	16	15.7	12	12.1	15.6	14.2	15.8	11.9
Stairs	3	5.2	2.2	2.2	9.4	3.5	4.4	9.3
Picking up object from ground	2	3.5	0	1.1	1	2.7	2.6	3.4
Standing task	5	8.7	4.3	4.4	5.2	2.7	3.5	2.5
Bed/couch	4	9.5	8.7	11	5.2	5.3	3.5	5.1
Ladder	2	2.6	0	1.1	1	0.9	1.8	1.7
Unknown/other	19	8	13	8.8	8.3	12.4	14	11.9
Place/Room of Fall % (n=596)	N=77	N=85	N=53	N=64	N=68	N=87	N=64	N=98
Bedroom	28.6	27.1	22.6	25	26.5	26.4	32.8	20.4
Bathroom	20.8	17.7	24.5	15.6	19.1	33.3	14.1	27.6
Living room	2.6	15.3	1.9	14.6	13.2	12.6	9.4	12.2
Kitchen	9.1	10.6	13.2	7.8	7.4	4.6	6.3	6.1
Community	15.6	8.2	7.6	6.3	7.4	4.6	4.7	6.1
Dining room	2.6	1.2	1.9	3.1	1.5	1.5	4.7	5.1
Stairs	5.2	7.1	3.8	4.7	8.8	4.6	7.1	11.2
Hallway	3.9	4.7	7.6	10.9	4.4	8	1.6	3.1
Outside of home	11.7	8.2	17	12.5	11.7	4.6	18.8	8.1
Fall Injuries % (n=834)	N=100	N=114	N=92	N=90	N=96	N=113	N=113	N=116
Hip fracture	60	56.1	57.6	58.9	48.9	52.2	57.5	47.4
Head injury	19	20.2	21.7	16.7	26	26.6	20.4	21.6
Pelvic fracture	5	8.8	5.4	10	5.2	6.2	5.3	5.2
Cervical fracture	3	0.9	6.5	2.2	6.3	2.7	7.1	7.7
Wrist/arm fracture	3	1.8	2.2	6.7	3.1	3.5	1.8	4.3
Lower leg fracture	2	2.6	1.1	3.3	1	2.7	0.9	6
Rib fracture	2	5.3	1.1	1.1	2.1	0	4.4	2.6
Other	3	1.8	2.2	1.1	4.2	4.4	1.8	1.7
Compression fracture	2	2.6	1.1	0	2.1	0.9	0.9	0.9
Distal femur fracture	1	0	1.1	0	1	0.9	0	2.6

fall-related mortality are similar to those who experience falls in general.⁵ Why certain residents die after a fall and others do not is still inconclusive. Yet, as data from this report suggests, persons over 85 years who experience a fall resulting in a hip fracture may be at high risk for mortality.

CONCLUSION

Fall-related mortality in Waukesha County over the past 8 years has demonstrated consistent demographics and fall injury characteristics each year.

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The Development of a Summary Measure to Estimate the Relative Burden of Smoking in Wisconsin Counties

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ABSTRACT

Background: The rate of cigarette smoking among US adults has declined over the past 50 years. Yet smoking remains the leading cause of preventable death and marked disparities now exist in smoking rates based on education level, socioeconomic status, race/ethnicity, and geographic location. In order to target resources to reduce these disparities, a summary measure comparing the relative burden of smoking among smaller populations is needed.

Objective: To create a single summary measure that assesses the relative health burden from smoking in Wisconsin counties using age-adjusted mortality rates for smoking-attributable diseases, current adult smoking prevalence, and the current rate of mothers who smoked during pregnancy.

Results: Rates varied significantly between counties for smoking-attributable deaths (2-fold), adult smoking prevalence (5-fold), and smoking in pregnancy (5-fold). The summary measure of relative smoking burden was highest in rural counties and in counties with less education, higher rates of poverty, and more veterans. The ranking of a county's smoking burden was highly correlated with its overall health ranking from the County Health Rankings.

Discussion: The burden from smoking varied markedly across Wisconsin and was highest in the least advantaged counties in the state. Additional public health efforts must be directed toward the counties with the greater relative smoking burden in order to reduce these disparities.

INTRODUCTION

Even though smoking rates declined among US adults between 1965 (42.4%) and 2012 (18.1%), smoking remains the leading cause of preventable death in the United States.¹ Reductions in smoking rates did not occur evenly across society, resulting in health disparities by education levels, socioeconomic status, race/ethnicity, and geographic location.¹ Well-funded, comprehensive statewide tobacco campaigns have proven effective in other

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states,^{2,3} and additional resources spent on evidence-based tobacco control policies will increase demand to quit smoking⁴ and diminish the monetary and health costs due to smoking.⁵ However, reducing the disparate burden of smoking is also a priority and will require new approaches that specifically target those populations at highest risk of smoking. One approach to such targeting would be to focus on smaller geographic locations such as counties.

The County Health Rankings has already taken this approach and offers community leaders, county health departments, nonprofit hospitals, and nongovernmental organizations critical information for assessing the overall health of their county, relative to other counties in the state—information that is useful when developing a community health improvement plan.⁶ The prevalence of adult smoking was included

in the County Health Rankings but, similar to other metrics, provided only 1 aspect of smoking burden at a single point in time. The Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC), developed by the Centers for Disease Control and Prevention (CDC), is a good tool to measure the health and economic burden of tobacco, though it requires data that are rarely available in small communities (eg, age-specific smoking prevalence data or mortality due to uncommon smoking-related diseases). The objective of this study was to compare and contrast the relative burden of smoking among Wisconsin's 72 counties using a summary measure that combines existing data on age-adjusted mortality rates for smoking-attributable diseases, adult smoking prevalence rates, and the rates of mothers who smoke during pregnancy.

METHODS

Smoking-attributable mortality rates, adult smoking prevalence rates, and smoking during pregnancy rates for each Wisconsin

county were compiled from readily available epidemiologic databases. These rates were then combined into a single summary measure that estimated the relative burden of smoking among Wisconsin counties. Finally, this summary measure was compared to demographic information and the County Health Rankings. This study utilized secondary data of nonidentifiable, aggregate information and therefore did not need approval by an Institutional Review Board.

Smoking-attributable Mortality Rates

Smoking-attributable mortality rates were calculated for adults age 35 and older in all 72 Wisconsin counties from 2001 to 2010 using mortality data from Wide-ranging Online Data for Epidemiologic Research (WONDER), an online database at the CDC (<http://wonder.cdc.gov/>). These data were grouped into 4 categories of smoking-attributable diseases as done in previous research⁷—neoplasm of the lung, other tobacco-related neoplasm, heart disease and stroke, and respiratory disease.

Death rates for each county were age-adjusted to the 2000 United States population, the most recent available option. County smoking-attributable mortality rate for each disease category was estimated by multiplying the county's age-adjusted mortality rates by the category's respective statewide smoking-attributable fraction.⁷ This method is similar to the CDC's calculation of smoking-attributable mortality in larger populations.⁸ Neoplasm of the lung had the highest smoking-attributable fraction (79%) compared to other tobacco-related neoplasm (34%), heart disease and stroke (14%), and respiratory disease (57%).

Adult Smoking Prevalence Rates

The prevalence of cigarette smoking among adults (18 years of age and older) in each Wisconsin county was compiled previously and reported by the University of Wisconsin Population Health Institute for its County Health Rankings and accessed on that web page (<http://www.countyhealthrankings.org>). These rates were based on a 7-year average of data from the CDC's Behavioral Risk Factor Surveillance System, for the years 2006 to 2012.

Smoking During Pregnancy Rates

The prevalence of smoking during pregnancy was included to capture some of the future costs that will result from smoking today, such as the cost of adverse health effects of babies born to mothers who smoke during pregnancy⁹ or increased risk of future smoking by the mother's child.¹⁰ These data were obtained for all counties for the years 2001 to 2010 from the Wisconsin Department of Health Services' clinical information database Wisconsin Interactive Statistics on Health (WISH) from its web page (<https://www.dhs.wisconsin.gov/WISH/>). Using 10-year averages provided more stable estimates for smaller counties.

Smoking Summary Measure

A single summary measure estimating relative smoking burden was calculated for each county by combining the 3 rates above, and weighting smoking-attributable mortality (50%), adult prevalence (25%), and smoking during pregnancy (25%). Greater weight was given to the smoking-related mortality rates given the burden from this health outcome. This calculated z-score encapsulated an estimate of the burden of smoking due to smoking in the past (smoking-attributable mortality), an estimate of the current burden of smoking (adult smoking prevalence), and an indication of the future burden of smoking (smoking during pregnancy). This method of using weighted z-scores to assess the relative health of counties was similar to the approach used in the County Health Rankings¹¹. Z-scores were calculated for each county in the following manner:

$$\left[\begin{array}{l} \text{Smoking} \\ \text{Burden} \\ \text{z-score} \end{array} \right] = [50\%] * \left[\frac{(\text{County SAM}) - (\text{Mean SAM})}{(\text{St Dev SAM})} \right] + [25\%] * \left[\frac{(\text{County Prev}) - (\text{Mean Prev})}{(\text{St Dev Prev})} \right] + [25\%] * \left[\frac{(\text{County SDP}) - (\text{Mean SDP})}{(\text{St Dev SDP})} \right]$$

SAM = Smoking Attributable Mortality

Prev = Adult Smoking Prevalence

SDP = Smoking During Pregnancy

A z-score provided an estimate of how many standard deviations a particular data point lay from the mean (negative z-scores indicated lower burden and positive z-scores indicated higher burden). The counties then were ranked according to these smoking burden z-scores.

Demographic and Health Characteristics of Counties

County demographic data including percent living in poverty, veterans, and who had a bachelor's degree or higher were gathered from the US Census Bureau's QuickFacts on its web page (<http://www.census.gov>) using data from 2008 to 2012. The overall health outcome ranking for each county was taken from the County Health Rankings (www.countyhealthrankings.com) for 2014.

These county demographics and health outcomes measures were correlated with the smoking burden z-score. Using US Census Bureau definitions,¹² differences between the smoking burden of rural counties (with no urban center of 10,000 people or more), micropolitan counties (with an urban center of at least 10,000 people but fewer than 50,000 people), and metropolitan counties (with an urban center of 50,000 people or more) were compared using between-samples *t* tests. Correlations between counties' summary measure burden of smoking and overall health outcome were calculated using Spearman rank correlation.

Table. Smoking-Related Burden for Wisconsin's 72 Counties. Ranked from Lowest (1) to Highest (72) Relative Burden

County	SAM per 100,000 People 2001-2010 Average (Rank)	Adult Smoking Prevalence 2006-2012 Average (Rank)	Smoking During Pregnancy 2001-2010 Average (Rank)	Total Smoking Burden Z-score (Rank)	County	SAM per 100,000 People 2001-2010 Average (Rank)	Adult Smoking Prevalence 2006-2012 Average (Rank)	Smoking During Pregnancy 2001-2010 Average (Rank)	Total Smoking Burden Z-score (Rank)
Calumet	176 (1)	11% (2)	8.9% (3)	-1.64 (1)	Walworth	233 (46)	19% (41)	14.8% (24)	-0.07 (37)
Ozaukee	192 (2)	12% (3)	6.9% (1)	-1.39 (2)	Bayfield	220 (33)	16% (18)	25.7% (59)	-0.03 (38)
Lafayette	204 (13)	8% (1)	11.9% (9)	-1.23 (3)	Oconto	225 (38)	19% (36)	20.5% (47)	-0.01 (39)
Dane	199 (10)	14% (6)	8.9% (4)	-1.13 (4)	Sauk	230 (42)	17% (26)	21.3% (51)	0.04 (40)
Pierce	193 (5)	14% (7)	11.1% (6)	-1.11 (5)	Shawano	220 (32)	21% (49)	21.6% (53)	0.05 (41)
Waukesha	204 (14)	16% (20)	7.7% (2)	-0.96 (6)	Rusk	233 (45)	16% (17)	22.2% (55)	0.05 (42)
Washington	203 (12)	14% (7)	11.2% (7)	-0.94 (7)	Green Lake	234 (48)	19% (42)	18.5% (39)	0.08 (43)
Portage	197 (9)	15% (13)	12.7% (14)	-0.94 (8)	Racine	234 (49)	23% (59)	14.2% (18)	0.12 (44)
Door	194 (6)	16% (15)	14.2% (19)	-0.92 (9)	Milwaukee	247 (58)	21% (50)	11.6% (8)	0.13 (45)
Kewaunee	192 (3)	18% (32)	12.5% (13)	-0.88 (10)	Lincoln	213 (24)	23% (57)	24.6% (57)	0.16 (46)
Taylor	193 (4)	17% (23)	15.9% (28)	-0.81 (11)	Vilas	225 (37)	18% (34)	26.0% (62)	0.19 (47)
St. Croix	213 (23)	15% (12)	9.4% (5)	-0.79 (12)	Columbia	235 (50)	23% (54)	17.2% (35)	0.23 (48)
Dunn	195 (8)	16% (16)	17.0% (33)	-0.79 (13)	Waushara	235 (51)	21% (51)	20.7% (49)	0.28 (49)
Green	206 (17)	12% (4)	16.5% (30)	-0.78 (14)	Chippewa	228 (40)	24% (65)	20.5% (48)	0.29 (50)
Marathon	195 (7)	18% (28)	16.8% (31)	-0.70 (15)	Oneida	238 (54)	20% (45)	21.5% (52)	0.29 (51)
Outagamie	205 (15)	18% (30)	12.5% (12)	-0.68 (16)	Barron	233 (44)	24% (66)	19.7% (44)	0.36 (52)
Pepin	219 (31)	14% (5)	12.8% (15)	-0.65 (17)	Burnett	232 (43)	15% (11)	33.5% (71)	0.39 (53)
Clark	205 (16)	21% (52)	12.2% (10)	-0.51 (18)	Crawford	242 (56)	23% (57)	18.1% (38)	0.40 (54)
Brown	211 (19)	19% (39)	13.0% (16)	-0.51 (19)	Jackson	241 (55)	20% (47)	25.9% (61)	0.55 (55)
Jefferson	212 (20)	16% (18)	17.1% (34)	-0.50 (20)	Monroe	250 (59)	23% (54)	19.5% (43)	0.57 (56)
Manitowoc	201 (11)	18% (31)	19.9% (45)	-0.46 (21)	Florence	226 (39)	26% (69)	26.3% (63)	0.59 (57)
Fond du Lac	212 (21)	18% (34)	14.5% (21)	-0.45 (22)	Washburn	236 (53)	23% (61)	25.7% (60)	0.60 (58)
Sheboygan	216 (28)	17% (25)	14.8% (25)	-0.45 (23)	Kenosha	268 (68)	21% (52)	14.6% (23)	0.63 (59)
La Crosse	225 (36)	15% (14)	14.6% (22)	-0.39 (24)	Rock	259 (65)	23% (63)	18.7% (40)	0.73 (60)
Buffalo	214 (25)	19% (36)	15.8% (26)	-0.37 (25)	Iron	255 (63)	19% (43)	28.0% (66)	0.82 (61)
Wood	207 (18)	18% (32)	19.4% (42)	-0.36 (26)	Waupaca	273 (70)	20% (46)	20.1% (46)	0.84 (62)
Winnebago	217 (29)	18% (28)	16.1% (29)	-0.35 (27)	Douglas	260 (66)	23% (63)	22.0% (54)	0.87 (63)
Trempealeau	215 (26)	19% (38)	15.9% (27)	-0.35 (28)	Marquette	255 (62)	24% (67)	23.5% (56)	0.89 (64)
Richland	219 (30)	16% (21)	17.5% (36)	-0.34 (29)	Langlade	251 (60)	23% (62)	27.6% (64)	0.92 (65)
Iowa	213 (22)	21% (48)	14.4% (20)	-0.34 (30)	Marinette	246 (57)	27% (70)	25.5% (58)	0.93 (66)
Eau Claire	223 (35)	17% (24)	16.9% (32)	-0.27 (31)	Forest	261 (67)	19% (43)	31.9% (70)	1.06 (67)
Grant	234 (47)	17% (27)	13.3% (17)	-0.20 (32)	Juneau	257 (64)	26% (68)	27.7% (65)	1.15 (68)
Price	229 (41)	15% (10)	19.3% (41)	-0.18 (33)	Sawyer	254 (61)	27% (71)	28.7% (67)	1.20 (69)
Vernon	221 (34)	23% (56)	12.3% (11)	-0.17 (34)	Ashland	285 (71)	16% (21)	31.5% (68)	1.30 (70)
Polk	216 (27)	19% (40)	21.0% (50)	-0.14 (35)	Adams	270 (69)	23% (60)	31.6% (69)	1.38 (71)
Dodge	236 (52)	15% (9)	18.0% (37)	-0.12 (36)	Menominee	387 (72)	46% (72)	40.6% (72)	4.24 (72)

Abbreviation: SAM, smoking-attributable mortality.

RESULTS

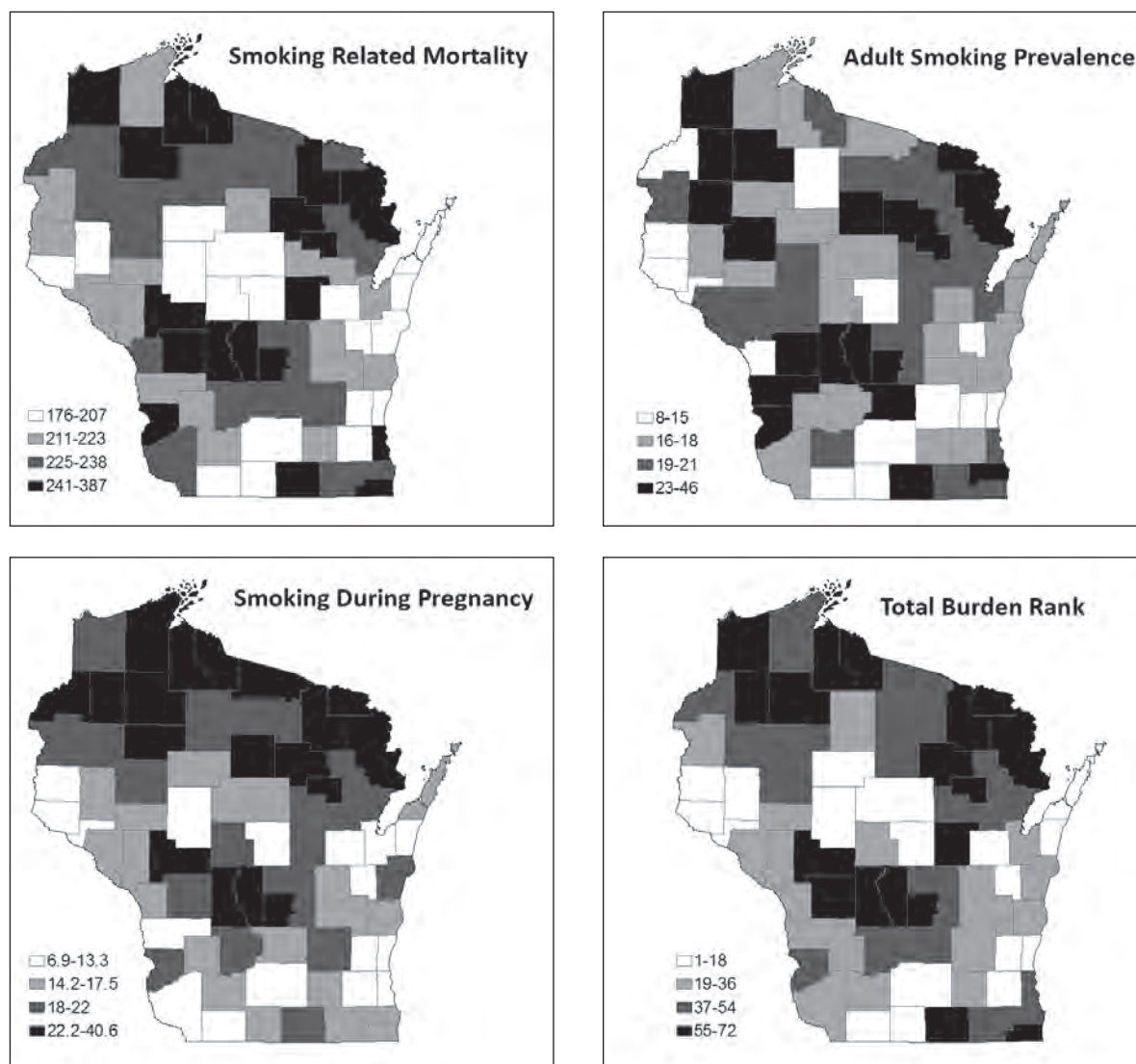
The median smoking-attributable mortality rate among Wisconsin counties during 2001 to 2010 was 225 deaths per 100,000 people, ranging over 2-fold, from a low of 176 in Calumet County to a high of 387 in Menominee County. Median adult smoking prevalence among Wisconsin counties during 2006-2012 was 19%, ranging over 5-fold, from a low of 8% in Lafayette County to a high of 46% in Menominee County. Menominee County had a significantly higher prevalence of adult smoking with the next highest prevalence of 27% seen in Marinette County. The median rate of women who smoked during pregnancy among Wisconsin counties during 2001-010 was 17.8%, ranging over 5-fold from a low of 6.9% in Ozaukee County to a high of 40.6% in Menominee County.

The summary smoking burden z-scores for each county ranged from a low of -1.64 in Calumet County to a high of +4.24 in Menominee County (Table). All 3 measures that comprised the burden of smoking were highly correlated with one another. The highest correlation was seen between mortality and adult smoking ($r=0.75$, $P<0.001$), followed by mortality and smoking during pregnancy ($r=0.71$, $P<0.001$), and adult smoking and smoking during pregnancy ($r=0.58$, $P<0.001$).

County Characteristics and County Smoking Burden

Statewide, smoking burden was generally highest in counties in the northern, central, and southeastern regions of the state, with lower rates generally seen in the western, north-central, northeastern, and Milwaukee suburban counties (Figure). While high rates

Figure. Wisconsin's 72 Counties Grouped Into Quartiles Based on Smoking-attributable Mortality (Deaths/100,000 Population); Adult Smoking Prevalence (%); Smoking Rates Among Pregnant Women (%), and Summary Rank of Relative Smoking Burden.



of smoking-attributable mortality were seen distributed throughout the state, including metropolitan areas, it appeared that adult prevalence and smoking during pregnancy were more confined to the northern counties and excluded larger metropolitan areas.

The overall smoking burden was greatest for the 34 rural counties (mean z-score = +0.35, range -1.23 Lafayette to +4.24 Menominee); was less in the 13 micropolitan counties (mean z-score = -0.19, range = -0.94 Portage to +0.93 Marinette); and lowest for the 25 metropolitan counties (mean z-score = -0.40, range -1.64 Calumet to +0.87 Douglas). The only statistically significant difference existed between metropolitan counties ($M = -0.40$, $SD = 0.65$) and rural counties ($M = +0.35$, $SD = 0.95$; $t(57) = -3.38$, 2-tailed), $P < 0.05$. This significant difference remained when Menominee County (a potential outlier) was

removed from the rural group.

Separate simple linear regression analyses showed that the smoking burden was greatest in those counties with more adult poverty ($r = 0.61$, $P < 0.001$), lower levels of education ($r = 0.50$, $P < 0.001$), and a higher percent of adult veterans ($r = 0.49$, $P < 0.001$). These 3 variables were then included in a multiple regression model to identify interactions. All 3 independent variables continued to significantly predict a portion of total smoking burden z-scores ($r^2 = 0.55$, $P < 0.001$). The counties' summary measure of smoking burden rank was highly correlated with the overall health outcome rank, obtained from the County Health Rankings (Spearman rank order correlation = 0.78). Of the 10 counties with the highest smoking burden, 5 were ranked as the 10 least healthy counties in the state. Similarly, of the 10 counties

with the lowest smoking burden, 7 were ranked as the healthiest 10 counties in the state.

DISCUSSION

Significant disparities between Wisconsin counties were observed for smoking-attributable death rates (2-fold), adult smoking prevalence rates (5-fold), and smoking in pregnancy rates (5-fold). These measures of the burden of smoking encapsulated problems due to smoking in the past (mortality data), current health concerns (adult smoking prevalence), and future anticipated smoking-related health problems (smoking during pregnancy). When combined, these factors provided a single summary measure of the relative smoking burden in each county that includes current health and economic burden from smoking-related diseases, as well as future health and economic burden related to higher smoking prevalence rates among adults and pregnant women.

Several demographic factors explained most of the variation in the overall burden from smoking, with the greatest burden occurring in rural counties and in counties with the highest rates of poverty, lowest rates of education, and a higher percent of a county's population that were veterans. These findings were consistent with previous research, and similar to the factors that were associated with higher rates of smoking among individuals.^{1,13-15} These disparities have increased over time, as the effects of tobacco control interventions have been most effective among persons with more education and living in wealthier communities.^{1,16}

The burden from smoking was greatest in Menominee County—with the highest rates in the state for smoking-attributable deaths, smoking among adults, and smoking among pregnant women. This finding is not unique to Wisconsin, as the prevalence of smoking and smoking-related diseases is higher in many American Indian communities across the nation.¹⁷ Some of this burden can be explained by the factors that have been associated with smoking throughout Wisconsin, as Menominee County is a rural community with high rates of poverty and lower rates of education. However, additional factors including the culture of tobacco use, availability of low-cost cigarettes, and differences in tobacco policies may explain this greater burden.

Limitations

Several limitations should be considered when interpreting the results from this study. First, only limited demographic data were examined for each county, and other factors—including current levels of tobacco control and prevention efforts—may explain the observed differences in smoking prevalence and smoking-attributable mortality. Second, the time period of data collected for smoking prevalence did not align with the data collected for smoking-attributable mortality and smoking during pregnancy. This was purposefully done to obtain an average after smoking prevalence rates stabilized statewide in the mid-2000s. The slight

differences in timeframe for data collection likely had little impact since the objective of this study was to create a practical tool to compare the relative burden of smoking using existing data. Third, measures of smoking among youth, such as data from the Wisconsin Youth Risk Behavior Survey (YRBS) are available only at the state level and therefore were not available to include in our analysis of individual counties. Fourth, when calculating the summary measure z-score, changing the weights for each of the factors may change the overall county rank (though these changes would be minor since the individual measures were highly correlated). Finally, this study used rates to identify whether smoking burden was equitably distributed among counties, though the absolute smoking burden is greatest in counties with larger populations.

CONCLUSION

The burden from smoking varies markedly across Wisconsin and is highest in the least advantaged counties in the state. Given the health effects from smoking, it is not surprising that counties with the highest burden from smoking are also those counties that rank as some of the least healthy in the County Health Rankings. Although it is likely that other social, cultural, and environmental factors contribute to these differences, much of the variability in smoking burden among Wisconsin counties can be attributed to rates of poverty, less education, and the number of veterans living in a county. Ultimately, this model of calculating relative smoking burden among counties can be used as a single measure to help identify counties with successful tobacco control and prevention programs and policies, as well as identifying counties in need of investments for improvement.

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A Brief Clinical Update on Hepatitis C—The Essentials

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ABSTRACT

Infection with the hepatitis C virus (HCV) is a common cause of cirrhosis and liver failure and the most common indication for liver transplant in the United States. Based on the prevalence of HCV infection at 1.3% of the US population, there are an estimated 74,000 people living with HCV infection in the state of Wisconsin, the majority of whom are undiagnosed. HCV infections in Wisconsin have increased, reflecting the increasing use of intravenous heroin in the state. This review discusses up-to-date guidelines for screening, diagnosis, and treatment of HCV. New direct-acting antiviral medications have revolutionized the treatment of HCV with significantly improved outcomes. High cost and limited availability of these medications present challenges in overall management of HCV.

BACKGROUND AND EPIDEMIOLOGY

Infection with the hepatitis C virus (HCV) is a common cause of cirrhosis and liver failure and the most common indication for liver transplant in the United States. HCV is a single-stranded RNA virus that is transmitted via blood. It is estimated that over 4 million people in the United States are infected with HCV.¹ Risk factors for transmission include IV drug use, sexual intercourse with someone who uses IV drugs, chronic hemodialysis, and blood transfusions prior to 1992.²

The epidemiology of HCV in Wisconsin reflects national trends. As of December, 2013, the Wisconsin Department of Health had

received 38,354 reports of HCV infection.³ Based on the prevalence of HCV infection at 1.3% of the US population, there are an estimated 74,000 people living with HCV infection in the state of Wisconsin, the majority of whom are undiagnosed. HCV incidence has slowly increased since 2006, with an average of 2500 new cases each year.³ In 2013, Milwaukee County accounted for about 22% of all new cases, and 10% came from the Wisconsin correctional system.³ Males accounted for 57% of new cases, with increasing numbers of infections identified

in men ages 50 to 69 (Baby Boomers).^{3,4} Non-Hispanic blacks were 2 times as likely, and American Indians 3 times as likely, to be diagnosed with HCV infection as non-Hispanic whites.³ HCV incidence in people under 30 years of age has increased from 5% in 2003 to 27% in 2013 with the concomitant rise in heroin use, reflecting intravenous (IV) transmission.³

In 2012, there were 3865 hospitalizations in Wisconsin for HCV infection.³ Of these hospitalizations, almost a third also had a diagnosis of liver disease, a quarter had alcohol abuse and 10% had IV drug use. Males ages 50 to 69 were hospitalized at higher rates than females, reflecting high risk behaviors in the past. Recent statistics show similar rates of HCV infections in young people of both genders, which may lead to a more equal hospitalization rate in the future.³ Approximately 20% of all liver transplants performed in Wisconsin from 2009 to 2012 were due to chronic hepatitis C infection.³

Mortality in people with HCV infection is estimated at 3 times higher than in people without the infection.⁴ People with HCV infection die on average 22 years younger than people without the infection, and are more likely to have cirrhosis and liver and renal failure.⁵ The number of HCV-related deaths in Wisconsin more than doubled from 2000 to 2011 to almost 160.

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Screening

In 2013, the United States Preventive Services Task Force (USPSTF) recommended screening for HCV infection in adults



CME available. See page 270 for more information.

Table 1. Risk Factors for HCV

Risk Factors Identified by the USPSTF, the AASLD/IDSA, and the CDC^{6,7,9}
Born between 1945 and 1965

Risk Factors Identified by the USPSTF and the AASLD/IDSA^{6,7}

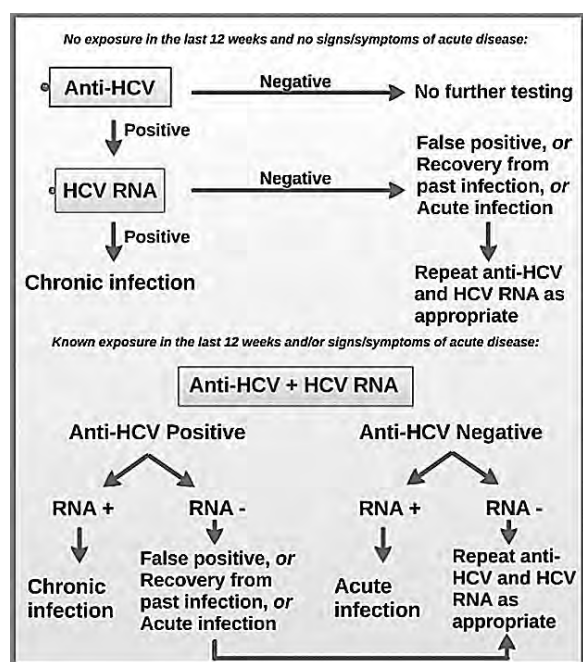
Past or current injection drug use
Receiving a blood transfusion before 1992
Long-term hemodialysis
Being born to an HCV-infected mother
Incarceration
Intranasal drug use
Getting an unregulated tattoo
Other percutaneous exposures

Risk Factors Identified by the AASLD/IDSA Only⁷

HIV infection
Unexplained chronic liver disease
Chronic hepatitis including elevated alanine aminotransferase levels
Solid organ donor

Abbreviations: HCV, hepatitis C virus; USPSTF, United States Preventive Services Task Force; AASLD/IDSA, The American Association for the Study of Liver Diseases/Infectious Diseases Society of America; CDC, Centers for Disease Control and Prevention.

Figure. Diagnosis of Hepatitis C



at increased risk of infection and 1-time screening in all adults born between 1945 and 1965 (Grade B recommendation).⁶ Immunoassay for HCV antibody is the preferred initial screening test for all patients, though nucleic acid amplification testing (NAT) for HCV RNA should be considered for patients with concern for exposure in the last 6 months; who are immunocompromised; or who may have been reinfected after clearing or

treating a previous infection.⁷ While no studies have attempted to link HCV screening with reduced morbidity or mortality, the USPSTF did find adequate evidence that screening tests accurately diagnose HCV infection, and that treatment with antiviral medications leads to sustained virologic response (SVR) and improved clinical outcomes.

The 2013 USPSTF review evaluated 5 studies that compared different screening strategies targeting multiple risk factors for HCV infection.⁸ No 2 studies evaluated the same strategy, but all 5 confirmed that screening strategies based on risk factors were associated with sensitivity greater than 90% and small numbers (<20) needed to screen to identify 1 case of HCV infection. Individuals with continued risks should be screened periodically, but there is not evidence to define frequency of testing. While there are no published studies evaluating the effectiveness of a birth cohort-based screening strategy, the recommendation was expanded to include persons born between 1945 and 1965, based on several factors: 76.5% of HCV prevalence occurs in this age group; previous risk-based screening was ineffective in clinical practice due to poor understanding and application of screening guidelines; and 45% to 85% of HCV-infected individuals were unaware of their infection status. These patients are more likely to be diagnosed with HCV, either because of a history of blood transfusion or presence of other, decades-old risk factors^{6,7,9} (Table 1).

The initial screening test for HCV is a serologic assay for HCV antibody (anti-HCV). A systematic review found that the sensitivity of enzyme immunoassays (EIAs) for anti-HCV ranges from 97.2% to 100% when compared to NAT, which encompasses polymerase chain reaction (PCR) as a gold standard. Data regarding the specificity of EIA are limited, but in the studies available specificity ranged from 97% to 100% when compared to PCR, even though 15% to 45% of patients who are EIA-positive are not viremic.⁸ Since the 2004 review, a rapid test for anti-HCV has become available and has received a Clinical Laboratory Improvements Amendments waiver to allow for point-of-care testing in nontraditional settings; its sensitivity and specificity are comparable to traditional anti-HCV testing.¹⁰

Diagnosis

As described above, testing for chronic HCV begins with serologic testing for anti-HCV antibody. Serologic tests are both sensitive and specific for HCV infection. If serologic testing is negative for anti-HCV, no further testing is needed. If serologic testing is positive for anti-HCV, then testing for the presence of HCV RNA is the next step in evaluation (Figure). If anti-HCV serology and HCV RNA are both positive, chronic HCV infection is confirmed. If anti-HCV serology is positive but HCV RNA is negative, there are 3 possible explanations: (1) the patient has completely recovered from a past HCV infection; (2) the initial serologic test was falsely positive; or (3) the patient is acutely

Table 2. Measures of Liver Fibrosis

Measure	Commentary
Invasive	Invasive testing is the gold standard for evaluation of liver fibrosis because it distinguishes between a minimum of 3 stages of fibrosis: early/none, intermediate, and advanced/cirrhosis. ¹³ Staging historically has informed treatment decisions. However, with the advent of novel pharmacotherapies, recommendations around fibrosis evaluation and timing of treatment are in flux. ¹²
Liver biopsy	Liver biopsy distinguishes between stages of fibrosis, which may aid in treatment decisions and in determining need for ongoing screening. It also assesses severity of inflammation and/or steatosis and helps rule out other causes of liver injury. ⁷ However, it has small but real risks of pain, bleeding, and organ perforation. ¹²
Noninvasive	Noninvasive tests avoid the risks associated with liver biopsy, but have lower sensitivity and specificity and are unable to distinguish minimal disease from intermediate fibrosis. ¹³
Bedside evaluation (age, history, and physical examination)	Bedside evaluation includes assessment of disease duration, age of onset, degree of alcohol exposure, co-existing disease such as HIV, physical examination, and routine laboratory testing and imaging. Bedside evaluation accurately distinguishes minimal from advanced fibrosis but fails to identify intermediate stages. ¹³
Routine laboratory tests (AST, ALT, GGT, cholesterol, platelet count, insulin resistance)	An assortment of routine laboratory tests, and ratios between them, are used to assess liver fibrosis. All have low sensitivity, specificity, or both. ¹³
Proprietary test panels (PGA or PGAA index, Fibrotest)	Proprietary blood test panels and algorithms are not necessarily superior to routine laboratory tests. ¹³
Specialized blood or breath tests (clearance of indocyanine green, sorbitol, or galactose; C-galactose and C-aminopyrine breath tests; MEGX test; Fibroscan; European Liver Fibrosis test)	Many specialized tests have been developed to assess hepatic perfusion and metabolic capacity and the presence of extracellular matrix components that may indicate increased levels of fibrogenesis and fibrolysis; some proprietary panels combine some of these tests with more conventional approaches. These tests all lack sensitivity to detect early or intermediate fibrosis. ¹³
Conventional imaging (ultrasound, computed tomography [CT])	Conventional imaging with CT or ultrasound detect advanced disease reliably but typically miss minimal or intermediate fibrosis. ¹³
Transient elastography	Transient elastography combines ultrasound with low-frequency elastic waves to measure liver elasticity. However, because its signal only penetrates 25mm to 65mm, its use is limited in obese patients or those with ascites. False positive results have occurred in patients with acute inflammation. ^{12,13}

Abbreviations: AST, aspartate aminotransferase; ALT, alanine aminotransferase; GGT, gamma-glutamyl transferase; PGA, prothrombin time, gamma glutamyl transferase, apolipoprotein A1); PGAA, prothrombin, gamma glutamyl transferase, apolipoprotein A1, alpha-2 macroglobulin.

infected with HCV but has not yet generated significant viremia. In these situations, repeat HCV RNA testing in 4-6 months distinguishes acute HCV infection from recovery from old infection.¹¹ HCV RNA may be detected as little as 2 weeks following exposure,¹² so earlier repeat testing also may be reasonable.

If the patient presents with symptoms or signs concerning for acute infection, or if there is concern for recent HCV exposure, serologic testing and testing for HCV RNA should be performed simultaneously. HCV RNA may be positive as early as 2 weeks following infection, while anti-HCV does not typically appear on serologic testing until 8 to 12 weeks after infection. If there is sufficient concern for acute exposure but both serology and RNA are negative, antibody testing may be repeated in 4 to 6 months. Simultaneous anti-HCV and HCV RNA testing also is indicated in situations where serology may be falsely negative, for example in those who are immunocompromised, on hemodialysis, or have HIV.¹¹ Once the diagnosis of HCV infection has been made, HCV genotype should be determined, as this will guide treatment decisions. Baseline viral load should be documented before initiating therapy.⁷

In patients with confirmed HCV infection, the American

Association for the Study of Liver Disease/Infectious Diseases Society of America (AASLD/IDSA) recommends evaluating for liver fibrosis and cirrhosis as a way of determining appropriate treatment strategy and need for additional evaluation; eg, hepatocellular carcinoma screening, which is recommended every 6 months in patients with advanced fibrosis.⁷ Liver biopsy is the gold standard for assessing fibrosis and cirrhosis, but is associated with added medical cost and risks including perforation of other organs, bleeding, pain, and anxiety.¹¹ Many noninvasive alternatives for evaluating fibrosis are currently in use, including blood and imaging tests; and in its 2014 guidelines the AASLD/IDSA recommended liver biopsy, imaging, or noninvasive markers^{7,12, 13} (Table 2). There is no consensus that any one noninvasive alternative to biopsy is the best.

Clinical Course

The time course of acute HCV infection has been difficult to clearly define, as most individuals have mild, nonspecific symptoms at the onset of infection, and therefore do not seek care, going undiagnosed.¹⁴

In a prospective cohort of 632 individuals identified through clinical referral, prison surveillance, or community

outreach with documented HCV seroconversion or those with acute, symptomatic HCV infection, about half of participants reported symptoms consistent with acute infection.¹⁵ The most commonly reported symptoms are self-limited flu-like symptoms, but a few individuals develop the typical symptoms of hepatitis, including jaundice, abdominal pain, anorexia, and dark urine. Fifteen percent to 25% of acutely infected individuals spontaneously clear the viremia, while 75% to 85% of individuals develop chronic HCV infection, defined as the presence of HCV RNA in the blood for at least 6 months. While greater than 80% of clearance of HCV occurs within the first year after infection, spontaneous clearance of HCV after acute infection can vary considerably; in 1 prospective study of 179 IV drug users, clearance varied from 94 to 620 days after initial viremia.¹⁶ Re-infection after clearance of acute HCV has been documented in HIV-positive patients.

For the vast majority of patients, the clinical course of chronic HCV infection remains benign. The majority are asymptomatic. The most common symptoms include mild arthralgias and myalgias. Mild, fluctuating elevations of liver enzymes occur during the course of the illness. HCV infection commonly has been associated with several hematologic, rheumatologic, dermatologic, renal, and endocrine disorders in several small, observational studies. However, the prevalence of many of these disorders is confounded by the presence of other risk factors. A case control study of 34,204 hospitalized veterans with HCV infection showed an increase in the prevalence of porphyria cutanea tarda, lichen planus, vitiligo, cryoglobulinemia, membranoproliferative glomerulonephritis, and non-Hodgkin's lymphoma.¹⁶ While this study did show an association of HCV infection with diabetes, the association was not statistically significant after controlling for age. However, a later meta-analysis of 34 retrospective and prospective case control studies showed an increased risk of diabetes (OR 1.8, CI 1.20-2.40) in patients with HCV infection.¹⁷ The prevalence of mixed cryoglobulinemia is extremely variable in several series, with rates as low as 1.9% and as high as 51% in individuals with HCV infection; conversely, the prevalence of patients with essential cryoglobulinemia with either anti-HCV antibodies or HCV RNA in serum or precipitate is widely variable, but greater than 80% in some series.¹⁶⁻¹⁹ Only about one-quarter of individuals develop clinical manifestations of cryoglobulinemia syndrome, which include glomerulonephritis, peripheral neuropathy, purpura, and arthritis.

In chronic HCV infection, 10% to 20% of individuals develop cirrhosis, typically over 20 to 30 years. However, the course of progression is highly variable and nonlinear, depending on several demographic factors. Younger age, female sex, and white race are associated with lower risk of progression to advanced liver disease.¹⁴ Of patients with who develop cirrhosis from HCV, 1% to 4% will develop hepatocellular carcinoma (HCC) each year, and 20% per year will further progress to decompensated cirrhosis. Once signs of decompensation develop, the 5-year mortality rate approaches 50%.¹⁴ Chronic HCV infection is the most common reason for liver transplant in the United States.

Razavi et al developed a model to project the progression of disease and the future cost burden of HCV.²⁰ The peak prevalence of chronic HCV occurred in 1994 and is now declining. Due to the lag time of the development of cirrhosis, the peak prevalence of compensated cirrhosis will occur in 2015, with the peak in decompensated cirrhosis in 2019, the peak in HCC in 2018, and peak in liver-related deaths in 2020.

Several factors can impact the trajectory of HCV liver disease. Alcohol use of greater than 50 grams per day and metabolic syndrome have been associated with acceleration of fibrosis, and even HCC.^{21,22} Treatment of chronic HCV infection with pegylated interferon with ribavirin that achieves SVR has been shown to reduce (1) progression to fibrosis and cirrhosis, (2) incidence of HCC, (3) liver-related complications (ascites, encephalopathy, gastrointestinal bleeding), (4) liver-related deaths, and (5) all-cause mortality.²³ Long-term outcomes with new direct-acting antivirals for hepatitis C are not yet known. However, in a meta-analysis of 49 studies including 8534 individuals, the 5-year re-infection after SVR was 0.9% in "low risk" patients, and as high as 21.8% for HIV/HCV co-infected patients.²⁴

In chronic HCV infection, HCC occurs almost exclusively in patients with cirrhosis. Screening for HCC in the setting of chronic HCV infection should therefore be limited to individuals with advanced fibrosis, as described above.

Prevention of Progression and Transmission of HCV Infection

Abstinence from alcohol is recommended, despite the lack of consistent evidence that smaller doses of alcohol contribute to progression of liver disease. In addition, brief intervention for at-risk alcohol use, and treatment and referral for alcohol use disorder is effective in reducing alcohol use in HCV-infected individuals. Due to similar risk factors and worse prognosis, all HCV-infected patients should be evaluated for HIV and HBV infections. Hepatitis A and B vaccine series should be completed for susceptible patients. IV drug users should be counseled on safe practices, including needle exchange. HCV is not transmitted through casual household contact. Sexual transmission of HCV is rare, but may be much higher amongst heterosexuals with increasing numbers of partners and men who have sex with men, particularly when partners are HIV co-infected.

Pharmacotherapy of Active HCV Infection

From the early to mid-1990s treatment for hepatitis C focused

on the use of standard interferon.²⁵ Early treatment regimens resulted in sustained virologic response (SVR) ranging from 6% with 6-month treatment to 12% with a 12-month treatment course. The addition of ribavirin to standard interferon in the mid-1990s improved SVR to 34% with 6-month therapy and 42% with 12-month therapy. The introduction of pegylated interferon (peginterferon) mono-therapy in early 2000 improved SVR to 39% with 12 months of treatment, and to up 55% when co-administered with ribavirin. Until recently, peginterferon and ribavirin have been the mainstays of treatment with activity against all hepatitis C genotypes.²⁶

Two protease inhibitors, boceprevir and telaprevir, were the first generation of direct-acting antiviral (DAA) agents introduced in early 2011 as additions to traditional peginterferon and ribavirin regimens.²⁶ These agents improved SVR rates up to 75% in some subgroups of patients. But regimens containing interferon and ribavirin remained complex with the need for injections, long durations of treatment and significant side effects. Rapid development of new DAA agents since the fall of 2013 has brought improvement in SVR, shorter treatment duration, and shift from need for interferons and ribavirin, thus reducing adverse events and simplifying medication administration (Table 3).

The second-generation DAA agents have unique pharmacological and pharmacokinetic profiles. Table 4 describes the mechanism of action, basic dosing recommendations, metabolic pathways, drug interactions, and side effects.

While treatment is recommended for all patients with chronic hepatitis C infection, those with advanced fibrosis, compensated fibrosis, liver transplants, and extrahepatic disease are recommended for immediate treatment.⁷ Before starting treatment for hepatitis C, drug interactions should be evaluated because patients with hepatitis C tend to be older and may have comorbid conditions, including HIV and history of organ transplant.³¹ In patients being treated for HIV or using immunosuppressive agents, significant drug interactions are possible with some DAA agents. A website developed by the University of Liverpool (www.hep-druginteractions.org) may be useful in exploring potential drug-drug interactions.

Baseline laboratory tests including complete blood cell count (CBC), international normalized ratio (INR), hepatic function panel, thyrotropin (TSH) (if interferon is part of regimen), and glomerular filtration rate (GFR) should be obtained as well as hepatitis C genotype and subtype and quantitative viral load. Monitoring of CBC, creatinine, GFR and hepatic panel should be repeated 1 month after beginning treatment.

Table 3. Introduction of Second Generation Direct-Acting Antivirals for Treatment of Hepatitis C and Sustained Virologic Response (SVR) Outcomes

FDA Approval	Regimen	SVR %
November 2013 ^{26,27}	simeprevir (Olysio)+ribavirin +/-peginterferon	59-100
December 2013 ^{26,28}	sofosbuvir (Sofvaldi)+ribavirin+/-peginterferon)	59-93
October 2014 ^{26,29}	ledipasvir/sofosbuvir (Harvoni)	94-99
November 2014 ²⁶	sofosbuvir+simeprevir	92
December 2014 ³⁰	ombitasvir/paritaprevir/ritonavir+dasabuvir (Viekira Pak)	91-100

Abbreviations: SVR, sustained virologic response; FDA, Food and Drug Administration.

For regimens with peginterferon, TSH should be obtained every 12 weeks. Quantitative viral load testing also is recommended to monitor response during treatment.

Pharmacologic recommendations for therapy are based on hepatitis C genotype (and subtype), whether this is initial treatment or retreatment, and degree of fibrosis.⁷ For patients undergoing initial treatment, the presence or absence of cirrhosis influences therapy, and in those patients who have experienced treatment failure, the type of treatment previously received and the presence or absence of cirrhosis also influences recommendations. Because of the frequent changes in treatment recommendations, the most up-to-date information should be obtained from the website: <http://www.hcvguidelines.org>.

The newer DAA medications and combinations form the cornerstone of initial treatment of all 6 hepatitis C genotypes.⁷ For example, for treatment-naïve patients with genotype 1b, the 3 combinations of DAA agents approved in 2014 are recommended as initial therapy. While other genotypes are treated with different drug combinations, all regimens include newer DAA medications.

Insurance coverage for medications has garnered significant attention due to the cost of the newest treatment options, which typically exceed \$100,000 per course of therapy. Prior authorization criteria of several Dane County insurance providers typically include presence of advanced fibrosis or cirrhosis, HCC, or failure of pegylated interferon with ribavirin. The prescription needs to be written by physicians in the following specialties: gastrointestinal (GI), hepatology, infectious disease, or transplant medicine. Patients are excluded if they have advance renal disease. The restriction of use of the most effective regimens for HCV to specialty practitioners as well as the enormous cost may limit the ability to address the current HCV disease burden. Prediction models show that a combination of increased diagnosis, increased treatment, and high efficacy therapies offer the largest reduction in HCV-related morbidity and mortality.³² Comanagement of patients between specialty and primary care providers offers one promising solu-

Table 4. Direct Acting Antivirals Pharmacologic Profiles

Direct-Acting Antiviral Side Effects	Class	Administration	Elimination	Drug Interactions	
simeprevir ²⁶	NS3A/4 protease inhibitor	Take with food; 150 mg once daily	Highly protein bound; metabolism CYP450 3A	Many drug interactions possible —eg, CYP3A4 inducers and inhibitors	Rash, pruritis, photo sensitivity, transient increase in bilirubin
sofosbuvir ²⁶	NS5B polymerase inhibitor	Take without regard to food; 400 mg once daily	Prodrug—requires metabolism to active form. Renal elimination (80%)	Inducers of P-glycoprotein may decrease concentration	Mild to moderate fatigue, headache, insomnia, diarrhea, and anemia
ledipasvir ³¹	NS5A inhibitor	Take without regard to food; 90 mg once daily	Highly protein bound; excreted via feces	No significant CYP450 activity; inducers of P-glycoprotein may reduce concentration; increases in stomach pH may decrease solubility and concentration of ledipasvir.	Since studied in combination with sofosbuvir, similar profile
ombitasvir/ ^{33,34} paritaprevir/ritonavir and dasabuvir	NS5A inhibitor NS3/4A protease inhibitor No antiviral properties-booster nonnucleoside and NS5B polymerase inhibitor	Take with food; (ombitasvir 25 mg plus paritaprevir 150 mg plus ritonavir 100 mg combination tablet) 1 tablet daily along with dasabuvir 250 mg tablet twice daily	All agents highly protein bound; ombitasvir is hydrolyzed, other 3 agents metabolized by CYP450; ritonavir is highly potent CYP450 inhibitor.	Combination may have inhibitory effect on metabolism of drugs like pravastatin, rosuvastatin ARBs, and calcium channel blockers; CYP3A inducers may decrease concentration; CYP2C8 inhibitors may increase dasabuvir concentration.	Overall well-tolerated when not used with ribavirin; paritaprevir associated with transient bilirubin elevation.

tion to manage the upcoming surge of HCV-infected patients who will be identified by broader screening and would benefit from medical therapy.

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Quiz: A Brief Clinical Update on Hepatitis C— The Essentials

EDUCATIONAL OBJECTIVES

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

1. Recognize appropriate screening procedures for individuals at risk for hepatitis C virus (HCV) infection.
2. Describe the possible clinical course for patients infected with HCV.
3. Describe the current treatment programs for patients infected with HCV.

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QUESTIONS

1. Which of the following statements about HCV infection is false:
 - ☐ A. The prevalence of HCV infection in the US population is thought to be about 1.3%.
 - ☐ B. In Wisconsin, among patients hospitalized for HCV infection, almost a third had a diagnosis of liver disease, a quarter had alcohol abuse, and 10% had intravenous drug use.
 - ☐ C. People with HCV infection die on average 22 years younger than people without the infection.
 - ☐ D. The number of HCV-related deaths in Wisconsin declined from 2000 to 2011.
 - ☐ E. None of the above.

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2. Which of the following statements about screening for HCV infection is true:
 - ☐ A. Nucleic acid testing (NAT) for HCV RNA is the preferred initial screening test for all patients.
 - ☐ B. A systematic review found that the sensitivity of enzyme immunoassays (EIAs) for HCV antibody (anti-HCV) ranges from 97.2% to 100%.
 - ☐ C. If serologic testing is positive for anti-HCV, no further testing is recommended.
 - ☐ D. If anti-HCV serology is positive but HCV RNA is negative, it is highly unlikely that an acute or chronic HCV infection is present.
 - ☐ E. None of the above.
3. The majority of individuals infected with HCV develop the typical symptoms of hepatitis, including jaundice, abdominal pain, anorexia, and dark urine.
 - ☐ True.
 - ☐ False.
4. The following factors can affect the progression of HCV hepatic disease.
 - ☐ A. Alcohol use over 50 grams per day.
 - ☐ B. The presence of metabolic syndrome.
 - ☐ C. Treatment of chronic HCV infection with pegylated interferon with ribavirin that achieves sustained virology response.
 - ☐ D. All of the above.
 - ☐ E. None of the above.
5. Which of the following factors have been identified as risk factors for HCV infection:
 - ☐ A. Born between 1970 and 1984.
 - ☐ B. Female gender.
 - ☐ C. Long-term hemodialysis.
 - ☐ D. Receiving a blood transfusion before 1980.
 - ☐ E. All of the above.
 - ☐ F. None of the above.

Successful Treatment of Collagenous Gastritis in a Child With a Gluten-Free Diet

Raza U. Bajwa, MD; Aditya Joshi, MD, MPH; Janice B. Heikenen, MD

ABSTRACT

Collagenous gastritis is a rarely encountered disease entity first described in 1989, and it is very rarely reported in children. We report the case of a 13-year-old boy with clinical, endoscopic, and histological findings of collagenous gastritis who reported rapid and sustained symptom resolution on a gluten-free diet.

INTRODUCTION

Collagenous gastritis (CG) is a rarely encountered disease entity first described by Colletti and Trainer in 1989.¹ Few of the subsequently published case reports involve children.^{2,3} Although clinical symptoms and endoscopic findings are variable, diagnosis is based on standard histological criteria from an intestinal mucosal biopsy specimen.³ The etiology, pathogenesis, and natural history of CG remain unclear. A variety of therapeutic interventions have been attempted without uniform improvement. We report a 13-year-old boy with clinical, endoscopic, and histological findings of CG who reported rapid and sustained symptom resolution on a gluten-free diet.

CASE PRESENTATION

A 13-year-old boy with no prior medical illness presented with a 6-month history of generalized abdominal pain; frequent loose, nonbloody stools; and a 5-pound weight loss. Outpatient laboratory evaluation consisting of complete blood count with differential, complete metabolic panel, *Helicobacter pylori* antibodies, free T4 and TSH (thyroid-stimulating hormone), inflammatory markers, and a celiac panel (serum immunoglobulin A [IgA] lev-

els, endomysial, and tissue transglutaminase antibodies) was normal. Celiac genetics were performed due to a maternal history of “gluten sensitivity” with heterozygosity for HLA-DQ8/HLA-DQ2. Stools on several occasions were negative for bacterial and parasitic pathogens, and no occult blood was detected. A computed tomography scan of the abdomen and pelvis was unremarkable.

phly scan of the abdomen and pelvis was unremarkable.

An esophagogastroduodenoscopy with unrestricted gluten exposure was notable for diffuse nodularity involving the gastric body and fundus with antral sparing (Figure 1). The gastric body showed gastritis, and the antrum showed mild chronic gastritis. The duodenum showed normal villi and normal disaccharidases. Colonoscopy was visually normal with normal histological appearance. Histology from the upper gastrointestinal tract revealed thickening of the collagen table (Figure 2).

Following the endoscopic evaluation, the patient was placed on a gluten-free diet with symptom abatement at 1 month and resolution at 6 weeks. Repeat esophagogastroduodenoscopy at 6 months showed a subjective normalization of the fundus, with unchanged gastric body nodularity and persistent antral sparing (Figure 3). The patient's abdominal pain resolved and his stools normalized, with resumption of appropriate weight gain. Histology showed improvement and continued normal linear growth velocity. He continues to do well on a gluten-free diet 3 years following diagnosis, with only transient diarrhea attributed to known gluten exposure.

DISCUSSION

Collagenous gastritis (CG) is an uncommon diagnosis, particularly in children. Clinical symptoms are variable and appear to have 2 age-related subgroups. Children and young adults present with upper abdominal pain and anemia, with disease limited to the gastric mucosa. Adults generally experience watery diarrhea and can manifest with associated collagenous colitis.³⁻⁵ Significant overlap occurred in our patient, as in other case reports. Collagenous enterocolitides may represent an age-related spectrum. Endoscopic findings in published case reports con-

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Figure 1. Diffuse Nodularity Involving the Gastric Body and Fundus on Initial Endoscopy

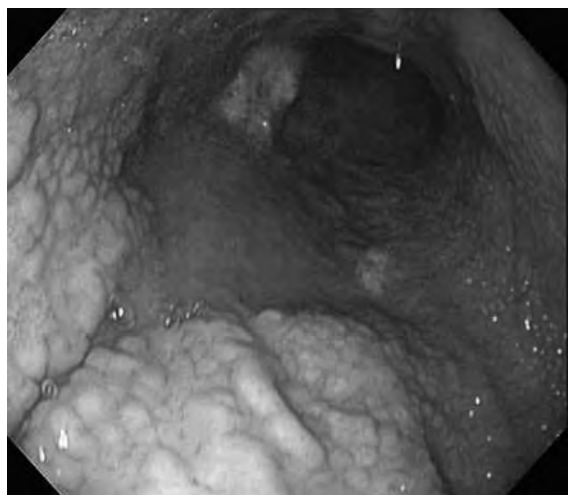
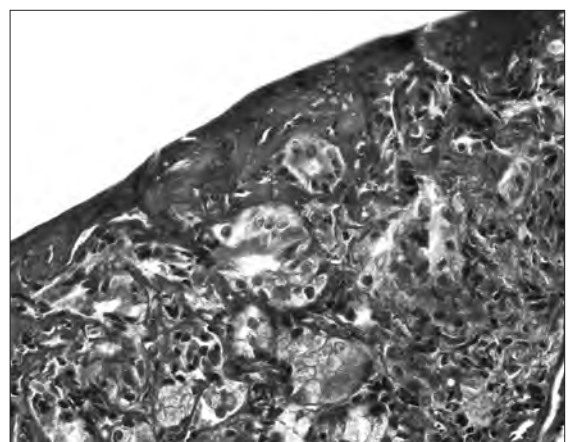


Figure 2. Gastric Mucosa With Thickening of Collagen Table Consistent With Collagenous Gastritis



Masson trichrome stain, original magnification x400.

tently describe nodularity in the stomach along the greater curvature with variable antral sparing, and accompanying histological findings are consistent with subepithelial collagen deposition,⁶ which also is seen in collagenous colitis and collagenous sprue. Several hypotheses have been proposed to explain the increased subepithelial collagen deposits including chronic inflammation and autoimmunity, abnormality of the pericryptal fibroblast sheath and plasma protein, and fibrinogen leakage with subsequent collagen replacement.³ These mechanisms of subepithelial collagen deposition involve a reparative process in response to a prior inflammatory, infectious, or toxic insult. An intriguing possibility includes the pathogenetic role of an altered immune

Figure 3. Gastric Mucosa With Patchy Collagenous Involvement While on Gluten-free Diet



Masson trichrome stain, original magnification x400.

response to a luminal agent triggering an inflammatory response with subsequent collagen deposition.⁶ It may be that CG is a feature of a diffuse disease process rather than a distinct disorder.^{3,7} Celiac disease has been associated with CG in adults, although a causal relationship is unclear.⁸ Although our patient did not have histologic evidence for celiac disease, removal of dietary gluten resulted in symptom resolution, which raises the question of the role of gluten in some individuals with CG.

There is marked variability in mucosal changes among patients with celiac disease, nonceliac gluten sensitivity, and collagenous gastritis. Celiac disease presents with an increased number of intraepithelial lymphocytes (>25 per 100 enterocytes), elongation of crypts, and partial to total villous atrophy.⁹ In nonceliac, gluten-sensitive patients, the histological pictures show minor abnormalities with intraepithelial lymphocytes in their duodenal mucosa.¹⁰ However, patients with CG have the defining feature of subepithelial collagen deposition. Arnason et al reported marked heterogeneity in associated inflammatory pattern.¹¹ In 40 patients with CG, there were increased intraepithelial lymphocytes in 5 patients, eosinophil-rich pattern was noted in 21 patients, and in 7 patients biopsy noted atrophic gastric mucosa.¹¹

The natural course and treatment of CG is unknown. A variety of interventions including topical and systemic anti-inflammatory therapies, acid suppression, and gluten elimina-

tion have not resulted in consistent symptomatic or pathologic improvement.³ In our patient, a gluten-free diet appeared to be an effective treatment for the management of his gastrointestinal symptoms. Although the precise pathogenic mechanism of CG is unknown, intraluminal gluten may be involved in the pathogenesis and/or symptoms of CG. Treatment with a gluten-free diet should be considered for pediatric patients diagnosed with CG. Further research may help uncover factors that can assist in determining whether a gluten-free diet may be efficacious for a given patient.

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Howard H. Bailey, MD



Robert N. Golden, MD

Serving the State Through Medical Research

Howard H. Bailey, MD; Robert N. Golden, MD

One of the main goals of the University of Wisconsin School of Medicine and Public Health (UWSMPH) and the UW Carbone Cancer Center (UWCCC) is to foster continued, productive interactions with the excellent health care systems and providers throughout Wisconsin. This is valuable on multiple levels. First, Wisconsin's residents want it. Ten years ago, during the public forums on the pending privatization of Blue Cross & Blue Shield United of Wisconsin, attendees repeatedly shared that they wanted broader access to the health innovations of the state's medical schools. Second, health care leaders recognize that regionalization of health care discovery/clinical research¹ is an important goal for the following reasons:

- Research regionalization is more efficient in terms of accrual time due to the larger pool of potential participants and because it incorporates "real world" providers in the design and performance of health care interventions.

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- More inclusive research participation leads to more efficient dissemination and wider application of the knowledge gained, insuring that clinicians provide the most current standard of preventive and therapeutic care.

Regionalization of health care research, in general, is more amenable in Wisconsin due to advantageous characteristics of our state, including:

- a stable population with limited out-migration.
- the excellent clinical/translational research originating in the state.
- a history of overwhelming acceptance and participation in clinical research by Wisconsin residents, which is exceptionally high compared to other regions of the country.
- a rich diversity of populations, eg, rural, urban, and underserved minority populations (African-American, Hispanic, Native American, Hmong).

Specific to cancer, statewide collaboration offers major benefits because health care research findings (mammography screening and breast cancer mortality) in Wisconsin most closely represent and model results in the United States.² Our rich history of research demonstrates the value of state and/or community participation. Examples of Wisconsin residents' willingness to participate in health care research are evidenced by:

- **The Wisconsin Longitudinal Study**—This

project involved collecting extensive health and social information from a random sample of 10,317 men and women who graduated from Wisconsin high schools in 1957 and from their randomly selected brothers and sisters.³ As the first large-scale, longitudinal investigation of American adolescents, this provided an opportunity to study participants' life course from late adolescence through their early- to mid-60s. This study continues to provide access to important health and social data for researchers worldwide.⁴

- **The Wisconsin Epidemiological Study of Diabetic Retinopathy (WESDR)**—Initiated in 1979 by Drs Barbara and Ronald Klein, this study was designed to describe the frequency and incidence of complications associated with diabetes; identify risk factors that may contribute to the development of these complications; and assess health care delivery for people with diabetes.⁵⁻⁶ Data from WESDR has been used in developing national and international guidelines for eye care for people with diabetes. This work also led to the following Wisconsin studies of international importance: The Beaver Dam Eye Study,⁷ the Epidemiology of Hearing Loss Study,⁸ and the Wisconsin Epidemiologic Study of Cardiovascular Disease in Diabetes.⁹
- **The Survey of the Health of Wisconsin**—This statewide study, which combines public health and biomedical perspectives, was

launched in 2008 and has already enrolled more than 4500 subjects. Supported by the Wisconsin Partnership Program, it will provide important epidemiologic and clinical data that will identify risk factors for a wide variety of diseases and offer insights into ways we can promote health.

UWCCC researchers recognize the value of collaborating with health care systems and community-based providers in improving accrual rates, providing greater access to “cutting edge” health care research, and improving knowledge dissemination based on evidence that health care providers who participate in clinical trials are more likely to incorporate new knowledge into their practice.¹⁰

For example, the advent of the Department of Family Medicine and Community Health’s Wisconsin Research and Education Network has led to cancer-related studies in primary care practices throughout Wisconsin.¹¹ In 1998, the UWCCC initiated a network of clinical researchers (Wisconsin Oncology Network, or WON) to perform federal- and industry-sponsored translational research principally in cancer therapeutics.¹² WON is composed of approximately 20 oncologic practices and more than 100 oncologists throughout the state who have performed at least 40 clinical cancer studies and accrued greater than 1000 cancer patients in therapeutic cancer studies.

WON’s success directly led to another recent research endeavor: the Wisconsin Oncology Network for Imaging eXcellence (WONIX). This partnership among the state of Wisconsin, UWCCC, UWSMPH, the school’s Departments of Radiology and Medical Physics, and statewide clinics aims to increase the availability of advanced molecular imaging agents, improve imaging standards and establish an informatics highway for high- and low-volume clinical outcomes data.

The history of many successful applications of statewide health research related to cancer and other fields continually shows that Wisconsin citizens are committed to participating in clinical investigations. Their participation will help improve the diagnosis, treatment, and prevention of major, burdensome diseases.

We remain committed to continuing and enhancing our collaboration throughout the state. Serving the state through health-related research is an important manifestation of the “Wisconsin Idea” and holds great promise for promoting the health of our citizens.

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MetaStar Security Risk Assessments: HIPAA and Meaningful Use

Jay A. Gold, MD, JD, MPH; Brad Trudell, JD

Under both HIPAA and the meaningful use criteria of the Electronic Health Record (EHR) Incentive Program, providers are required to conduct a security risk assessment (SRA), which is an analysis of the provider's compliance with the 2005 HIPAA Security Rule. Hospitals and providers participating in the EHR Incentive Program must attest that they have conducted an SRA, which is a core measure of the program. The Centers for Medicare & Medicaid Services (CMS) oversees audits to ensure that those receiving incentive payments are complying with the program's core measures. The failure rate of attesting providers who have been audited is almost 25%, and one of the most commonly cited problems has been noncompliance with the requirement to conduct an SRA. Providers who fail an audit must repay funds received under the incentive program.

The Security Rule contains administrative, physical, and technical requirements that must be met in order to safeguard electronic protected health information (ePHI).

- Administrative safeguards include conducting risk assessments, naming a security official, providing security training, granting/terminating access to ePHI, managing passwords, responding to security

incidents, and planning for emergencies that may impact ePHI.

- Physical safeguards include limiting access to facilities, preventing theft of equipment, restricting access to workstations, and properly disposing of equipment that may contain ePHI.
- Technical safeguards include assigning unique usernames/passwords, automatic logoffs after inactivity, auditing activity in systems containing ePHI, and encrypting data at rest and in transit.

These safeguards are required so that providers protect the confidentiality, integrity, and availability of ePHI that they store and transmit.

Methodology for Conducting an SRA

While the Security Rule requires practices to conduct an SRA, it is silent as to what methodology must be used for the assessment. Several such methodologies exist but the NIST SP 800-30, which was released by the National Institute of Standards and Technology (NIST) in 2002, is considered by industry experts to be the gold standard. It is a relatively straightforward 9-step process that can be used by providers to develop a prioritized listing of their security risks, which represent gaps in compliance with the Security Rule's requirements.

Here is a high level summary of the 9 steps involved in the NIST SP 800-30 SRA methodology:

- System characterization—Define parameters of system to be assessed.
- Threat identification—Identify potential threats to system.

- Vulnerability identification—Identify system's weaknesses.
- Control analysis—Analyze controls in place to prevent vulnerabilities from being exploited.
- Likelihood determination—Determine probability of a vulnerability being exploited.
- Impact analysis—Analyze impact on organization should a vulnerability be exploited.
- Risk determination—Develop prioritized listing of risks (ie, gaps in compliance), achieved by multiplying likelihood determination by impact analysis.
- Control recommendations—Suggest controls for addressing identified risks.
- Results documentation—Develop SRA report showing prioritized risks and recommended controls.

Any robust assessment of a practice's compliance with the requirements of the Security Rule should follow this process or something similar.

HIPAA Audits

In addition to the ongoing meaningful use audits, the Department of Health and Human Services' Office of Civil Rights (OCR) has announced that in early 2016 it will launch Phase 2 of its audit program aimed at measuring compliance with HIPAA's privacy, security, and breach notification requirements. The HIPAA audits will include covered entities such as hospitals and providers as well as business associates. OCR plans to refine the audit protocol originally posted on its website

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in 2012, and over the next few months will identify and assess information about a pool of potential audit subjects. Ensuring that a thorough SRA has been completed recently will be very important for practices selected to take part in OCR's upcoming HIPAA audits.

MetaStar Services

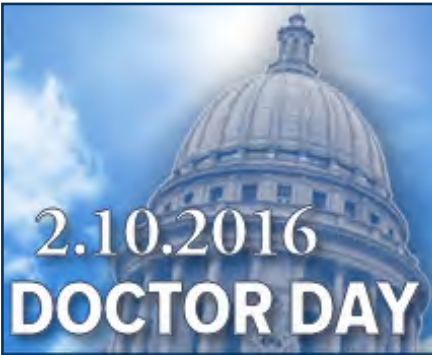
MetaStar offers both virtual and onsite SRAs. In a virtual SRA, MetaStar provides the client with access to and instruction on our robust web-based SRA tool, which incorporates the 9-step NIST SP 800-30 methodology. The client answers the SRA interview questions in the tool, with MetaStar providing assistance as needed. When the client has finished answering the interview questions, MetaStar then produces the client's final SRA report. MetaStar conducts virtual SRAs for clients located all over the United States.

For onsite SRAs, MetaStar staff travel to

the client's facility and work directly with the client's staff to answer all of the SRA interview questions, again using our robust web-based tool. While onsite, a physical walk-through of the client's facility is conducted with MetaStar's assistance to identify areas of potential concern. After the onsite visit is completed, MetaStar compiles the final SRA report for the client.

Much of the Security Rule is to ensure that certain policies, procedures, and other types of documentation are in place. Lack of adequate security policies and procedures is the most common cause of noncompliance with the Security Rule's requirements. To assist practices that may need help in this area, MetaStar also offers a policies and procedures service to help provide the documentation required to comply with HIPAA.

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