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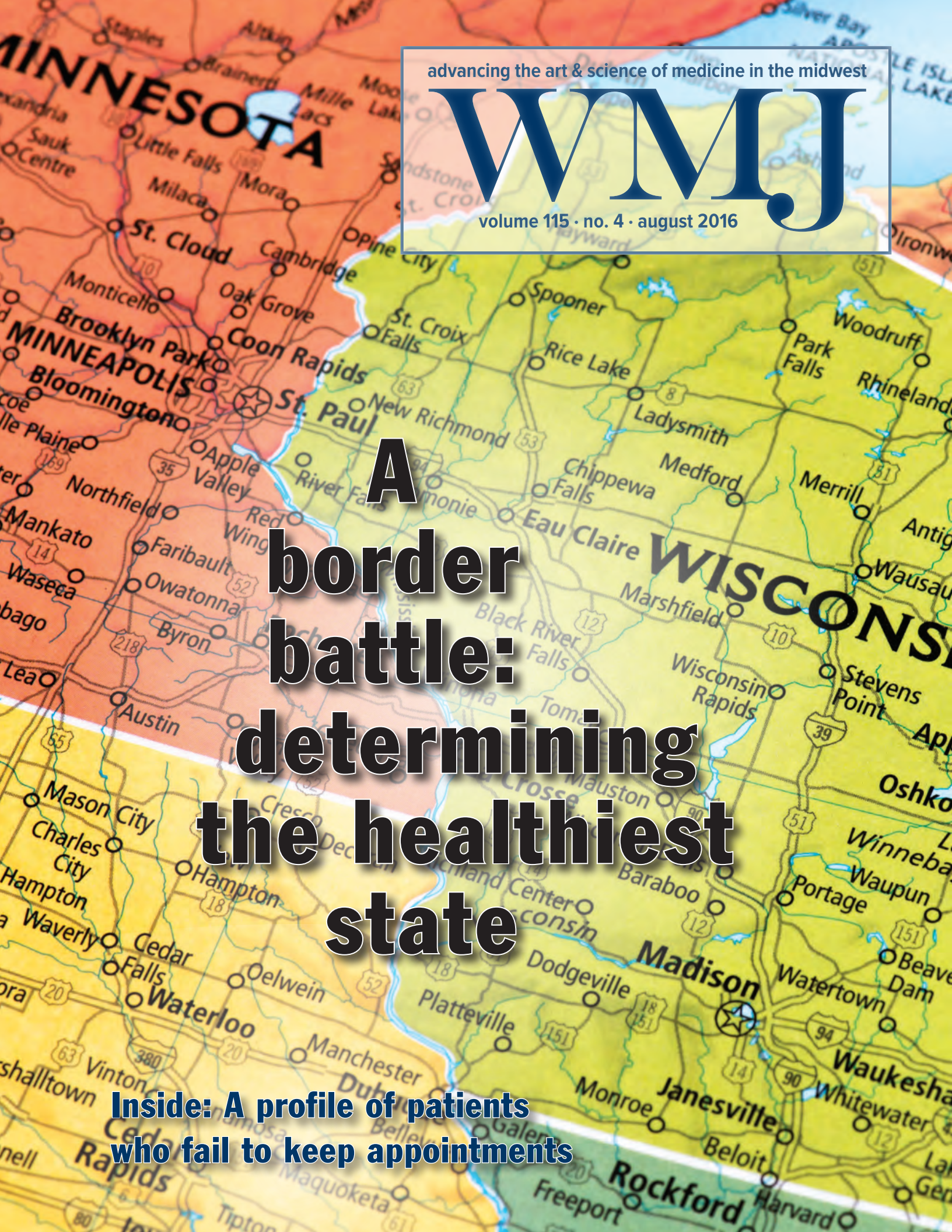

# A border battle: determining the healthiest state

Inside: A profile of patients who fail to keep appointments

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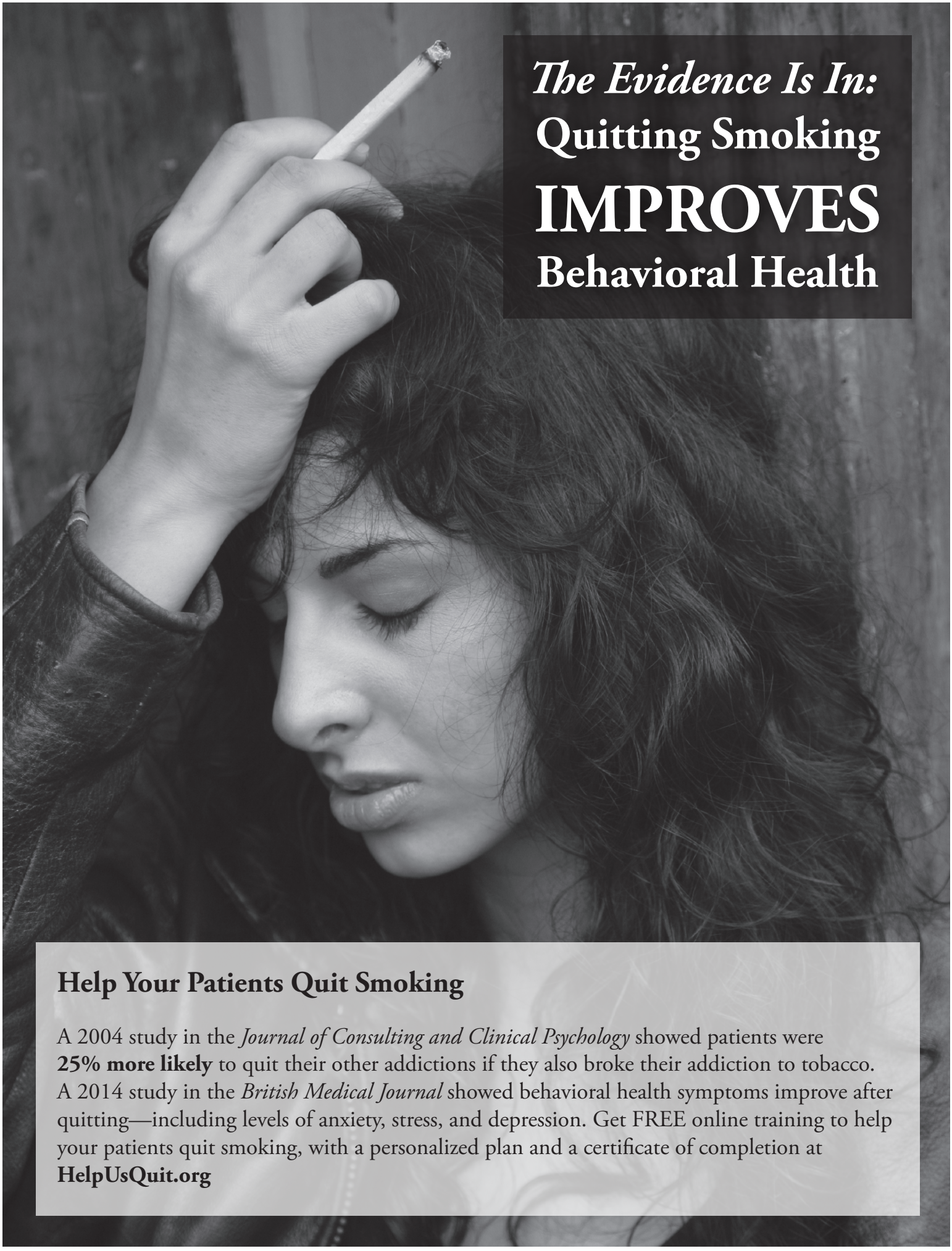

# *The Evidence Is In:* Quitting Smoking IMPROVES Behavioral Health

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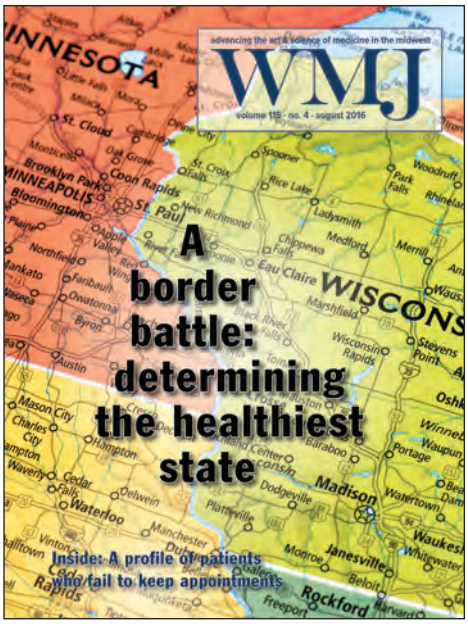


## COVER THEME
## A border battle: determining the healthiest state

From size and population diversity to climate, Wisconsin and Minnesota share a number of similarities. Yet when it comes to measuring health outcomes, Minnesota consistently fares better. Using County Health Rankings for both states, a study in this issue of *WMJ* breaks down the results and explores reasons for the health differences.

Cover design by
Mary Kay Adams-Edgette

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# WMJ

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

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# US Government Health Activities

*Editor's Note: The following editorial was published in* WMJ, *Volume 15, No. 8, p. 292-293, January, 1917.*

Complete refutation of the claim that the government does not concern itself with the loss from preventable disease is contained in the annual report of the Surgeon General of the Public Health Service submitted to Congress recently. Activities ranging from the prevention and cure of blindness, scientific studies of pellagra, the protection of the health of industrial workers, the prevention of the introduction of typhus fever, investigations of child labor and health insurance, the eradication of communicable disease and the control of the pollution of navigable streams, are recorded and demonstrate conclusively that the national government is vitally concerned in the health of its citizens.

The most striking achievement of the year relates to pellagra, an affliction which in certain states destroys more lives than tuberculosis. Pellagra is no longer a disease of mystery as the Public Health Service has clearly shown that it is caused by a restricted diet and that it may be prevented and cured by means of a properly balanced ration. The practical application of this knowledge has already resulted in a material reduction in the prevalence of this affliction in all parts of the country ...

... In eradication of trachoma, a contagious disease of the eyes frequently terminating in blindness, such marked success has been obtained that the methods followed, the converting of private residences into small hospitals and the holding of free open air clinics, have been adopted by the Egyptian government. During the year 1,700 persons were operated upon for the relief of partial or complete blindness, nearly 2,000 received hospital treatment, while more than 19,000 were treated at hospital dispensaries and clinics. When it is realized that large proportion of these people were doomed to years of suffering terminating in at least partial blindness and that they may have been restored to lives of usefulness, in some instances even being taken from county poorhouses where they had been public charges for the greater portion of their days, the importance of this most beneficent work can be imagined...

... Increased interest was shown by the government in the health of rural dwellers and Congress has recognized, by making an appropriation for studies in rural sanitation, that the welfare of the country resident is not to be neglected. During the past three years 80,270 homes in 15 different counties of 13 states were visited and complete sanitary surveys made of the premises. In every instance definite recommendations were given to remedy such evils as existed, as for example the pollution of wells, the presence of disease bearing insects and the improper disposal of excreta. In addition, 22,234 homes were revisited, mostly at the request of the owners, in order that the government agents could inspect the improvements instituted. Wherever this method of bringing the lessons of sanitation directly to the rural dweller has been followed, a marked reduction has been observed in the prevalence of typhoid fever, hookworm, malaria and other preventable diseases.

Attention has also been given to the health of children of the nation, more especially to rural school children. Over 32,000 children attending the public school were examined during the year in order to determine their mental retardation and deficiency. In addition, 7,000 physical examinations were completed for the determination of physical defects.

The health of industrial workers has been safeguarded to a greater extent than at any time in the past. Studies have been made of the occupational hazards of steel workers in many of the leading industrial establishments of the country and insanitary and harmful condition corrected. In the zinc mines of Missouri methods have been adopted which should go far toward eradicating tuberculosis from that district. Investigations of child labor and of health insurance have also been made.

What is regarded as the largest and most important single undertaking of this nature yet inaugurated, the investigation of the pollution of the Ohio River, is still in progress. Surveys of the Atlantic Coast and New England watersheds have, however, been completed and the extent and effects of their pollution is now known; this knowledge demonstrates that Federal legislation to prevent the contamination of water sources is a necessity.

Better provision for the health of travelers has been obtained by safeguarding the water supplies of common carriers and through the promulgation of regulations governing the transportation of persons suffering from communicable diseases.

Energetic efforts have been made to prevent the introduction of all communicable diseases and to control those already with us. Typhus fever has been combated at all points on the Mexican border and disinfection plants established where the clothing and persons of all incoming aliens have been disinfected. At one station alone, El Paso, Texas, 26,000 persons were inspected and treated in such a manner as to insure their freedom from this highly fatal infection...

In only a single field, the medical inspection of immigrants, has the work of the Public Health Service shown any diminution during the year but this has been compensated for by the more thorough examination accorded. 481,270 aliens were examined for the purpose of determining physician and mental defects. Of these, 16,327 were certified for deportation, proportionately a greater number than has ever been recorded. The percentage of mental defectives certified is also steadily increasing.

# Rivalries Can Be Good

John J. Frey III, MD, Medical Editor

Whether from our experience with colleges, sports events, or in the more medical world of quality of care, when faced with comparisons between "our" team and others, we tend to use scores as either validation of our work or a stimulus to improve. That is the point behind the data transparency that is a regular part of medical care delivery in the United States. The County Health Rankings, begun at the University of Wisconsin and now a collaboration between the UW Population Health Institute and the Robert Wood Johnson Foundation, have served as stimuli for communities to strive for improvement. In many cases, the program also has brought public health, the practicing community, community agencies, and elected officials together to find ways to improve a community's rank. The *WMJ* has published examples of community-driven processes to improve health that have used the Rankings as a benchmark.[1]

In this issue of the *WMJ*, Pollack and colleagues have used the Rankings to explain the overall health differences between Minnesota and Wisconsin.[2] As they note, the states share a number of similarities including size, population diversity, and climate, but find that Minnesota consistently has better measures of health outcomes than Wisconsin. Just as moving away from individual clinician measures of quality to a total clinic view helps focus on a population and smooths individual variation, moving from a county to a state helps give us a view of regions and clusters of potential problems that might not be seen looking county by county.

Their analysis showed that the most important differences are not in the medical systems or workforce but in the issues that we know affect health—educational attainment, poverty, unemployment, and behaviors, such as drinking, smoking, and obesity. Perhaps the most important data from this study are that the large cities in both states differ dramatically in their health rankings, with the Twin Cities ranking in the middle to lower third of Minnesota counties and Milwaukee being second from the bottom of Wisconsin counties.

…the most important differences are not in the medical systems or workforce but in the issues that we know affect health—educational attainment, poverty, unemployment, and behaviors, such as drinking, smoking, and obesity.

Maps, as a geography colleague has repeatedly told me, don't solve problems but raise questions and demand the stories behind the data. The maps in this article are striking—but need more stories and studies to explain them. Looking at the combined maps of both states, the counties that have the lowest rankings are in a swath across the northern areas of both states. While Wisconsin and Minnesota may tout the wonders of lakes and forests to attract visitors, the health data on the people who live there are less glowing. Rural poverty, demographics, education, and health behaviors and their consequences can be seen clearly in those maps.

If Minnesota and Wisconsin are rivals in health outcomes, Pollack and colleagues have clearly laid out what needs to be done for Wisconsin to be more competitive. Providing quality health care is a small part of the problem. Both states do that very well, and while there are some advantages that Minnesota has with primary care and psychiatry, in general the workforces in each state are similar. Therefore, changing the economic, educational, and cultural factors that find Wisconsin trailing in this rivalry will require political and economic solutions across the state.

## Also in This Issue

In the past few years, we've seen high profile stories on Veterans Affairs (VA) services troubled by problems of access to primary

care. The VA health system does not have economic barriers for access but still struggles with patients who miss appointments, often repeatedly. Boos and colleagues describe their work at the VA Nebraska-Western Iowa Health Care System, trying to identify patients who miss appointments in an effort to improve system performance.[3] In a yearlong study, they found that the profile of patients who missed appointments in their system were young, nonwhite men who had mental health problems. These are the people who often suffer the most from recent involvement in military actions and for whom preventive measures can have the greatest effect. Targeted outreach and further studies, including interviews and focus groups would help find possible solutions to a vexing problem.

Technology can be a boon to helping continuing medical education, as demonstrated by Ross and colleagues with a highly successful simulation program for emergency physicians in neonatal resuscitation.[4] Simulation centers have been a great resource for improving skills for operating room staff, intensive care clinicians, community emergency medical technicians, and medical students. This study shows that simulation centers also can help clinicians maintain essential skills throughout a career.

Sherid and colleagues report on the profile of younger (<50) and older cohorts of patients with ischemic colitis, which has been primarily a disease of the elderly associated with disseminated arteriosclerotic disease.[5] Although the younger cohort was not large, they had a much higher level of gastrointestinal bleeding as a presenting symptom. The important lesson here is that ischemic colitis should be added to the differential in younger patients with rectal bleeding.

Schrager and colleagues discuss 4 cases of primary hyperparathyroidism and offer a review of the subject.[6] Their 4 cases from primary care clinics appeared to have some level of risk for autoimmunity as a possible complicating or etiologic factor. They also showed that, in a primary care population over a 6-year period, the rate of primary hyperparathyroidism has been fairly stable at 35 per 100,000, putting the problem into a "rare but keep it in mind" category.

Clinical trials have continued to suffer from low enrollments and low diversity of populations studied. Both threaten the value of studies and their generalizability. Some studies suggest that almost 50% of clinical trials in all fields are not able to enroll sufficient subjects by the end of the study period. Oncology networks have had similar struggles. Saphner and colleagues report on the success of a first-year program based in a large health system —Aurora Health Care—in increasing enrollment in a large number of clinical trials.[7] Just as primary practice-based research networks have added to the understanding of the incidence and management of health problems in communities as opposed to specialty-based academic health centers, improving the collaboration between well-organized health systems and academic health centers can both help more clinical trials successfully enroll patients and also get patients access to new technology and treatments. Such linkages are win-win for all involved.

Finally, Danford and colleagues report the case of a rarely seen type of diabetic-related ketoacidosis compounded by a rarely used drug and the need to keep looking for drug-related adverse consequences as a source of unexplained or unanticipated illness.[8]

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**8.** Danford C, Chan P, Magill S. 'Euglycemic' ketoacidosis in a patient with type 2 diabetes being treated with canagliflozin. *WMJ.* 2016;115(4); 206-209.


## Errata

*WMJ.* 2016;115(3):134-138.

In "A qualitative pilot study of pediatricians' approach to childhood obesity" by Traun, et al, on page 134 the second sentence in the Introduction should read as follows: "In the United States, it is currently estimated that approximately 17% of children are obese." This correction has been made to the report online, available at https://www.wisconsinmedicalsociety.org/_WMS/publications/wmj/pdf/115/3/134.pdf.

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# Wisconsin Versus Minnesota: A Border Battle for the Healthiest State

Elizabeth Pollock; Corina Norrbom, MD; Edward Ehlinger, MD; Patrick Remington, MD, MPH


## ABSTRACT

**Background:** Measuring and ranking the health of counties helps raise awareness of health disparities based on where people live. Recently, there has been increasing interest in comparing the health of counties across state lines, to potentially measure the impact of local and state-level policies.

**Methods:** The counties in Minnesota (n = 87) and Wisconsin (n = 72) were combined into a single 2-state region, and all 159 counties were ranked according to the *County Health Rankings* methods, with summary ranks for health outcomes and health factors. Multivariable regression analysis was then used to examine the potential impact of state-based programs and policies on health outcomes.

**Results:** Minnesota was healthier overall than Wisconsin, with lower rates of premature death and better quality of life. Minnesota also performed better than Wisconsin for all 9 health behavior measures, 4 of 7 clinical care measures, 7 of 8 social and economic factors, and 3 of 5 physical environment measures. Furthermore, counties in Wisconsin were more likely to have lower (worse) ranks than counties in Minnesota for both health outcomes and health factors, as well as for the subcategories that make up these summary ranks. Regression analysis showed that Minnesota's better health status was explained primarily by healthier behaviors and more desirable social and economic factors.

**Conclusions:** Minnesota's better health outcomes are largely explained by better social, economic, and behavioral factors. These findings suggest a need for examination of policies and strategies that may be influencing the observed differences across these 2 states.


• • •

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CME available. See page 179 for more information.

## INTRODUCTION

The ultimate goal of public health is to assure conditions so that all people can live long and healthy lives.[1,2] Achieving this goal requires a public health approach that brings together community leaders to work collaboratively to promote evidence-based policies and programs.[3] Health has multiple determinants, including health care, health behaviors, and the socioeconomic and physical environment, and therefore improving the health of a population cannot be achieved by a single sector. The health care system recently has embraced this public health approach in the "Triple Aim" of better care, lower costs, and improved population health.[4] Improved population health can be achieved only with the purposeful involvement of leaders in education, business, governmental agencies, academics, the media, nonprofits, and more, in addition to leaders in health care.

More than a decade ago, the University of Wisconsin Population Health Institute developed a model to measure and rank health outcomes and health factors in Wisconsin counties.[5] Ranking the health of a county helps to raise awareness and to see where the county stands in terms of the health of its community members. In 2010, with support from the Robert Wood Johnson Foundation, the *County Health Rankings* were expanded to measure the health of nearly every county in all 50 states in the nation.[6] Published online at countyhealthrankings.org, the *Rankings* help counties understand what factors affect the length and quality of life of their residents. The *Rankings* examine a variety of measures that affect health, such as access to healthy foods, physicians, and safe and affordable housing, as well as rates of smoking, high school graduation, and uninsured, among others. The *Rankings* have been used to garner support for local health improvement initiatives among

**Table 1.** Health Outcomes and Health Factors for Minnesota and Wisconsin, 2014

| | State of Minnesota | MN Best County | MN Worst County | State of Wisconsin | WI Best County | WI Worst County |
|---|---|---|---|---|---|---|
| **Health Outcomes** | | | | | | |
| **Length of Life** | | | | | | |
| Premature death rate[a] | **5,126** | **3,536** | 11,979 | 5,878 | 3,692 | **15,929** |
| **Quality of Life** | | | | | | |
| Poor or fair health | **11%** | **6%** | **22%** | 12% | 7% | 21% |
| Poor physical health days | **2.8** | **1.2** | 4.4 | 3.2 | 1.9 | **4.8** |
| Poor mental health days | **2.6** | **1.2** | 5.7 | 3.0 | 1.7 | **6.3** |
| Low birthweight | **6.5%** | **4.0%** | 8.1% | 7.0% | 4.6% | **9.3%** |
| **Health Factors** | | | | | | |
| **Health Behaviors** | | | | | | |
| Adult smoking | **16%** | **7%** | 35% | 18% | 8% | **46%** |
| Adult obesity | **26%** | **22%** | 34% | 29% | 24% | **40%** |
| Food environment index | **8.5** | **10** | 6 | 8.3 | 9 | **5** |
| Physical inactivity | **20%** | **17%** | 31% | 22% | 18% | **32%** |
| Access to exercise opportunities | **80%** | **100%** | 22% | 78% | 98% | **1%** |
| Excessive drinking | **19%** | **9%** | **42%** | 24% | 17% | 36% |
| Alcohol-impaired driving deaths | **32%** | 0% | **100%** | 39% | 0% | 68% |
| Sexually transmitted infections[a] | **316** | **42** | 531 | 431 | 43 | **1794** |
| Teen births[a] | **25** | 10 | 87 | 29 | **7** | **114** |
| **Clinical Care** | | | | | | |
| Uninsured | 10% | 6% | 16% | 10% | **6%** | **18%** |
| Primary care physicians | **1116:1** | **418:1** | 9219:1 | 1233:1 | 546:1 | **15439:1** |
| Dentists | **1602:1** | 1195:1 | 9525:1 | 1703:1 | **936:1** | **11074:1** |
| Mental health providers | **766:1** | **407:1** | **21722:1** | 1050:1 | 440:1 | 13427:1 |
| Preventable hospital stays[a] | **49** | 29 | **110** | 55 | **28** | 87 |
| Diabetic screening | 88% | **97%** | **57%** | **90%** | 95% | 85% |
| Mammography screening | 68% | **84.6%** | **54.8%** | **70%** | 79.3% | 56.0% |
| **Social and Economic Factors** | | | | | | |
| High school graduation | 77% | **97%** | **56%** | **87%** | 96% | 57% |
| Some college | **73%** | **81.2%** | 47.4% | 65% | 80.8% | **44.9%** |
| Unemployment | **5.6%** | **3.7%** | 11.2% | 6.9% | 4.7% | **15.3%** |
| Children in poverty | **15%** | **5%** | 34% | 18% | 6% | **47%** |
| Inadequate social support | **14%** | **2%** | 19% | 17% | 8% | **29%** |
| Children in single-parent households | **27%** | 16% | 50% | 30% | **15%** | **55%** |
| Violent crime[a] | **234** | **0** | **780** | 248 | 30 | 751 |
| Injury deaths[a] | **54** | **35** | 101 | 62 | 37 | **111** |
| **Physical Environment** | | | | | | |
| Air pollution-particulate matter | 12.0 | **10.4** | **13.3** | **11.5** | 10.5 | 12.6 |
| Drinking water violations | **1%** | 0% | **63%** | 6% | 0% | 56% |
| Severe housing problems | **14%** | **7%** | 19% | 15% | 8% | **21%** |
| Driving alone to work | **78%** | **66%** | 84% | 80% | 72% | **86%** |
| Long commute-driving alone | 29% | **10%** | **53%** | **26%** | 12% | 45% |
| **Total Best/Worst** | **28** | **27** | **11** | **5** | **4** | **23** |

Bold indicates best state or best/worst county in the region for that category (does not include ties).
Abbreviations: MN, Minnesota; WI, Wisconsin.
[a] Years of potential life lost before age 75 (rate per 100,000 population, age-adjusted to the 2000 US population).

governmental agencies, health care providers, community organizations, business leaders, policymakers, and the public.

The *Rankings* rank counties within their own states to allow geographically relevant comparisons, aligning with state-level public health departments and governments. However, there has been increasing interest in comparing counties across state lines to potentially determine the policy, system, programmatic, and environmental factors that may contribute to differences in health. The purpose of this paper is to compare the counties of the states of Minnesota and Wisconsin by ranking all of the counties as a single 2-state region. Minnesota and Wisconsin share many attributes, with similar culture, climate, geography, total population (5.3 and 5.7 million people in 2010, respectively), and diversity of residents (16.9% and 16.7% minority population, respectively). (See http://www.indexmundi.com/factsunited-states/quick-facts/compare/wisconsin.minnesota.) However, it has been fairly well established in reports such as *America's Health Rankings* that the state of Minnesota as a whole is healthier than the state of Wisconsin.[7,8] Therefore, the data for Minnesota counties were combined with the data for Wisconsin counties to re-rank Minnesota and Wisconsin counties together in 1 combined dataset in order to understand the relative health of the 2 states and to compare communities that some feel may be more similar than the dividing state line implies. Information ascertained from a Minnesota/Wisconsin comparison could be used to improve the health of both states and provide insights for the rest of the country.

## METHODS

### Study Population

In this study, the counties in Minnesota and Wisconsin were examined as one 159-county region in order to compare and contrast health outcomes and factors across state lines.

### Data Sources and Measures

The data and measures used in this study come from the 2014 *County Health Rankings*. Thirty-four different measures are available including 5 health outcome and 29 health factor measures. As in the *Rankings*, 2 summary rankings for the counties in these states were provided: the health outcomes (based on an equal weighting of measures of length and quality of life) and the health factors (based on weighted scores for measures of health behaviors, clinical care, social and economic factors, and the physical environment). Methods on the calculations of all health measures as well as the data sources

and years can be found on the *County Health Rankings* website at www.countyhealthrankings.org.

### Data Analysis

The 87 counties in Minnesota were combined with the 72 counties in Wisconsin into a single 159-county region, and the *Rankings* were reanalyzed using the same approach for individual states.[6] Once all 159 counties were ranked according to this method, the counties were split into deciles (about 16 counties in each decile) for both health outcomes and health factors in order to examine where counties in each state fell according to their rankings. Wilcoxon rank-sum tests were performed to find the average differences in ranks between the 2 states for all categories of health. Multivariable OLS regression was then used to examine the association between state and health outcomes.

## RESULTS

Table 1 includes the health outcome and health factor measures for Wisconsin, as well as the value of the counties in each state that performed best for each measure and worst for each measure. The state of Minnesota ranked better than Wisconsin for 28 of the 34 health measures included in the study, Wisconsin ranked better for 5 measures, and they had the same value for 1 measure. Of the top-ranked counties in the region, 27 were Minnesota counties and 5 were Wisconsin counties (for 2 measures the best counties were tied). Of the bottom-ranked counties in the region, 11 were Minnesota counties and 23 were Wisconsin counties.

**Table 2.** Health Outcomes and Health Factors Ranks for Minnesota Counties (Within Minnesota and Wisconsin Counties Combined), Based on Data From the 2014 *County Health Rankings*

| County | Outcomes Rank | Factors Rank | County | Outcomes Rank | Factors Rank |
|---|---|---|---|---|---|
| Carver | 1 | 4 | Martin | 70 | 84 |
| McLeod | 2 | 48 | Isanti | 72 | 82 |
| Waseca | 4 | 68 | Jackson | 73 | 15 |
| Nobles | 6 | 71 | Chippewa | 74 | 114 |
| Redwood | 7 | 94 | Faribault | 75 | 102 |
| Steele | 8 | 20 | Clay | 79 | 30 |
| Nicollet | 9 | 5 | Hennepin | 80 | 32 |
| Washington | 10 | 3 | Murray | 81 | 54 |
| Dodge | 11 | 28 | Todd | 82 | 119 |
| Fillmore | 12 | 42 | Crow Wing | 83 | 72 |
| Scott | 13 | 6 | Polk | 84 | 110 |
| Wright | 14 | 18 | Benton | 85 | 60 |
| Olmsted | 15 | 2 | Pope | 87 | 34 |
| Dakota | 16 | 11 | Hubbard | 88 | 111 |
| Yellow Medicine | 17 | 74 | Koochiching | 89 | 108 |
| Le Sueur | 19 | 40 | Kanabec | 94 | 131 |
| Kandiyohi | 20 | 85 | Marshall | 97 | 61 |
| Stearns | 23 | 22 | Freeborn | 98 | 112 |
| Winona | 24 | 23 | Itasca | 101 | 97 |
| Lac qui Parle | 29 | 45 | Ramsey | 104 | 80 |
| Brown | 32 | 53 | Rock | 108 | 27 |
| Rice | 33 | 17 | Pennington | 110 | 37 |
| Douglas | 35 | 19 | Stevens | 111 | 38 |
| Meeker | 36 | 95 | Becker | 112 | 98 |
| Blue Earth | 40 | 26 | Norman | 113 | 86 |
| Sherburne | 41 | 49 | Big Stone | 115 | 59 |
| Lincoln | 43 | 44 | Grant | 116 | 92 |
| Wilkin | 44 | 31 | Cottonwood | 118 | 64 |
| Red Lake | 46 | 93 | Clearwater | 119 | 157 |
| Cook | 47 | 56 | Aitkin | 121 | 127 |
| Lake of the Woods | 49 | 90 | St. Louis | 122 | 73 |
| Roseau | 51 | 39 | Beltrami | 125 | 153 |
| Sibley | 52 | 88 | Pine | 126 | 135 |
| Lyon | 54 | 36 | Carlton | 130 | 75 |
| Chisago | 55 | 77 | Pipestone | 131 | 81 |
| Mower | 56 | 103 | Morrison | 138 | 116 |
| Kittson | 57 | 62 | Renville | 140 | 87 |
| Otter Tail | 58 | 50 | Lake | 141 | 52 |
| Swift | 59 | 83 | Wadena | 146 | 130 |
| Goodhue | 62 | 33 | Traverse | 148 | 47 |
| Watonwan | 63 | 120 | Mille Lacs | 152 | 146 |
| Houston | 64 | 14 | Cass | 156 | 150 |
| Anoka | 66 | 55 | Mahnomen | 158 | 159 |
| Wabasha | 69 | 10 | | | |

Tables 2 and 3 show the health outcomes and health factors ranks for Minnesota and Wisconsin counties when combined and ranked together, listed alphabetically by state and county. Figure 1 and Figure 2 then depict the decile (10th percentile) in which the ranks fell for each county in Minnesota and Wisconsin for health outcomes and health factors, respectively. Lighter colors indicate better performance in the respective summary rankings. Wisconsin counties were, on average, less healthy than Minnesota counties. Wisconsin counties were more likely to have lower ranks and to be in lower deciles for both health outcomes and health factors.

For instance, as shown in Table 4, for the overall distribution of ranks, the average differences in ranks between Minnesota counties and Wisconsin counties after the 2 states were combined into 1 region were statistically significant for all health categories, favoring the state of Minnesota, with the exception of clinical care and the physical environment. The average difference in rank between the 2 states for health outcomes was 22 ($P<0.01$), and the average difference in rank for health factors was 32 ($P<0.001$). The largest differences within health factors were seen in the categories of social and economic factors and health behaviors (average difference in rank 35 and 27, $P<0.0001$ and $<0.001$, respectively).

**Table 3.** Health Outcomes and Health Factors Ranks for Wisconsin Counties (Within Minnesota and Wisconsin Counties Combined), Based on Data From the 2014 *County Health Rankings*

| County | Outcomes Rank | Factors Rank | County | Outcomes Rank | Factors Rank |
|---|---|---|---|---|---|
| Ozaukee | 3 | 1 | Sauk | 99 | 96 |
| Kewaunee | 5 | 46 | Sawyer | 100 | 152 |
| Portage | 18 | 35 | Manitowoc | 102 | 89 |
| Taylor | 21 | 113 | Winnebago | 103 | 58 |
| Door | 22 | 65 | Ashland | 105 | 121 |
| Pierce | 25 | 24 | Crawford | 106 | 129 |
| Calumet | 26 | 13 | Bayfield | 107 | 138 |
| St. Croix | 27 | 16 | Buffalo | 109 | 101 |
| Pepin | 28 | 57 | Dodge | 114 | 104 |
| Washington | 30 | 12 | Monroe | 117 | 122 |
| Iowa | 31 | 51 | Waupaca | 120 | 105 |
| Eau Claire | 34 | 43 | Douglas | 123 | 124 |
| Dunn | 37 | 70 | Iron | 124 | 142 |
| Vernon | 38 | 118 | Langlade | 127 | 143 |
| Waukesha | 39 | 7 | Oneida | 128 | 67 |
| Green | 42 | 29 | Waushara | 129 | 140 |
| Dane | 45 | 8 | Richland | 132 | 123 |
| Wood | 48 | 21 | Vilas | 133 | 126 |
| La Crosse | 50 | 9 | Oconto | 134 | 109 |
| Grant | 53 | 69 | Burnett | 135 | 151 |
| Florence | 60 | 134 | Rusk | 136 | 132 |
| Outagamie | 61 | 25 | Lincoln | 137 | 117 |
| Price | 65 | 91 | Washburn | 139 | 133 |
| Marathon | 67 | 66 | Jackson | 142 | 139 |
| Barron | 68 | 137 | Shawano | 143 | 136 |
| Sheboygan | 71 | 41 | Marinette | 144 | 128 |
| Chippewa | 76 | 100 | Green Lake | 145 | 115 |
| Clark | 77 | 145 | Rock | 147 | 144 |
| Jefferson | 78 | 79 | Juneau | 149 | 149 |
| Columbia | 86 | 106 | Kenosha | 150 | 141 |
| Fond du Lac | 90 | 63 | Racine | 151 | 147 |
| Trempealeau | 91 | 107 | Marquette | 153 | 148 |
| Lafayette | 92 | 78 | Adams | 154 | 155 |
| Polk | 93 | 125 | Forest | 155 | 154 |
| Brown | 95 | 76 | Milwaukee | 157 | 156 |
| Walworth | 96 | 99 | Menominee | 159 | 158 |

Linear regression techniques were then used to confirm these overall results and to explore whether there was still an independent state-level effect on health outcomes after controlling for health factors. All models were controlled for demographic variables, including population, age distribution, racial structure, and urban/rural status (data not shown). Before adjustment, state (ie, whether the county belonged in Minnesota vs Wisconsin) was independently associated with health outcomes z-score ($P<0.001$). However, after accounting for overall health factors z-score, the relationship between state and health outcomes was attenuated by 77% and no longer statistically significant. Social and economic factors z-score and health behaviors z-score accounted most for this attenuation (97%) and also independently attenuated the relationship (by 76% and 57%, respectively). Within these categories, the measures of unemployment (69%), children in poverty (52%), sexually transmitted infections (35%), some college education (32%), and adult obesity (21%) most attenuated the relationship (nearly 100% when all included in the model).

## DISCUSSION

The *County Health Rankings* provide data on the health of communities in order to stimulate conversations and mobilize communities toward action.[5] Ranking all the counties in Minnesota and Wisconsin provides an opportunity to explore how measured and unmeasured factors might explain the observed differences in the health outcomes between the 2 states. Overall, this analysis reinforced what has been shown in the past: that overall, Minnesota has better health outcomes than Wisconsin, with lower premature death rates, better self-reported quality of life, and better birth outcomes. These better health outcomes are experienced by numerous counties within Minnesota, with its major metropolitan counties (Hennepin [80th] and Ramsey [104th]) ranking significantly better than Milwaukee County (157th). This finding also has been reported in America's Health Ranking, with Minnesota ranking 4 and Wisconsin ranking 24 in 2015.[8] More concerning is the finding that the gap between the 2 states is also widening. Wisconsin's health has been getting worse compared to other states over the past few years while Minnesota's health has been getting slightly better, according to America's Health Rankings.[8]

Our study also demonstrated that the better health outcomes in Minnesota is mostly explained by better rates of the factors that affect health—including rates of education, unemployment, poverty, obesity, and sexually transmitted infections. This finding can stimulate further research to examine specific reasons why these social, economic, and behavioral factors are better in Minnesota. For example, are there specific public health or health care policies in place in Minnesota and not in Wisconsin that are driving these differences that the state of Wisconsin could consider adopting?

Differences in educational and economic policies between the 2 states may explain the differences in rates of poverty, unemployment, and educational attainment—major "upstream" determinants of the health of populations. The relationship between these social and economic factors and health is undisputed—as

**Figure 1.** Health Outcomes Ranks by Decile for Minnesota and Wisconsin Combined

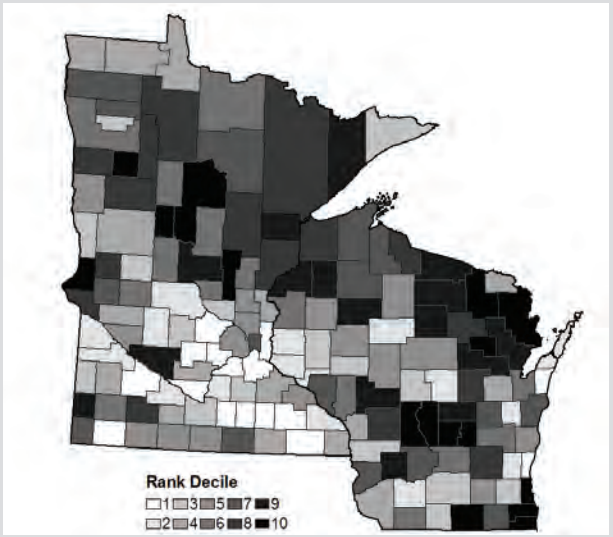


**Figure 2.** Health Factors Ranks by Decile for Minnesota and Wisconsin Combined

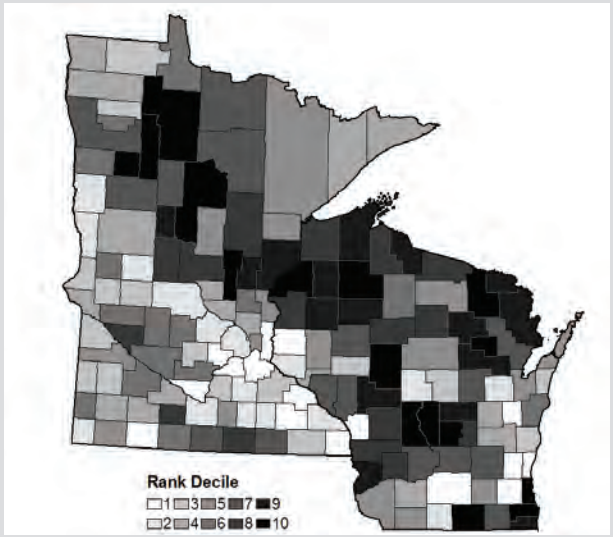


**Table 4.** Average Difference in Health Outcomes, Health Factors, and Subcategory Ranks Between Minnesota Counties and Wisconsin Counties (Within Minnesota and Wisconsin Counties Combined), Based on Data From the 2014 *County Health Rankings*

| | Health Outcomes | Length of Life | Quality of Life | Health Factors | Health Behaviors | Clinical Care | Social and Economic Factors | Physical Environment |
|---|---|---|---|---|---|---|---|---|
| Average Difference In Rank[a] | 22 | 21 | 17 | 32 | 27 | 2 | 35 | 2 |
| *P*-value | 0.004 | 0.009 | 0.026 | 0.0001 | 0.0008 | 0.85 | < 0.0001 | 0.80 |

[a]A positive difference indicates that counties in Minnesota had better ranks, on average, than counties in Wisconsin.

individuals with more education and better jobs experience longer, healthier lives.[9] Minnesota traditionally has had an advantage over Wisconsin in key economic growth sectors, including education, health services, and professional and business services. In contrast, Wisconsin has a bigger stake in manufacturing, which has been in steady decline for years as a jobs creator.[10] Although it is clear that governmental policies can affect economic development,[11] significant controversy exists today about which policies are more effective.[12]

Differences in the public health or health care system organization and financing also could explain some of these observed differences in unhealthy behaviors, such as those related to obesity and sexually transmitted diseases.[13] For example, integrated health systems are important in the health care landscape of both Minnesota and Wisconsin, but integration evolved sooner and is perhaps more developed in Minnesota. In addition, between the states, there may be differences in private business engagement in community health and whether employers go beyond worker wellness to address the health of the families of employees as well as the health of the entire community.

This comparison of the health of Minnesota and Wisconsin counties has substantive strengths and is based on a model of population health that emphasizes the many factors that, if improved, can help make communities healthier places. This approach could be used as a model or protocol for states in which there may be sufficient border communities, to better understand the health of their counties. While this discussion is framed as a "border battle" in order to encourage competition and raise awareness, it is also important to think of this as a comparison to understand what works and what doesn't in each state in order for both states to achieve optimal health for all of their residents. It is also important to recognize limitations of this study. For instance, a few of the measures used in the *County Health Rankings* are not readily comparable across states. When compiled for the *Rankings*, some measures are modeled to produce the estimates, and some of these models include a state-level effect to inform the county-level estimates, which could impose a larger difference in counties across states than there is in reality. Additionally, while the *Rankings* draw upon the most reliable data available, there is uncertainty in the underlying data, especially for small areas. This, in turn, affects the certainty of the ranks, which should not be considered as fixed numbers but rather as summary scores, and therefore this analysis simply focuses on looking for patterns between the 2 states. Lastly, there may still be some factors that

are important to health and to the differences in health between these 2 states that are unmeasured or not captured in the *County Health Rankings* model.

This analysis provides insight into the differences between the health status of Minnesota and Wisconsin and some of the factors that affect these health differences. However, there is a further need for in-depth examination of state and local policies and strategies, not only in the governmental sector but in the health care and business sectors as well, that may be influencing these observed disparities. Using the strengths of both states may open the door for building a research and learning collaborative both in terms of community-level action and cross-sector data collection and analysis from which both states could benefit. Establishing a learning community across Minnesota and Wisconsin for communities to share aims, activities, learnings, outcomes, process, and best practices may increase the likelihood for even greater impact.

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CME

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# Quiz: Wisconsin Versus Minnesota: A Border Battle for the Healthiest State

## EDUCATIONAL OBJECTIVES

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

1. Apply population health principles and management to their practice and health care provision.
2. Identify factors that most influence disparities in health between Minnesota and Wisconsin counties in order to reduce these disparities and improve the health of both states.

**PUBLICATION DATE:** September 22, 2016

**EXPIRATION DATE:** September 22, 2017

## QUESTIONS

1. Historically, reports have found the health of the states of Minnesota and Wisconsin to be similar.
   - ❑ True
   - ❑ False

2. In which of the following subcategories of health factors did Wisconsin counties perform the worst, according to average difference in ranks in comparison to Minnesota counties?
   - ❑ Health Behaviors
   - ❑ Clinical Care
   - ❑ Social and Economic Factors
   - ❑ Physical Environment

3. According to this analysis, which of the following examples of health factor measures may have the greatest potential to improve the health of these communities and decrease the disparities in health between the two states?
   - ❑ Children in poverty
   - ❑ Uninsured
   - ❑ Adult obesity
   - ❑ Air pollution

4. The result that the state indicator variable was no longer statistically significant after accounting for health factor variables in the analysis implies that the better health outcomes in Minnesota are driven largely by better rates of the factors that influence health rather than an independent state-level effect.
   - ❑ True
   - ❑ False

5. This study demonstrates that the better health outcomes observed in Minnesota, compared with Wisconsin, can be mostly explained by better ratings in Minnesota in all of the following factors affecting health EXCEPT:
   - ❑ Education
   - ❑ Unemployment
   - ❑ Insurance coverage
   - ❑ Poverty
   - ❑ Obesity
   - ❑ Sexually transmitted infections

• • •

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

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# Simulation Training to Maintain Neonatal Resuscitation and Pediatric Sedation Skills for Emergency Medicine Faculty

Joshua Ross, MD; Greg Rebella, MD; Mary Westergaard, MD; Sara Damewood, MD; Jamie Hess, MD


## ABSTRACT

**Background:** Neonatal resuscitations and significant adverse cardiorespiratory events during pediatric sedations are infrequent. Thus, it is challenging to maintain the skills necessary to manage patients experiencing these events. As the pediatric emergency medicine specialty expands, exposure of general emergency medicine physicians to these potentially critical patients may become even more limited. As such, effective training strategies need to be developed. Simulation provides the opportunity to experience a rare event in a safe learning environment, and has shown efficacy in skill acquisition for medical students and residents. Less is known regarding its use for faculty-level learners.

**Objectives:** To assess the acceptability, efficacy, and feasibility of a simulation-based educational intervention for emergency medicine faculty on their knowledge, comfort, and perceived competence in neonatal resuscitation and pediatric sedation skills.

**Methods:** Eighteen academic emergency medicine faculty participated in a 4-hour educational intervention with high-fidelity simulation sessions focused on neonatal resuscitation (precipitous delivery of a depressed newborn) and adverse events associated with pediatric sedation (laryngospasm and hypoventilation). Faculty also practiced umbilical vein catheterization, video laryngoscopy skills, and reviewed supplies stocked in our pediatric resuscitation cart. A pre- and postintervention evaluation was completed consisting of knowledge and attitude questions. Paired *t* test analysis was used to detect statistically significant change ($P \leq 0.05$).

**Results:** Results were obtained from 17 faculty members. Simulation training was well accepted pre- and postintervention, and simulation was effective with statistically significant improvement in both knowledge and attitude. This type of event was feasible with 83% of emergency medicine faculty participating.

**Conclusion:** Emergency medicine faculty have limited opportunities to manage neonatal resuscitations and adverse events in pediatric sedations. Simulation training appears to be an effective educational modality to help maintain these important skills.


• • •

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## INTRODUCTION

Survey data has shown that nearly half of US emergency departments (EDs) provide care to fewer than 10 pediatric patients per day.[1] With such a paucity of young patients, maintenance of pediatric clinical skills can be challenging for emergency physicians at these centers. Even among academic centers with higher volumes, additional factors frequently limit the emergency medicine (EM) physician's exposure to pediatric patients. Subspecialty workforce analysis indicates that the majority of pediatric EM subspecialists practice in medical school hospitals, effectively reducing the pediatric volume for the general EM physicians at these same institutions.[2] Furthermore, given the relative rarity of events requiring resuscitation in the pediatric population, erosion of skills necessary to recognize and manage potentially critical situations is a concern. In their 2009 joint policy statement, the American College of Emergency Physicians and the American Academy of Pediatrics recommended monitoring skills for all ED physicians with baseline and periodic competency evaluations. In addition to this oversight, the statement acknowledges a need for continuing education and identified patient simulation as a suggested mechanism to maintain proficiencies.[3]

Simulation-based training has been shown to be an effective tool that provides a controlled learning environment in which to practice a wide range of clinical scenarios.[4-9] Recognizing this potential, residency programs have integrated simulation into their curriculum as an adjunct to live patient encounters with

encouraging results.[10-17] Similarly, simulation exercises have been used for attending-level education by several specialties.[12,18]

While simulation-based learning has been employed successfully for EM resident and non-EM faculty training, its utility and acceptance among EM faculty has yet to be assessed. In particular, there has not been an evaluation of this training modality as a method for general EM physicians to maintain pediatric critical care skills. Two ED-based scenarios requiring seldom-used clinical skills are neonatal resuscitation and the management of adverse events associated with procedural sedation. Given the rarity of these scenarios, simulation may provide an ideal method to achieve and maintain the requisite decision-making and procedural competencies. With this background, we have undertaken an investigation with the objective to design and assess the efficacy, acceptability, and feasibility of a simulation-based educational intervention for general EM faculty. Our specific aim is to assess changes in their knowledge, comfort, and perceived competence in neonatal resuscitation and adverse events associated with pediatric sedation.

## METHODS

### Study Design, Setting, and Population

This was a prospective cohort study of academic general EM faculty who participated in a simulation-based educational workshop emphasizing neonatal resuscitation and management of adverse events associated with pediatric sedations. In addition to serving as the intervention for our present investigation, the workshop curriculum was developed for ongoing departmental faculty education. The investigation occurred in the University of Wisconsin Health Simulation Center, a 6400 square foot state-of-the art center with dedicated space and high-fidelity equipment for simulation, skills, debriefing, and lectures. The site's Institutional Review Board exempted this study, and all participants consented to the use of their data.

### Study Protocol

Prior to the workshop, participants completed a closed-book pre-test and survey consisting of 11 medical knowledge and 10 attitude questions. Test questions were based on intervention content and developed by Pediatric EM-boarded study faculty. Following completion of the pretest, educational materials pertinent to neonatal resuscitation and pediatric procedural sedation were provided for review prior to the training session.[19-21]

The intervention curriculum began with two 30-minute didactic conferences. The first provided an update on Pediatric Advanced Life Support and Neonatal Resuscitation Program (NRP). The second lecture reviewed concepts in pediatric sedation including a discussion of adverse events. Faculty was then divided into groups to take part in 3 simulation-based stations: sedation, neonatal resuscitation, and skills.

The sedation scenario utilized the SimBaby simulator (Laerdal Medical, Wappingers Falls, New York) and presented a 2-year-old child requiring procedural sedation for fracture reduction who developed laryngospasm and upper airway obstruction. The scenario was developed and led by the study site's pediatric critical care faculty. The learning objectives were: (1) perform a comprehensive presedation assessment and consent, (2) conduct a sedation using appropriate medications and monitoring, (3) recognize and respond appropriately to the adverse event.

The neonatal resuscitation scenario utilized the SimNewB simulator (Laerdal Medical, Wappingers Falls, New York) and presented a precipitous ED delivery of a limp and cyanotic newborn. The case was developed and led by study site's neonatology faculty. The learning objectives were to appropriately perform a neonatal resuscitation consistent with NRP guidelines and demonstrate appropriate skills such as use of T-connector to deliver mask ventilation, endotracheal intubation, and insertion of an umbilical catheter.

The third station provided an opportunity for faculty to practice critical skills for neonatal resuscitation and pediatric airway support. Participants received instruction from pediatric EM faculty and used lower-fidelity mannequins to practice umbilical line insertion as well as video laryngoscopy utilizing a GlideScope (Verathon Inc, Bothell, Washington) for pediatric/neonatal intubation. This session concluded with a review of the contents of the pediatric ED resuscitation cart.

Upon conclusion of all training sessions, faculty gathered for a final debriefing and question-answer period. Participants then completed a postintervention questionnaire consisting of the same 11 medical knowledge and 13 attitude questions as well as a written evaluation of the educational activity.

### Data Analysis

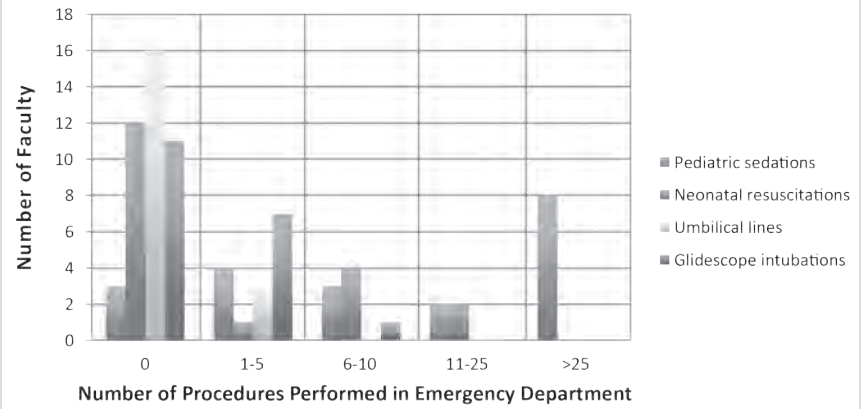
Results of the pre/posttests were blinded via assignment of a unique identifier for each participant. The primary outcome measure was the change in score for both medical knowledge and attitude questions between pre- and postintervention. Pre- and postintervention attitude questions were scored on a 5-point Likert scale. Paired *t* tests were used to compare differences between pre- and posttest scores and further assess effectiveness of the intervention. All calculations were conducted using SAS 9.3 for Windows (SAS Institute Inc, Cary, North Carolina).

## RESULTS

### Faculty Experience

There were 18 participants in the study, with complete data collected on 17 faculty. Average years removed from residency for the cohort was 4.3 (range 0.5 to 22). Background experience for selected skills performed by faculty after completion of residency training is shown in the Figure. Over half the faculty previously had performed at least 11 pediatric sedations with approximately

**Figure.** Emergency Medicine Faculty Post-Residency Clinical Experience




40% reporting greater than 25. The majority of faculty (65%) had yet to participate in a neonatal resuscitation and 90% had never placed an umbilical line. Similarly, exposure to pediatric video laryngoscopy was minimal with 60% of faculty yet to utilize in practice and greater than 90% having performed the procedure 5 or fewer times.

### Medical Knowledge and Attitude

Overall, knowledge scores improved 29% from pre- to postintervention (Table). The largest improvements were noted for questions relating to umbilical vessel anatomy and chest compression: ventilation rates (350% and 115% increase in correct answers, respectively).

Pre-intervention attitude questions demonstrated the lowest comfort with neonatal resuscitation skills. The lowest mean scores were for umbilical line placement competence (2.18), followed by neonatal resuscitation comfort (2.59), and competence (3.06). Postintervention scores on all 3 NRP-related skills increased significantly, particularly for umbilical line placement (70% change, $P = <0.0001$). Furthermore, 90% of participants felt more comfortable with umbilical line placement and 53% with neonatal resuscitation following the simulations. Pre-intervention knowledge scores for pediatric sedations and airway management were generally higher, particularly with respect to competence in performing pediatric sedations (3.88). Pre-intervention competence scores for airway management skills including use of video laryngoscopy (3.71) and other pediatric airway equipment (3.71) were also high among faculty. Following the educational curriculum, all sedation and airway-related scores demonstrated statistically significant increases. This was most notable for competence with the GlideScope, which showed a 15.6% positive change ($P = 0.0002$).

### Acceptability and Feasibility

Eighty-three percent of eligible faculty participated in the study. Prior to the intervention, faculty strongly agreed that simulation is a good way to update pediatric critical care skills (4.59). This was unchanged following the curriculum (4.71, $P = 0.16$). The simulation exercises were associated with a level of anxiety among participants, which was similar before (3.65) and after (3.76) the exercises ($P = 0.69$). The workshop required 21 billable hours of simulation center time including set-up, room use for didactic sessions, scenario administration, and take-down for a total cost of $2985. The endeavor also required approximately 6 hours of faculty time, including review of reading material, completing the written tests, and workshop participation.

## DISCUSSION

Maintaining skills necessary to expertly manage the wide range of critical scenarios encountered in the Emergency Department is a daunting challenge. Given the relative rarity of neonatal clinical encounters, it is not surprising there is unease with NRP-based procedures among EM physicians. Similar to our academic faculty, Kester-Greene and Lee reported lower confidence in neonatal-related competencies among community ED physicians and suggested simulation exercises to enhance skills and comfort.[22] Our results support this educational modality as evidenced by significant postintervention improvements for all neonatal-based knowledge and attitude scores. Such large improvements likely reflect both a general discomfort with neonates pre-intervention as well as improved knowledge and confidence attained via practiced skills.

Pediatric sedations occur daily in many EDs and physicians must be vigilant to detect and manage complications. Not surprisingly, compared to the neonatal-based scenarios, our general EM faculty had both greater pre-intervention experience and comfort with airway management (Table). Despite these high pre-intervention scores, all improved significantly following the intervention, demonstrating the efficacy of simulation-based learning to supplement faculty prior experience and reinforce skills necessary for competence in pediatric sedations and airway management.

The popularity of simulation may be related to the intrinsic hands-on nature of the learning environment such that trainees perceive they are engaged in real-life clinical situations. While operating in a controlled setting, instructors and students can examine how the learners react in specific clinical scenarios. However, despite impressive advances in simulation fidelity,

**Table.** Comparison of Pre/Post Simulation-Based Educational Intervention on Knowledge and Attitude

| | Pre-intervention Average | Post-intervention Average | % Change | P Value |
|---|---|---|---|---|
| Medical Knowledge Aggregate Test Score (11 questions) | 6.83/11 | 10/11 | **28.9%** | **<0.0001** |
| **Attitude Questions*** | | | | |
| I feel comfortable in managing adverse events that occur in pediatric sedations | 3.41 | 3.88 | **13.8%** | **0.0068** |
| I feel competent in performing emergent pediatric sedations | 3.88 | 4.12 | **5.9%** | **0.0413** |
| I feel comfortable in performing emergent neonatal resuscitations | 2.59 | 3.41 | **31.7%** | **0.0061** |
| I feel competent in performing emergent neonatal resuscitations | 3.06 | 3.65 | **19.3%** | **0.0036** |
| I feel competent in performing umbilical lines | 2.18 | 3.71 | **70.2%** | **<0.0001** |
| I feel competent in performing pediatric airway techniques using a GlideScope | 3.71 | 4.29 | **15.6%** | **0.0002** |
| I feel competent in handling and identifying pediatric airway equipment in the ED | 3.71 | 4.24 | **14.3%** | **0.0149** |
| Participating in this workshop with my colleagues will be (was) anxiety provoking | 3.65 | 3.76 | 3.0% | 0.6959 |
| Simulation is a good way to update my pediatric critical care skills | 4.59 | 4.71 | 2.6% | 0.1635 |

* On a 5-point Likert scale, with 5 indicating "strongly agree" and 1 indicating "strongly disagree."
Statistically significant change ($p \leq 0.05$) in bold.

many nuances of the clinical experience cannot be recreated. This limitation makes full engagement in the exercise difficult for some, and identifying acceptance of simulation is an important component to assessing its usefulness. Furthermore, direct costs for Simulation Center use, as well as indirect costs associated with faculty time must be factored as potential barriers to its utility.

While medical student and resident trainee acceptance appears to be high, it is possible that faculty with "real-world" experience may resist the simulated environment. However, despite being reported as somewhat anxiety provoking, our findings demonstrate that both pre- and postworkshop acceptance among our faculty was quite high. One study participant noted the most useful aspects of the experience was "having experts available to ask questions that you can't ask in other forums, feeling safe asking questions and getting exposure to pediatric equipment." Thus, it appears that even seasoned emergency medicine faculty members are accepting of the simulation experience for updating pediatric critical care proficiencies.

Academic EM faculty time is frequently divided among myriad commitments. To overcome inherent time constraints, we specifically scheduled the workshop during a departmental retreat, allowing us to capture 83% of faculty. The program costs were covered by departmental funds allocated for the annual retreat, indicating that even during fiscally tight times, appropriate budgeting can help offset the price of educational innovation. At an expense of $165 per participant, this may represent a small investment to an institution striving to provide the highest quality of care to its youngest patients. Still, we recognize time and financial resources vary widely and will need to be addressed individually by each institution. However, our approach indicates that when an appropriate departmental leadership and faculty commitment are available, simulation exercises to reinforce pediatric and neonatal critical care proficiencies have high acceptance and feasibility.

## Limitations

Our workshop evaluated faculty at a single tertiary care academic center, and our findings may not be generalizable other institutions. Given our single study site, our sample size is relatively small and represents a convenience sample of participants. Our data may be affected due to 1 study participant not completing a pretest, and only answering the posttest questions and evaluation. Despite our data trends demonstrating improvement in comfort and competence in performing pediatric procedures and managing pediatric sedations, the responses to our questions were self-reported by the participants, which may not accurately measure the participants' actual competency.

There were 2 interventions between the pretest and posttest: suggested readings and the simulated cases. It is unclear which intervention had the greatest direct effect on the improvement in scores of the knowledge questions. The knowledge-based posttest questions were identical to the pretest questions. Thus, participants may have made mental note of the questions while reviewing the suggested reading materials, such that they highlighted content germane to the questions or independently found the answers to the questions after turning in the pretest. Of note, faculty did not receive feedback on pretest performance so as to not unduly influence postintervention performance. Additionally, faculty submitted pretest answers well before the intervention/posttest timeframe to minimize the effect of prior familiarity with the knowledge-based questions.

The study participants completed the knowledge-based questions, survey questions, and course evaluation immediately following the simulation workshop. To better assess the long-term effect of this workshop on clinician knowledge and attitude, follow-up survey with knowledge and attitudinal questions would be helpful. Collection of such retention data was not feasible during the timeframe of the current investigation, but is planned for in future iterations of the curriculum. It is also unclear what the

actual effect of this simulation-based training is to patient care and outcomes. Comparing outcomes of critically ill neonates, pediatric sedations, and pediatric procedures in the ED before and after the workshop could better measure the effectiveness of this simulation-based training.

## CONCLUSION

General EM faculty have limited opportunities to manage neonatal resuscitations and adverse events associated with pediatric sedations. This study suggests that simulation-based training is an acceptable, effective, and feasible method to educate faculty-level learners. A simulation-based workshop in neonatal and pediatric critical care skills appears to be helpful in improving knowledge, comfort and perceived competence of general EM faculty in the face of expanding pedatric EM coverage.

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# A Profile of Patients Who Fail to Keep Appointments in a Veterans Affairs Primary Care Clinic

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## ABSTRACT

**Background:** Missed medical appointments ("no-shows") affect both staff and other patients who are unable to make timely appointments. No-shows can be prevented through interventions that target those most at risk to miss appointments. Young age, low socioeconomic status, a history of missed appointments, psychosocial problems, and longer wait times are some predictors that previously have been associated with higher no-show rates.

**Objective:** To determine predictors for outpatient appointment no-shows in primary care clinics of the Veterans Affairs Nebraska-Western Iowa Health Care System.

**Methods:** The study included 69,908 noncancelled primary care appointments between January 1, 2012 and December 31, 2013 among patients residing in ZIP codes within the Veterans Affairs Nebraska-Western Iowa Health Care System Service Area. Age, sex, race, presence of a mental health diagnosis, previous no-show rate in the past 2 years, appointment wait time, distance to clinic, and neighborhood deprivation index were extracted or measured for each patient.

**Results:** In log-binomial models accounting for clustering by ZIP code, the strongest predictors of no-shows were age between 20 and 39 (OR compared to 60+: 3.87, 95% CI, 3.48-4.31) or between 40 and 59 (OR compared to 60+: 2.23, 95% CI, 2.05-2.43), black (OR compared to white: 2.14, 95% CI, 1.98-2.31) or other nonwhite race (OR compared to white: 1.35, 95% CI, 1.17-1.56), male sex (OR compared to female: 1.30, 95% CI, 1.16-1.45), and presence versus absence of mental health diagnosis (OR: 1.16, 95% CI, 1.09-1.24).

**Conclusion:** These findings show that individuals who are younger, nonwhite, male, or have been diagnosed with mental health issues are more likely to no-show. Interventions to improve compliance could be targeted at these individuals in order to decrease the burden of no-shows on health care systems.


## INTRODUCTION

Missed medical appointments ("no-shows") affect both staff and other patients. No-show rates in primary care settings range from 5% to 55%.[1] Previous studies at Veterans Affairs (VA) hospitals have found no-show rates of 23% (for nutrition appointment attendance) and 37% (for coronary artery disease testing and treatment).[2,3] No-shows yield loss of time, resources, and efficiency for physicians and other staff.[4] Scheduled patients who miss appointments cause a reduction in the quality of care for patients who meet challenges scheduling timely appointments.[5] There are also significant economic losses to health care systems. One study determined that no-shows reduce revenue by approximately 16%.[6]

Within the broader realm of health care systems, the Veterans Health Administration represents a unique model. It has a benchmark for "missed opportunities," which includes no-shows and doctor cancellations, of no more than 10%. Beginning in spring 2014, media reports drew attention to wait time issues and some possible manipulation of patient waiting lists. An investigation determined that the Phoenix, Arizona VA facilities maintained paper waiting lists in order to conceal veterans' actual times to appointment.[7] These issues make the current study particularly timely. The study of no-shows can be part of the solution to improving the flow of health care systems and reducing barriers to receiving care.

No-shows can be prevented through well-designed interventions such as mail, telephone, and short message service (SMS)/text message reminders and open access scheduling.[6,8-16] One study found economic benefit of interventions, but there was no assessment of whether economic gain was made without loss of quality of care. Nonetheless, appropriate interventions resulted in a reduction of revenue loss from 16% to between 3.8% and 10.5%.[6]

In order to create interventions that target those most at risk

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to miss appointments, it is necessary to understand the multilevel factors that predict no-shows. Many individual-level characteristics may affect a patient's ability to attend an appointment, such as young age since younger patients may take less responsibility for attending appointments or have fewer medical issues.[9,17-22] Increasing wait times for clinic visits have resulted in higher no-show rates, which may be due to forgetfulness or a lack of reminders.[19] Area-based factors such as neighborhood deprivation and proximity to services also can impact no-shows as patients may have less access to transportation and appropriate care.

Previous studies of no-shows have focused largely on non-VA or nonprimary care clinics.[1-3,5,9,17-24] Robust and contemporary information about the significance of associations between comorbidities, such as psychosocial problems, and no-shows is thin.[9,23] This is particularly important considering approximately 46% of the general US population has a mental health diagnosis.[25] While neighborhood effects were assessed in a previous study of appointment keeping in a managed care setting, to our knowledge, they have not been assessed in previous studies of no-shows for primary care clinics.[24] This study aims to determine which individual, health system, and contextual factors are most associated with primary care appointment no-shows at the Veterans Affairs Nebraska-Western Iowa Health Care System in Omaha, Nebraska.

## METHODS

### Study Population

Medical records were retrieved for patients with visits between January 1, 2012 and December 31, 2013 at the VA Nebraska-Western Iowa Health Care System primary care clinics in Omaha, Nebraska. Inclusion criteria were nondeceased patients for these care clinics whose ZIP code was within the catchment area. Appointments cancelled by either patients or clinics were excluded. The initial dataset included 95,835 visits by nondeceased patients. Because the patients resided outside the catchment area, 1,741 visits were dropped, while 11,781 and 12,405 visits were excluded because they were cancelled by the patient and clinic prior to the visit, respectively. Following these exclusions, 69,908 visits remained for analysis.

### Ethical Review

Research Service at the VA Nebraska-Western Iowa Health Care System and the Emory University Institutional Review Board reviewed the research protocol, characterizing the work as quality improvement and not classified as research.

### Variables

*Individual Level*—Individual level variables of age, race, sex, any prior mental health diagnosis (yes or no), and rate of previous primary care no-shows were obtained from medical records. Age was categorized as 18-39, 40-59, and 60 or older. Race was determined through patient self-identification of either white, black/African American, Asian, American Indian/Alaska Native, Native Hawaiian/other, unknown, or declined to answer. Mental health diagnosis was determined as ever having a diagnosis with an International Classification of Disease code of 290 to 799.59. The rate of previous primary care no-shows was calculated by dividing the number of no-shows for primary care appointments in the study period by the number of primary care appointments during that time for each appointment. This was used to assess history of missed appointments.

*Health Systems Level*—Health systems variables of wait time and day of week of appointment also were obtained from medical records. Wait time was determined by calculating the time between the date the appointment was made and the date of the appointment itself. The resulting variable was then categorized into 0 to 14 days, 15 to 30 days, 30 to 90 days, and greater than 90 days.

*Contextual Level*—Patient residential ZIP codes were linked to socioeconomic data available from the census for calculation of the Neighborhood Deprivation Index and distance from each ZIP code to the clinic. The Neighborhood Deprivation Index was composed of 8 variables from the 2008-2012 American Community Survey (percent of males in management and professional occupations, percent of crowded housing, percent of households in poverty, percent of female-headed households with dependents, percent of households on public assistance, percent of households earning less than $30,000 per year estimating poverty, percent earning less than a high school education, and percent unemployed).[26] Five-digit ZIP Code Tabulation Areas were chosen as the geographical area of interest in order to merge American Community Survey data with the patient ZIP codes. Distances from home to clinic were determined by inputting both patient and VA Nebraska-Western Iowa Health Care System ZIP codes into Google maps and categorized as 0 to 5 miles, 5 to 10 miles, 10 to 30 miles, and greater than 30 miles.

Appointments for patients with residential addresses and ZIP codes within the catchment area were retained. American Community Survey data used to create the Neighborhood Deprivation Index and distance to clinic were merged with patient-level information by ZIP Code Tabulation Areas. Actual ZIP codes were stripped and replaced with anonymized values in order to carry out the analysis on deidentified data.

### Statistical Analysis

We assessed for collinearity among predictor variables. Wald chi-square tests were used to determine significant differences between patients who missed visits and those who did not. Log-binomial generalized estimating equation models were fit to estimate bivariate associations between each predictor variable (age, race, sex, previous no-show rate, mental health diagnosis, wait time, day of

week of appointment, distance, and Neighborhood Deprivation Index) and the binary outcome of "no-show" while accounting for possible correlation of individuals from the same ZIP Code Tabulation Areas. An assessment of all possible subsets of predictors was performed separately by predictor domain beginning with individual level predictors. The significant individual predictors of age, race, sex, and mental health diagnosis were then used as the foundation for modeling all possible subsets of health systems and contextual predictors. Statistical interaction between age and sex and between standardized Neighborhood Deprivation Index and 3 individual level variables of age, race, and mental health each were assessed in bivariate analyses and in the final model using an alpha of 0.05. All analyses were performed using SAS Statistical Software (SAS Institute, Cary, North Carolina).

## RESULTS

The overall rate of no-shows in this study was 8.4%, but varied across individual predictors (Table 1). Table 1 shows the demographics of the set of study visits and the no-show frequency for each category of each predictor. No-shows were highest among 20-39 year olds, nonwhite patients, women, and patients with a mental health diagnosis. The frequency of missed appointments decrease as age increases. Although the majority of the visits (81.2%) were by white patients, 15.1% of black patients missed appointments compared to 7.2% whites and 9.6% of other races. Visits with wait times of 0 to 14 or 30 to 90 days appeared to have greater no-shows than when the wait times were 15 to 30 days or greater than 90 days. Patients living in the most deprived neighborhoods accounted for 38% of visits and 3.1% of missed appointments. Missed appointments by patients living in less deprived neighborhoods ranged from 0.9% to 2.0%.

Unadjusted bivariate analyses (Model 0, Table 2) show that patients age 20-39 were more than 3 times as likely to miss appointments as patients age 60 and older, and patients 40-59 were more than twice as likely as those over 60 to miss appointments. Black patients were twice as likely as whites to miss appointments. Men, who accounted for 91.6% of the visits, were less likely than women to miss appointments. Additionally, individuals diagnosed with mental health issues were more likely than those without mental health issues to miss appointments. Health systems predictors, contextual predictors, and interaction terms were all nonsignificant.

After assessing all possible subsets of individual predictors, we identified a subset of individual predictors for the adjusted individual model. While the odds ratios (OR) for age, race, and mental health diagnosis remained fairly constant across all models, the OR for men as compared to women changed from 0.80 in Model 0 to 1.30 in Model 1. No health systems predictors or area-based predictors were significantly associated with the outcome of no-show in the full model.

**Table 1.** Descriptive Statistics by Visits

| Variables | Total Appointments (n=69,908) % or Mean | No-show (n=5,888) % or Mean | *P*-value[a] |
|---|---|---|---|
| **Appointments** | 100% | 8.4% | |
| **Individual Predictors** | | | |
| **Age** | | | **<0.0001** |
| 20-39 | 10.6% | 17.2% | |
| 40-59 | 28.0% | 12.0% | |
| 60 and over | 61.5% | 5.3% | |
| **Race** (Missing = 153) | | | **<0.0001** |
| White | 81.2% | 7.2% | |
| Black | 13.5% | 15.1% | |
| Other[b] | 5.3% | 9.6% | |
| **Sex** | | | **<0.000** |
| Male | 91.6% | 8.3% | |
| Female | 8.4% | 10.2% | |
| **Mental Health Diagnosis** | | | **<0.0001** |
| Yes | 60.6% | 9.4% | |
| No | 39.4% | 6.9% | |
| **Primary Care No-show Rate in Past 2 Years** | **6.5** | **32.12** | **<0.0001** |
| **Health System Predictors** | | | |
| **Day of Week of Appointment** (Missing = 72) | | | **0.0002** |
| Monday | 19.6% | 1.8% | |
| Tuesday | 22.1% | 1.9% | |
| Wednesday | 20.8% | 1.7% | |
| Thursday | 18.0% | 1.4% | |
| Friday | 19.2% | 1.6% | |
| Saturday | 0.4% | 0.0% | |
| **Wait Time** (Mean In Days) (Continuous) | **28.38** | **28.17** | **0.5614** |
| **Wait Time** (Days) | | | **0.3553** |
| 0-14 | 45.8% | 3.9% | |
| 15-30 | 17.6% | 1.4% | |
| 30-90 | 31.8% | 2.6% | |
| >90 | 4.8% | 0.4% | |
| **Contextual Predictors** | | | |
| **Unique ZIP Codes (n=394)** | | 68.8% | |
| **Neighborhood Deprivation Index (Quintiles)** (Missing = 6) | | | **0.0818** |
| 1 - Least deprived | 23.6% | 2.0% | |
| 2 | 12.9% | 1.1% | |
| 3 | 14.7% | 1.3% | |
| 4 | 10.9% | 0.9% | |
| 5 - Most deprived | 38.0% | 3.1% | |
| **Distance to Clinic** (Mean Miles) (Continuous) | **20.32** | **20.91** | **0.1082** |
| **Distance to Clinic** (Miles) | | | **0.0009** |
| 0-5 | 22.0% | 1.8% | |
| >5-10 | 27.3% | 2.3% | |
| >10-30 | 31.0% | 2.5% | |
| >30 | 19.7% | 1.8% | |
| **LN (Distance to Clinic)** (ln Miles) | **2.38** | **2.41** | **0.0106** |

Abbreviation: LN, natural logarithm.
[a] *P*-value for comparison of no-show to show (numbers not shown).
[b] Other: Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Unknown.

**Table 2.** Model Selection

| Predictors | Model 0 Unadjusted Bivariate Models[a] OR | 95% | CI | Model 1 Full Model OR | 95% | CI |
|---|---|---|---|---|---|---|
| **Individual Predictors** | | | | | | |
| **Age** | | | | | | |
| 20-39 | 3.74 | 3.36 | 4.15 | 3.87 | 3.48 | 4.31 |
| 40-59 | 2.45 | 2.25 | 2.67 | 2.23 | 2.05 | 2.43 |
| 60 and over (referent) | 1.00 | | | 1.00 | | |
| **Race** | | | | | | |
| White (referent) | 1.00 | | | 1.00 | | |
| Black | 2.29 | 2.13 | 2.46 | 2.14 | 1.98 | 2.31 |
| Other[b] | 1.36 | 1.16 | 1.60 | 1.35 | 1.17 | 1.56 |
| **Sex** | | | | | | |
| Male | 0.80 | 0.72 | 0.89 | 1.30 | 1.16 | 1.45 |
| Female (referent) | 1.00 | | | 1.00 | | |
| **Mental Health Diagnosis** | | | | | | |
| Yes | 1.39 | 1.30 | 1.49 | 1.16 | 1.09 | 1.24 |
| No (referent) | 1.00 | | | 1.00 | | |
| Primary care no-show rate in past 2 years | 1.07 | 1.07 | 1.07 | | | |
| **Health System Predictors** | | | | | | |
| **Day of Week of Appointment** | | | | | | |
| Monday | 0.93 | 0.59 | 1.45 | 0.89 | 0.57 | 1.38 |
| Tuesday | 0.83 | 0.54 | 1.30 | 0.82 | 0.53 | 1.27 |
| Wednesday | 0.80 | 0.52 | 1.25 | 0.76 | 0.50 | 1.17 |
| Thursday | 0.76 | 0.49 | 1.16 | 0.73 | 0.48 | 1.10 |
| Friday | 0.82 | 0.52 | 1.31 | 0.76 | 0.48 | 1.20 |
| Saturday (referent) | 1.00 | | | 1.00 | | |
| Wait time (days) (continuous) | 0.99 | 0.97 | 1.01 | 1.00 | 1.00 | 1.00 |
| **Wait Time (Days)** | | | | | | |
| 0-14 (referent) | 1.00 | | | | | |
| 15-30 | 0.95 | 0.87 | 1.04 | | | |
| 30-90 | 0.97 | 0.91 | 1.03 | | | |
| >90 | 1.05 | 0.94 | 1.17 | | | |
| **Contextual Predictors** | | | | | | |
| **Standardized Neighborhood Deprivation Index** (Quintiles) | | | | | | |
| 1 - Least deprived (referent) | 1.00 | | | 1.00 | | |
| 2 | 0.97 | 0.85 | 1.11 | 0.98 | 0.88 | 1.09 |
| 3 | 1.04 | 0.91 | 1.19 | 1.05 | 0.94 | 1.16 |
| 4 | 0.97 | 0.86 | 1.10 | 1.02 | 0.94 | 1.12 |
| 5 - Most deprived | 0.93 | 0.83 | 1.04 | 1.01 | 0.93 | 1.11 |
| **Distance to Clinic** (Miles) (Continuous) | **1.00** | **1.00** | **1.00** | **1.00** | **1.00** | **1.00** |
| **Distance to Clinic** (Miles) | | | | | | |
| 0-5 (referent) | 1.00 | | | | | |
| >5-10 | 1.00 | 0.99 | 1.01 | | | |
| >10-30 | 1.00 | 0.99 | 1.01 | | | |
| >30 | 1.01 | 1.00 | 1.02 | | | |
| LN (Distance to clinic) (ln miles) | 1.04 | 1.00 | 1.07 | | | |
| **QIC** | | | | **38262.3** | | |

Abbreviations: QIC, Quasilikelihood under the Independence model Criterion; LN, natural logarithm.
[a] Unadjusted bivariate analyses of predictors with the outcome of no-shows.
[b] Other: Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Unknown.

## DISCUSSION

This study aimed to determine factors associated with missed VA primary care appointments. Individual factors of age, race, sex, and mental health diagnosis were found to be the primary factors associated with missed appointments, while measured health system and contextual factors were relatively noncontributory.

The overall no-show rate in this study (8.4%) was within the range reported by previous studies of 5% to 55%, but was less than those reported for non-primary care visits at other VA hospitals (23% and 37%).[2,3] This study's findings reinforce previous findings that suggest a strong association between individual factors and missed appointments. In previous literature, younger patients were found to be associated with greater missed appointments.[19,21] Older patients tend to have more health issues that require regular attendance. Lacy et al[18] described a lack of understanding of the health care scheduling system, which could be more prevalent in younger patients and aid in explaining this difference.

Smith and Yawn[21] also found that white patients had lower no-show rates than Hispanic or African American patients. The direction of the association between sex and no-show was varied in previous literature.[20,22] Our finding that men were significantly associated with more no-shows is similar to that reported by Sharp and Hamilton.[20]

The association between mental health diagnosis was not explored deeply in recent literature of primary care clinics. It might be expected, as we found, that certain mental health issues would be barriers to keeping appointments. This finding is particularly important in the study population, with 60% having a mental health diagnosis compared to 46% prevalence among the general US population.[25] It is also plausible that mental health issues represent a much larger set of barriers to care that should be attended in order to provide high quality care.

We primarily found associations between no-shows and the individual level factors described above. This contradicted findings in recent literature, which reported higher no-show rates with longer wait times and appointments on specific days of the week.[19,20] Previous

studies also found an association between high neighborhood deprivation and poor appointment-keeping.[24]

Our findings can allow the primary care clinics in this study to target interventions at these high-risk groups to reduce no-shows and thus improve delivery of quality care. A number of potential interventions can be implemented, from mail, telephone, or SMS/text reminders to open access scheduling.[6,8-16] The San Francisco VA Medical Center implemented an orientation clinic for new patients that significantly reduced no-shows for first appointments from 45% in the preintervention group to 18% in the orientation clinic group.[13] Another effective intervention has been use of advanced or open access scheduling.[15]

### Strengths and Limitations

Our study has several strengths. We performed a complete analysis of all noncancelled primary care visits in a specified catchment area. The study assessed predictors of no-shows for primary care clinics that, to our knowledge, had not been explored previously. Our finding that having a mental health diagnosis is associated with increased risk of no-show fills a gap in contemporary literature and is worthy of further study. However, we were unable to discriminate among types of mental health diagnoses. Finally, our exploration of neighborhood effects is an important contribution to the literature. Even though we did not find significant effects of neighborhood deprivation on no-shows for this study, it is possible that the effect could be different for other VA locations, other types of clinics, or other geographic scales.

There were several study limitations. For confidentiality reasons, we were unable to link visits by patient ID, which made it impossible to account for clustering by patient. Additionally, not having patient IDs resulted in use of visit rather than patient as the unit of analysis. However, the variable of previous primary care no-show rates was calculated by the VA electronic health system for unique patients and is, therefore, still valid. We also did not have access to specific medical diagnoses of patients, which resulted in the inability to assess whether presence of major medical conditions was associated with missed visits.

Also due to confidentiality constraints, patient addresses could not be used to determine census tracts for area-based measures. We did capture ZIP code of residence, which allowed at least partial control for clustered events. ZIP Code Tabulation Areas are derived from ZIP codes, which are created by the US Postal Service. Although they are more useful than ZIP codes, ZIP Code Tabulation Areas are still areal representations of these ZIP codes and have inherent limitations. They may not represent the contextual environment or distances that are actual barriers and facilitators for access to care.

Due to the nature of this study as a medical record review, we only had demographic variables collected during routine doctor visits to assess as barriers to care. We did not have information about perceived barriers to care, which could have a greater effect on patient attendance. We created the "wait time" variable from the date patients scheduled their appointments and the actual appointment dates. It also may have been useful to assess the time between the patient's desired appointment date and the date for which they were scheduled, as well as the purpose of the appointment.

## CONCLUSION

These results show that individuals who are younger, nonwhite, male, or have been diagnosed with mental health issues are more likely to no-show. To decrease the burden of no-shows on health care systems, interventions to improve compliance could be targeted at these individuals. Further research is needed to understand more completely the barriers to keeping appointments in order to develop effective interventions.

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# Insights From Building a New National Cancer Institute Community Oncology Research Program Site

Thomas Saphner, MD; Michael A. Thompson, MD, PhD; Sara Planton, BSN; Maharaj Singh, PhD; Neha Glandt, BA; Lisa Robinson, BS; Jan DeBartolo, MSN

## ABSTRACT

**Background:** The new National Cancer Institute (NCI) Community Oncology Research Program (NCORP) went live August 1, 2014; 34 sites were selected for the program, including 7 new sites that previously did not have a research grant from the NCI. This report describes the first year of a new program site.

**Methods:** Accrual, investigator and site participation, and number of open studies by the program over the first 12 months of the grant were compared to performance at our institution over the prior 12 months.

**Results:** During the pre-NCORP period, 84 patients were accrued to NCI-sponsored trials and 106 patients to non–NCI-sponsored trials. In year 1 of the new program, 140 were accrued to NCI-sponsored trials—a 66% improvement, and 109 patients to non–NCI-sponsored trials ($P = 0.013$ when comparing corresponding increases for NCI vs non-NCI trials). Success of the NCI-sponsored trials was associated with increased accrual to both treatment trials ($P = 0.03$) and Alliance for Clinical Trials in Oncology-sponsored trials ($P = 0.0001$).

**Conclusions:** NCORP implementation was associated with a significant ($P = 0.013$) improvement in accrual to NCI-sponsored trials that was immediate (1 year) and large (a 66% increase in accrual). In year 2, the intention is to increase cancer control studies; foster inclusion of radiation, surgical, gynecologic, and neurologic oncologists; and focus on minority outreach. Studies that accrue poorly will be assessed, and those accruing poorly on a national basis will be considered for closure. Studies accruing well nationally will be evaluated for barriers to local accrual.

## INTRODUCTION

In recent years, the National Cancer Institute (NCI) has been challenged to do more research with less funding. Its cooperative groups were merged and all trials consolidated under the National Clinical Trials Network. In addition, the NCI's 2 community programs, the Community Clinical Oncology Program (CCOP) and the NCI Community Cancer Centers Program were replaced by the NCI Community Oncology Research Program (NCORP).[1,2] In August 2014, the NCI announced 34 institutions selected to receive NCORP community site grants. Most of these grants were awarded to sites that previously had a CCOP grant (n = 20) or mergers of multiple sites that previously had CCOP grants (n = 7). However, grants also were awarded to 7 new sites including the Aurora NCORP,[3] which is affiliated with the Milwaukee-based health provider Aurora Health Care.

Prior to being awarded the grant, Aurora was a main site for the National Surgical Adjuvant Breast Project and the Gynecologic Oncology Group and an affiliate site for the Radiation Therapy Oncology Group, 3 national groups that subsequently merged to form NRG Oncology. Aurora also was an affiliate site for Eastern Cooperative Oncology Group—American College of Radiology Research Network. Limited availability to trials from other cooperative groups was available through the Clinical Trials Support Unit.

In this report, the first year of the Aurora NCORP was compared to the year prior to its implementation to determine if there was any change in accrual patterns. The program's first-year performance also was compared to NCI expectations and the American Society of Clinical Oncology guidelines for excellence in community research.

## METHODS

*Terminology and Definitions:* "NCI-sponsored trials" were defined as trials from any of the NCI-sponsored research bases. "Non–NCI-sponsored trials" were industry-sponsored studies, investigator-initiated studies, and registries managed by the Aurora Research Institute (Milwaukee, Wisconsin) requiring institutional review board (IRB) approval and patient consent.

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"Investigators" were identified as physicians who had completed human subjects training in accordance with Aurora IRB requirements and were registered NCI investigators. This report includes investigators who met these requirements any time during the interval specified.

An "open clinical trial" was a trial open to accrual for any portion of time during the interval specified.

*Time Intervals:* August 1, 2013, to July 31, 2014 was the year "prior to NCORP;" "year 1" of the program was August 1, 2014, to July 31, 2015.

S*oftware and Statistical Analysis:* Via Oncology™ (Via Oncology, Pittsburgh, Pennsylvania) is a clinical decision support program[4] that was added to the electronic health record (Epic Systems, Verona, Wisconsin).[5] It prioritizes treatment choices by efficacy, followed by toxicity and then cost, and assists medical oncologists with treatment options. The system, which went live at our organization on November 3, 2014,[6,7] is configured to prioritize clinical trial options when available.

Patients with cancer were recorded and classified by the Aurora Health Care Cancer Registry. The accrual of patients to clinical trials was calculated based on the total number of new analytical cases recorded for the last complete year.

All categorical variables were described as frequencies and percentages, and comparisons across categories were made using chi-square or Fisher's exact test as appropriate. When expected frequencies were less than 5, including zero, Fisher's exact test was used. All continuous variables were described as mean, median, standard deviation (SD), and range of minimum-to-maximum values. Multivariate logistic regression was used to identify predictors of the NCORP accrual. For all statistical tests, alpha ≥ 0.05 was used as level of significance. All statistical analysis was done using SAS version 9.4 (SAS Institute, Cary, North Carolina).

*Monthly Reports:* The NCORP Update is a monthly report e-mailed to all investigators and other members of the clinical trials community (Appendix). It provides accrual metrics categorized by investigator, site, study, research base, and by oncology specialty. It also includes a summary of accrual for month- and year-to-date. The NCORP Open Trials document is updated monthly and sent with the NCORP Update. Both documents are restricted to a single page to encourage routine readership. The monthly program meeting is attended by principal investigators, the program administrator, the clinical trials director and the oncology clinical trials manager. The purpose of the meeting is to provide a forum of regular dialogue regarding program successes, challenges, and needs.

*Research Bases:* Prior to the NCORP, Aurora was a member of Eastern Cooperative Oncology Group – American College of Radiology Research and NRG Oncology. During year 1 of the program, Aurora added the following research bases: Alliance for Clinical Trials in Oncology (Alliance), University of Rochester Cancer Center, and Wake Forest University. The Cancer and Leukemia Group B, American College of Surgeons Oncology Group, and North Central Cancer Treatment Group merged to form the Alliance, whereas the University of Rochester Cancer Center and Wake Forest are research bases with special interest in cancer control research.

## RESULTS

*Aurora Tumor Registry:* The total number of cancer patients seen from August 1, 2013, to July 31, 2015, was 15,114. Non-Hispanic/non-Latino whites numbered 13,208; minority patients totaled 1,906 (12.6%). Prior to the NCORP, 7,065 new cancer patients were seen compared to an estimated 8,049 new patients in year 1.

*Number of Trials Open, Investigators:* Prior to NCORP, there were 49 NCI-sponsored trials and 30 non–NCI-sponsored trials. During year 1, NCI-sponsored trials increased to 63 and non-NCI-sponsored trials increased to 45. The number of NCI trials open as a percentage of all open trials was not significantly different between the 2 periods ($P = 0.61$). There were 63 investigators prior to the NCORP and 65 during year 1.

*Accrual Rate to NCI Clinical Trials:* Of the 7,065 patients in the tumor registry, 84 (1.2%) were accrued to NCI-sponsored trials prior to the NCORP vs 140 of 8,065 (1.7%) during year 1.

*Accrual to NCI vs Non-NCI:* Prior to the NCORP, 84 patients were accrued to NCI-sponsored trials and 106 patients to non–NCI-sponsored trials. During year 1, 140 were accrued to NCI-sponsored trials and 109 to non–NCI-sponsored trials. This change was a 66% improvement in accrual to NCI-sponsored trials, which is statistically significant compared to the corresponding increase in non–NCI-sponsored trials ($P = 0.013$).

*Accrual by Minority Status:* Eight of 84 accruals (10%) prior to the NCORP were minority patients, while 15 of 140 accruals (11%) during year 1 were minority patients ($P = 0.8$).

*Accrual by Treatment or Cancer Control:* Accrual to treatment trials increased from 72 to 132 after year 1; accrual to cancer control trials dropped from 12 to 8 ($P = 0.03$), respectively.

*Accrual by NCORP Research Base:* There has been a significant change in accrual by research base ($P < 0.0001$), except for Wake Forest, which experienced no increase during the study period. The Alliance experienced the greatest increase (from 7 to 46), and the University of Rochester Cancer Center accruals rose from 0 to 5 (Table 1).

*Accruals by Oncology Specialty:* During year 1, medical oncologists increased accruals from 72 to 119; radiation oncologists from 7 to 9, surgical oncologists from 0 to 6, and neurologic oncolo-

gists from 0 to 3. In contrast, gynecologic oncologists decreased accruals from 5 to 3. There was no difference in accrual by specialty from the year prior to the NCORP to year 1 ($P = 0.1$).

*Accrual by Investigator:* The Aurora program included 61 investigators: 37 accrued 1 or more patients; 24 accrued no patients. Mean accrual per investigator was 2.3 (SD: 3.2, range: 0-17). The median was 1 accrual per investigator; the mode was 0 accruals (Figure 1).

*Accrual by Site:* There were 19 program sites. Mean accrual by site was 7 (SD 6, range: 0-22). Both the median and mode were 5 accruals per site.

*Accrual by Study:* During year 1, there were 63 open NCI-sponsored clinical trials; 39 accrued at least 1 patient, and 24 trials had no accruals. Eight studies had no accrual for more than a year, and 5 trials had no accrual for 2 years. Mean accrual per study was 2.2 patients (SD: 3.1, range: 0-14).

*Accrual by Oncology Specialty:* For NCI-sponsored open studies, mean number of accruals per study was 2.2. Medical oncology had the highest number of accruals (3.3), while gynecologic oncology had the fewest accruals (0.3) (Table 2).

**Table 1.** Accrual by Research Base

| Research Base | Accrual Prior to NCORP | Accrual in NCORP |
|---|---|---|
| ECOG-ACRIN | 35 | 38 |
| NRG Oncology, NSABP, RTOG and GOG | 26 | 24 |
| Alliance, CALGB, NCCTG and ACOSOG | 7 | 46 |
| University of Rochester Cancer Center | 0 | 5 |
| Wake Forest | 0 | 0 |
| Southwestern Oncology Group (SWOG) through CTSU | 16 | 27 |
| **Total** | **84** | **140** |

Abbreviations: ACOSOG, American College of Surgeons Oncology Group; CALGB, Cancer and Leukemia Group B; CTSU, Clinical Trials Support Unit; ECOG-ACRIN, Eastern Cooperative Oncology Group – American College of Radiology Research Network; GOG, Gynecologic Oncology Group; NCCTG, North Central Cancer Treatment Group; NSABP, National Surgical Adjuvant Breast Project; RTOG, Radiation Therapy Oncology Group.

**Figure 1.** Accrual By Investigator in the Aurora NCORP

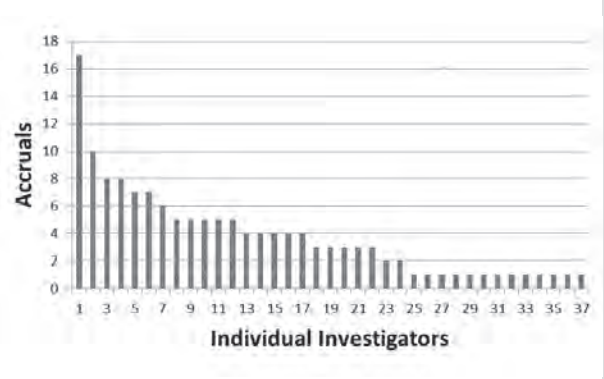



**Table 2.** Ratio of Accrual to Studies Open by Oncologic Specialty

| Oncologic Specialty | Accrual | Number of Studies Open | Ratio |
|---|---|---|---|
| Medical oncology | 119 | 36 | 3.3 |
| Radiation oncology | 9 | 7 | 1.3 |
| Gynecologic oncology | 3 | 11 | 0.3 |
| Surgical oncology | 6 | 7 | 0.9 |
| Neurologic oncology | 3 | 2 | 1.5 |
| **Total** | **140** | **63** | **2.2** |

## DISCUSSION

Accrual to NCI-sponsored trials increased 66% with formation of the Aurora NCORP. This increase was significantly greater than accrual to non–NCI-sponsored trials open during the same period. These findings are consistent with the observations of other community sites that received NCI grants for community cancer research.[8,9]

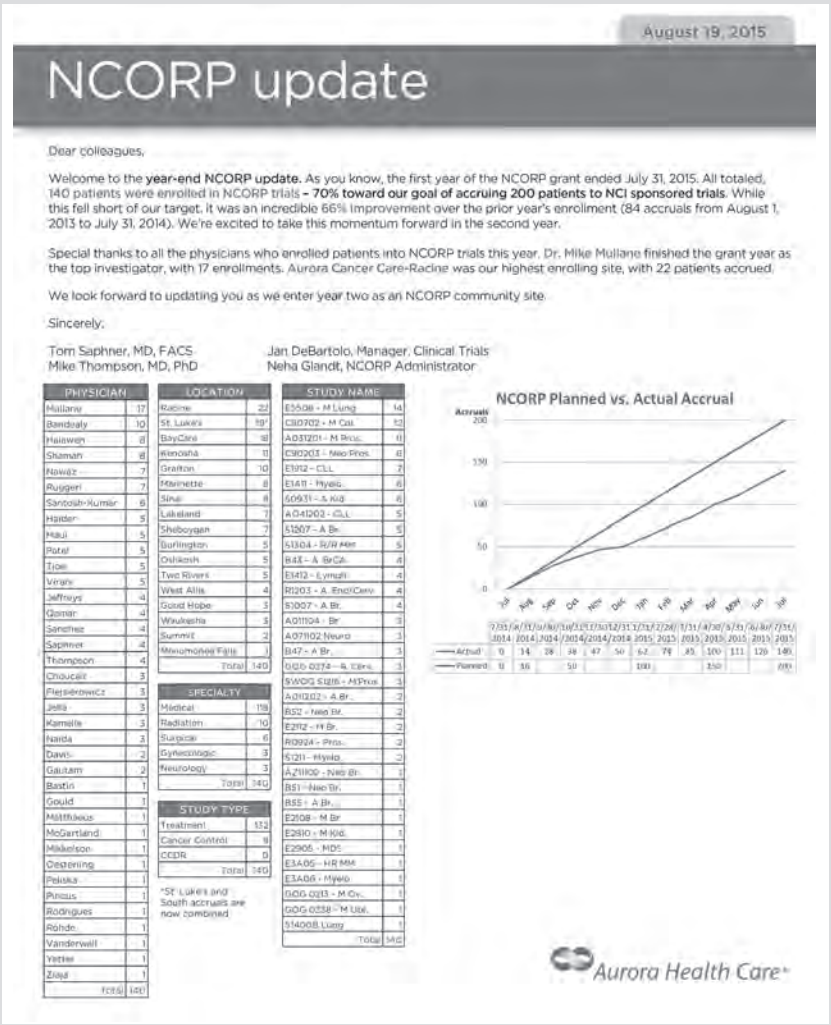
The 140 Aurora program accruals fall short of the 200 total accruals required to meet NCI's definition of a "high-performing" community site.[10] Accrual as a percentage of patients seen improved from roughly 1% to 2% in our program. This contrasts with the total accrual goal set by the American Society of Clinical Oncology (ASCO) of 10% of patients to all clinical trials[11,12] and implies that an accrual of approximately 800 patients at our institution is required to achieve excellence, as defined by ASCO.

Accrual improvement was associated with increased accrual to treatment trials as opposed to cancer control trials. NCI anticipates that a program site should accrue equally to cancer treatment and cancer control studies,[10] and aggregate data from all NCORPs demonstrated this to be typical.[10] This implies that accrual to treatment trials was acceptable at this site and that there is an opportunity for increased accrual in cancer control trials.

Increased accrual also was associated with increased accrual to Alliance-sponsored trials. It is likely this is related the availability of practical trials for common cancers from the Alliance and increased awareness of these trials after the Aurora program added the Alliance research base.

Increased accrual of minority patients was proportional to increased accrual in general. Relative accrual to minority trials was stable. The percent of minorities enrolled in clinical trials was 10%, while the percent in Aurora's tumor registry was 12%. This suggests that the highest minority accrual the program is likely to achieve is 12%, and published strategies for improvement of

**Appendix.** The NCORP Update, A Monthly Report E-mailed to All Investigators and Other Members of the Clinical Trials Community



August 19, 2015

# NCORP update

Dear colleagues,

Welcome to the **year-end NCORP update.** As you know, the first year of the NCORP grant ended July 31, 2015. All totaled, 140 patients were enrolled in NCORP trials **– 70% toward our goal of accruing 200 patients to NCI sponsored trials.** While this fell short of our target, it was an incredible 66% improvement over the prior year's enrollment (84 accruals from August 1, 2013 to July 31, 2014). We're excited to take this momentum forward in the second year.

Special thanks to all the physicians who enrolled patients into NCORP trials this year. Dr. Mike Mullane finished the grant year as the top investigator, with 17 enrollments. Aurora Cancer Care-Racine was our highest enrolling site, with 22 patients accrued.

We look forward to updating you as we enter year two as an NCORP community site.

Sincerely,

Tom Saphner, MD, FACS
Mike Thompson, MD, PhD
Jan DeBartolo, Manager, Clinical Trials
Neha Glandt, NCORP Administrator

| PHYSICIAN | |
|---|---|
| Mullany | 17 |
| Banderaly | 10 |
| Haiawen | 8 |
| Shaman | 8 |
| Nawaz | 7 |
| Ruggeri | 7 |
| Santosh-Kumar | 6 |
| Halder | 5 |
| Haui | 5 |
| Patel | 5 |
| Tiao | 5 |
| Virani | 5 |
| Jeffreys | 4 |
| Qamar | 4 |
| Sanchez | 4 |
| Saphner | 4 |
| Thompson | 4 |
| Choucair | 3 |
| Flerserowicz | 3 |
| Jalla | 3 |
| Kamelle | 3 |
| Narda | 3 |
| Davis | 2 |
| Gautam | 2 |
| Bastin | 1 |
| Gould | 1 |
| Matthaeus | 1 |
| McGartland | 1 |
| Mikkelson | 1 |
| Oesterling | 1 |
| Peiaia | 1 |
| Pircus | 1 |
| Rodrigues | 1 |
| Rohde | 1 |
| Vanderwill | 1 |
| Yetter | 1 |
| Zaid | 1 |
| Total | 140 |

| LOCATION | |
|---|---|
| Racine | 22 |
| St. Luke's | 19* |
| BayCare | 18 |
| Kenosha | 11 |
| Grafton | 10 |
| Marinette | 8 |
| Sinai | 8 |
| Lakeland | 7 |
| Sheboygan | 7 |
| Burlington | 5 |
| Oshkosh | 5 |
| Two Rivers | 5 |
| West Allis | 4 |
| Good Hope | 3 |
| Waukesha | 3 |
| Summit | 2 |
| Menomonee Falls | 1 |
| Total | 140 |

| SPECIALTY | |
|---|---|
| Medical | 118 |
| Radiation | 10 |
| Surgical | 6 |
| Gynecologic | 3 |
| Neurology | 3 |
| Total | 140 |

| STUDY TYPE | |
|---|---|
| Treatment | 132 |
| Cancer Control | 8 |
| CCDR | 0 |
| Total | 140 |

*St. Luke's and South accruals are now combined

| STUDY NAME | |
|---|---|
| E5508 - M Lung | 14 |
| CI07702 - M Col. | 12 |
| A031201 - M Proc. | 11 |
| CI02103 - Neo Pros. | 8 |
| E1912 - CLL | 7 |
| E1411 - Hyelg. | 6 |
| 50931 - A Kid. | 6 |
| A041202 - CLL | 5 |
| 51507 - A Br. | 5 |
| 51304 - R/R Mel. | 5 |
| 843 - A BrCA | 4 |
| E1412 - Lymph. | 4 |
| R1203 - A. Endi/Cerv. | 4 |
| 51007 - A Br. | 4 |
| A011104 - Br. | 3 |
| A071102 Neuro | 3 |
| 847 - A Br. | 3 |
| 0105 0274 - A. Colrc. | 3 |
| SWOG S1216 - M Pros. | 3 |
| A012102 - A Br. | 2 |
| 852 - Neo Br. | 2 |
| E2112 - H Br. | 2 |
| R0924 - Pros. | 2 |
| 51211 - Hyelg. | 2 |
| A211102 - Neo Br. | 1 |
| 851 - Neo Br. | 1 |
| 855 - A Br. | 1 |
| E2108 - M Br | 1 |
| E2910 - M Kid. | 1 |
| E2905 - MDS | 1 |
| E3A05 - HR MM | 1 |
| E3A06 - Myelo | 1 |
| GOG 0213 - M Cv. | 1 |
| GOG 0238 - M Ute. | 1 |
| 514008 Lung | 1 |
| Total | 140 |




Aurora Health Care

minority involvement[13-17] may not result in a decisive increase in accrual. Identification and quantification of minority patients who are not documented in the Aurora tumor registry may be an opportunity for improved minority accrual.

Accrual by investigator was highly variable; 24 of 61 total investigators had no accrual at all. The observation that physicians commonly complete registration to become an investigator and complete human subjects training but fail to accrue patients to trials is not new.[9] Medical oncologists accrued the most patients, followed by radiation oncologists and surgical oncologists, but the changes in accrual pre- and post-NCORP by specialty were not significant at this institution. This distribution of accrual by oncologic subspecialty is consistent with the literature.[9] It has been suggested that a minimum of 4 accruals to NCI-sponsored trials be required to maintain clinical investigator status.[18]

Accrual by study also was highly variable. Eight of the NCI studies had no accrual for a year, and 5 NCI studies had no accrual for 2 years. Two of these trials are accruing well nationally, and investigation of local barriers is underway. Three of the trials are not accruing well locally or nationally and are candidates for closure.

The mean number of accruals for an open trial at our program was 2.2, but the number of accruals for each open study varied greatly by oncologic subspecialty (range: 0.3-3.3). This could be interpreted as a guide to the types of trials to open to maximize accrual, or as a clue to the specific subspecialties that may have the greatest potential for increased accrual in the future.

Many activities were initiated during year 1 that likely improved accrual, including the initiation of Via Oncology—a clinical decision support program that prioritizes clinical trials, the NCORP Monthly Update, the NCORP Open Trials list, the monthly program meeting, and many others.[19,20] These activities were described qualitatively in the Methods section because it is likely they related to increased accrual, but they were not mentioned in the Results section because it was not possible to individually quantify their effects.

The NCORP grant was associated with a large (66%), significant, and immediate ($P=0.013$ at 1 year) improvement in accrual. Now in its second year, the Aurora NCORP acknowledges the following observations and opportunities:

- Cancer treatment studies historically have been the most successful at Aurora NCORP, but the greatest opportunity for increased accrual is cancer control studies.
- Medical oncologists are central to a successful community research program, but the greatest opportunity for enhanced accrual lies with radiation oncology, surgical oncology, gynecologic oncology, and neurologic oncology trials.
- Minority accrual is close to expected based on our registry data but if there are patients not captured in the registry, they may be a potential source of accrual growth.
- Studies that accrue poorly at the Aurora program and nationally will be closed. Studies that accrued poorly at Aurora but accrue well nationally will be evaluated for local barriers, as they may be a potential source of increased accrual.

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# Comparison of Ischemic Colitis in the Young and the Elderly

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## ABSTRACT

**Background:** Ischemic colitis is traditionally known as a disease of the elderly; however, its recognition among the young recently has increased. The aim of this study was to illustrate the features of ischemic colitis in a younger population.

**Methods:** Medical records of patients with ischemic colitis from January 2007 to January 2013 were reviewed. The study was conducted in 2 hospitals, and the patients were divided into 2 groups: < 50 and ≥ 50 years old.

**Results:** A total of 118 patients with ischemic colitis were identified. Fifteen patients (12.7%) were < 50 years of age; 103 patients (87.3%) were ≥ 50 years old. While drugs and vasculitis—as a group—was the most common precipitating factor for ischemic colitis in the younger age group, constipation was the most common precipitating factor in the older age group. All patients in the younger group had rectal bleeding vs 70.9% in the older group ($P = 0.009$). History of coronary artery disease, dyslipidemia, and hypertension were higher in the older group. Length of hospital stay was shorter in the younger group (3.4 days) than the older group (7.2 days).

**Conclusion:** In this study, 12.7% of the patients were under age 50. All patients in this "young" age group experienced rectal bleeding and their hospital stay was shorter.

## INTRODUCTION

Ischemic colitis is a consequence of a sudden reduction of the splanchnic blood flow to the colon, resulting in an ischemic insult. The incidence of ischemic colitis has been estimated to range from 4.5 to 44 per 100,000 population.[1] Ischemic colitis is usually a segmental disease with a sharp demarcation between the normal mucosa and the affected areas.[2,3] Although the splenic flexure and rectosigmoid junction—known as watershed areas—are the most commonly affected areas, the right colon is involved in 20% to 25% of cases.[4-8] These watershed areas, considered to be the weak points of blood supply, exist in the anastomotic areas between the superior mesenteric artery and the inferior mesenteric artery, and the inferior mesenteric artery and the internal iliac artery territory, respectively.[2-10]

The predisposing factors for ischemic colitis are generally divided into 2 categories: vascular factors and bowel factors; both lead to inadequate blood flow to the colonic wall and cause an ischemic injury. The most common cause for the development of ischemic colitis is transient hypoperfusion to the colon, regardless of the cause.[5,11] In systemic hypotension, ischemic injury preferentially occurs in the watershed areas of the colon, which have relatively limited collateral networks. In general, any condition that causes a reduction in the blood supply to the colon potentially can induce ischemic colitis. In this context, vascular surgery, including abdominal aortic aneurysm repair, coronary artery bypass grafting, aorto-iliac reconstruction surgery, endovascular repair of aorto-iliac aneurysm, and any surgical procedure that requires aortic vascular clamping have been associated with a higher incidence of ischemic colitis.[2,3,12,13]

Vasospasm of the colonic vessels is another mechanism for developing ischemic colitis, either due to systemic hypoperfusion, which shunts the blood from the intestine to the brain and other viable organs, or due to exposure to drugs and substances such as phenylephrine and cocaine that have direct or indirect vasoconstrictive effects.[5-8] A third pathophysiology is hyperco-

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agulable states, including gene mutations and coagulation factor deficiencies such as protein C and S.[14-17] Depending on the studies, 28% to 72% of patients with ischemic colitis have one or more coagulation disorders.[16,17] A final pathophysiology for the vascular factors that lead to ischemic colitis is vasculitis, as occurs in cases of systemic lupus erythematous (SLE) and antiphospholipid syndrome.[2,18]

Bowel factors that might precipitate ischemic colitis are constipation, irritable bowel syndrome (IBS), fecal impaction, colonic obstruction, and any other condition that increases the colonic intraluminal pressure, which may compromise the blood flow to the colonic wall, potentially causing ischemic injury.[1,2,14,19]

In spite of the fact that ischemic colitis is known as disease of the elderly, it has been diagnosed increasingly in younger patients but has not been studied extensively in this population. This study aimed to explore similarities and differences of ischemic colitis in a younger population vs an older age group and to identify any risk factors for developing ischemic colitis in the young age group.

## METHODS

The medical records of all patients with the diagnosis of ischemic colitis from January 2007 to January 2013 were reviewed. The study was conducted in 2 hospitals (CGH Medical Center, Sterling, Illinois, and Saint Francis Hospital, Evanston, Illinois) after obtaining Institutional Review Board (IRB) approval from each institution. Demographic details, clinical symptoms and signs, laboratory studies, imaging findings, endoscopic and histological features, location of ischemic colitis, comorbidities, concomitant use of medications, surgical treatment, blood transfusion, hospital stay, requirement for intensive care unit and mechanical ventilation, and all-causes mortality within 30 days were collected. Patients then were divided into 2 groups based on their age at diagnosis of ischemic colitis: younger age group (< 50 years) and older age group ( ≥ 50 years).

Ischemic colitis cases were identified by using International Classification of Diseases, Ninth Revision (ICD-9) codes (557.0: acute vascular insufficiency and 557.9: unspecific vascular insufficiency) because there is no specific code for ischemic colitis. We undertook a comprehensive chart review on each case to determine the diagnosis of ischemic colitis. The diagnosis was made based on clinical symptoms and signs, negative stool studies for infections, with at least 1 diagnostic study consistent with ischemic colitis (computed tomographic [CT] scan, colonoscopy, or histopathology). Exclusion criteria were age < 18 years, pregnancy, positive studies for enteric pathogens, colonic ischemia due to trauma or mechanical causes, acute mesenteric ischemia, chronic bowel (mesenteric) ischemia, acute flare of inflammatory bowel disease, and radiological or colonoscopic evidence of diverticulitis. In addition, we excluded any cases with equivocal or uncertain diagnosis of ischemic colitis or where ischemic colitis was merely considered in the differential diagnosis but never confirmed by objective modalities. The anatomic location of the involved colonic segments was based on the surgery report, CT scan, and colonoscopy findings. If the surgery was performed, then the surgical report was taken for the involved location regardless of the colonoscopy and radiology reports. If the surgery was not deemed necessary, and if there was any discrepancy between CT scan and colonoscopy in terms of location, then the colonoscopy report was utilized. The location of ischemic colitis was divided to the right colon and left colon and then to specific segments of the colon (rectum, recto-sigmoid junction, sigmoid, descending colon, splenic flexure, transverse colon, hepatic flexure, ascending colon, and the cecum). Patients may have 1 or more affected segments.

Our group utilized the same dataset for other studies related to ischemic colitis, however, objectives of the published data and comparison groups were different.[20-22]

### Statistical Analysis

Patients' data were entered into a Microsoft Excel spreadsheet in a coded format and secured with a password. All analyses were completed using SAS software (SAS Institute Inc, Cary, North Carolina). A 2-sided $P$ value of $< 0.05$ was considered statistically significant. For quantitative variables such as the laboratory studies, parametric 2 sample $t$-tests were conducted to compare the means of the 2 age groups, but the assumptions associated with $t$-tests—homogeneity of variances and normality of data—were not satisfied. Hence, the nonparametric Wilcoxon's rank sum test was conducted to compare the means of the groups. The results for quantitative variables were reported as mean and standard deviation. A chi-square analysis, Fisher's exact test, and a Pearson correlation were conducted for categorical variables such as comorbidities.

## RESULTS

### Patients' Clinical Characteristics (Table 1)

A total of 118 patients in both hospitals were diagnosed with ischemic colitis from January 2007 to January 2013. The mean age was 69.4 years, with a female predominance of 83%. These patients then were divided into 2 groups based on age at diagnosis: the "younger group" (< 50 years), and the "older group" (≥ 50 years). Fifteen patients (12.7%) were < 50 years at the time of diagnosis, compared to 103 (87.3%) who were ≥ 50 years. The mean age of the patients in the younger group was 40.8 years vs 73.6 years in the older group. The majority of patients in both groups were white women. There was no difference in smoking habits and body mass index between the groups.

All patients in the younger group (100%) presented with rectal bleeding when compared to 70.87% in the older group, which was statistically significant ($P = 0.009$). Other clinical

**Table 1.** Clinical Characteristics of Age Groups <50 Years and ≥ 50 Years

| | Younger Group (<50 Years) (N=15) | Older Group (≥50 Years) (N=103) | *P*-value |
|---|---|---|---|
| **Mean age (years)** | **40.8** | **73.6** | **NS** |
| **Sex** | | | |
| Female | 12 (80%) | 86 (83.50%) | |
| Male | 3 (20%) | 17 (16.5%) | NS |
| **Race** | | | |
| White | 12 (80%) | 85 (82.52%) | |
| Others | 3 (20%) | 18 (17.48%) | NS |
| Mean body mass index ±SD | 31.3±9.4 | 27.6±6.0 | NS |
| **Smoking Habits** | | | |
| Never smoked | 9 (60%) | 59 (57.84%) | |
| Ex-smoker | 1 (6.67%) | 23 (22.55%) | |
| Current smoker | 5 (33.33%) | 20 (19.61%) | |
| Missing data | 0 | 1 | NS |
| **Clinical Symptoms/Signs** | | | |
| Abdominal pain | 11 (73.33%) | 86 (83.50%) | NS |
| Nausea | 5 (33.33%) | 38 (36.89%) | NS |
| Vomiting | 2 (13.33%) | 32 (31.07%) | NS |
| Diarrhea | 11 (73.33%) | 54 (52.43%) | NS |
| *Rectal bleeding | 15 (100%) | 73 (70.87%) | 0.009 |
| Abdominal distension | 0 (0%) | 8 (7.77%) | NS |
| Fever | 5 (33.33%) | 13 (12.62%) | NS |
| Peritoneal signs | 0 (0%) | 6 (5.83%) | NS |
| Mean SBP±SD | 132.1±26.4 | 135.5±34.2 | NS |
| *Mean DSP±SD | 80.1±13.7 | 69.1±15.5 | 0.0133 |
| Mean HR±SD | 87.5±25.4 | 82.8±21.0 | NS |
| **Comorbidities** | | | |
| *Hypertension | 7 (50%) | 86 (83.50%) | 0.009 |
| *Hyperlipidemia | 3 (21.43%) | 65 (63.11%) | 0.004 |
| *Coronary artery disease | 0 (0%) | 37 (35.92%) | 0.003 |
| Diabetes mellitus | 1 (7.14%) | 24 (23.30%) | NS |
| Congestive heart failure | 1 (7.14%) | 9 (8.74%) | NS |
| Atrial fibrillation | 0 (0%) | 21 (20.39%) | NS |
| Peripheral vascular disease | 1 (7.14%) | 10 (9.71%) | NS |
| Cerebrovascular disease | 2 (14.29%) | 11 (10.68%) | NS |
| Chronic obstructive pulmonary disease | 0 (0%) | 17 (16.51%) | NS |
| Chronic kidney disease | 1 (7.14%) | 14 (13.59%) | NS |
| Deep vein thrombosis | 0 (0%) | 4 (3.88%) | NS |

| | Younger Group (<50 Years) (N=15) | Older Group (≥50 Years) (N=103) | *P*-value |
|---|---|---|---|
| **Comorbidities (continued)** | | | |
| Irritable bowel syndrome | 1 (7.14%) | 2 (1.94%) | NS |
| Abdominal aortic aneurysm | 0 (0%) | 9 (8.91%) | NS |
| Missing data | 1 | 0 | |
| Abdominal surgery (any) | 6 (40%) | 60 (59.41%) | NS |
| Appendectomy | 3 (20%) | 19 (18.81%) | NS |
| Cholecystectomy | 3 (20%) | 26 (25.74%) | NS |
| Hysterectomy | 5 (33.33%) | 31 (30.69%) | NS |
| Missing data | 0 | 2 | NS |
| **Drugs** | | | |
| *Clopidogrel | 0 (0%) | 24 (23.76%) | 0.024 |
| *Aspirin | 2 (13.33%) | 51 (50.50%) | 0.006 |
| *Statins | 1 (6.67%) | 52 (51.49%) | 0.001 |
| *Calcium channel blockers | 0 (0%) | 39 (38.61%) | 0.001 |
| β-blockers | 6 (40%) | 50 (49.51%) | NS |
| ACEIs | 4 (26.67%) | 50 (49.51%) | NS |
| ARBs | 0 (0%) | 13 (12.87%) | NS |
| Diuretics | 2 (13.33%) | 32 (31.68%) | NS |
| NSAIDs | 2 (13.33%) | 9 (8.91%) | NS |
| Digoxin | 0 (0%) | 6 (5.94%) | NS |
| Warfarin | 0 (0%) | 14 (13.86%) | NS |
| Antidepressants/ antipsychotics | 5 (33.33%) | 29 (28.71%) | NS |
| Missing data | 0 | 2 | |
| *Mean hospital stay ± SD (days) | 3.4±1.5 | 7.2±8.0 | 0.0007 |
| Intensive Care Unit stay | 1 (6.67%) | 21 (20.39%) | NS |
| Required mechanical ventilation | 0 (0%) | 14 (13.59%) | NS |
| Occurred while at hospital (inpatient onset) | 0 (0%) | 11 (10.68%) | NS |
| Recurrence | 1 (6.67%) | 9 (8.74%) | NS |
| Required blood transfusion | 1 (6.67%) | 23 (22.33%) | NS |
| Required surgery | 0 (0%) | 14 (13.59%) | NS |
| Death in 30 days | 0 (0%) | 5 (4.85%) | NS |
| Severe ischemic colitis (required surgery or died) | 0 (0%) | 15 (14.56%) | NS |
| **Direct Causes** | | | **0.002** |
| *Constipation | 1 (6.67%) | 15 (14.56%) | |
| *Hypotension | 1 (6.67%) | 6 (5.83%) | |
| *Drug/vasculitis | 4 (26.67%) | 2 (1.94%) | |

Abbreviations: ACEI: angiotensin converting enzyme inhibitors, ARB: angiotensin receptor blockers, NS: not statistically significant, NSAIDs: nonsteroidal anti-inflammatory drugs.
*Signifies statistical significant values.

symptoms and signs (abdominal pain, nausea, vomiting, diarrhea, abdominal distension, fever, and peritoneal signs) were not statistically significant. Although systolic blood pressure and heart rate at presentation were not significantly different between the groups, diastolic blood pressure was lower in the older group vs the younger group (69.1 ± 15.5 mmHg, and 80.1 ± 13.7 mmHg respectively, $P = 0.0133$). Hypertension (HTN) [83.5% vs 50%, $P = 0.009$], hyperlipidemia (HLD) [63.11% vs 21.43%, $P = 0.004$], and coronary artery disease (CAD) [35.92% vs 0.0%, $P = 0.003$] were significantly more frequent in the older group than the younger group. Other comorbidities (diabetes mellitus, congestive heart failure, atrial fibrillation, peripheral vascular disease, cerebrovascular accidents, chronic obstructive pulmonary disease, chronic kidney disease, deep venous thrombosis, IBS, abdominal aortic aneurysm, and autoimmune diseases) and a history of abdominal surgeries (hysterectomy, appendectomy, and cholecystectomy) were not statistically significant.

Use of medications was significantly higher in the older group than the younger group (Table 2). Use of other medi-

cations (beta-blockers, angiotensin converting enzyme inhibitors, angiotensin receptor blockers, diuretics, nonsteroidal anti-inflammatory drugs, digoxin, warfarin, and antidepressants/antipsychotics) was not significant between both groups.

To accurately calculate hospital length of stay (LOS), we used the website www.timeanddate.com. We included both admission and discharge days, but did not calculate LOS in hours. For the younger group, LOS was shorter (3.4 ± 1.5 days) than it was for the older group (7.2 ± 8.0 days) ($P = 0.0007$). The need for intensive care unit stays, mechanical ventilation, and blood transfusions was not different between groups. Severe ischemic colitis, the need for surgery, death within 30 days, recurrence, and inpatient onset of ischemic colitis were lower in the younger group but did not reach a statistical difference. Five patients in the older group died within 30 days of diagnosis from different causes (ischemic colitis [2], sepsis [2], and sudden cardiac death [1]). Four of those patients underwent surgery for ischemic colitis. The mean interval from the admission to death was 19.8 ± 10.3 days (3, 18, 22, 27, 29 days, respectively).

While drugs and vasculitis—together as one direct predisposing factor of ischemic colitis—was significantly higher in the younger group, constipation was noticed frequently in the older group ($P = 0.002$). There were 4 cases of drugs and vasculitis in the younger group (Hydroxycut: age 37, alosetron: age 40, systemic lupus erythematous [SLE]: age 21, fibromuscular dysplasia: age 42), and 2 cases in the older group (meclizine: age 80, SLE: age 73).

**Diagnostic Studies** (Table 3)

Although hemoglobin (Hb) upon admission was not significantly different between age groups, Hb dropped lower during hospitalization in the older group when compared to the younger group (10.2 ± 2.1 g/dL and 11.3 ± 1.5 g/dL, respectively, $P = 0.0367$). Albumin level was also lower in the older group vs the younger group (3.6 ± 0.5 g/dL and 4 ± 0.4 g/dL, respectively, $P = 0.0064$), and renal function as measured with serum creatinine level was worse in the older group than the younger group (1.4 ± 1 mg/dL and 1.0 ± 0.4 mg/dL, respectively, $P = 0.0203$). Blood glucose level at admission, white blood cell count (WBC) at admission, highest WBC during hospitalization, lactic acid levels, and amylase levels were higher in the older group but did not reach statistical significance. The levels of serum sodium (Na), alanine aminotransferase (ALT), lipase, bicarbonate at admission between groups were not statistically significant.

CT scan of the abdomen and pelvis was performed in 86.67% of the patients in the younger group compared to 74.76% of the patients in the older group. CT scan was normal in 7.69% of the younger group vs 11.69% of the older group. None of the radiologic findings of CT scan (wall thickening, induration, pericolonic fat stranding, loss of haustra, free intra-abdominal fluid, pneumatosis coli, portal or mesenteric vein air, pneumoperitoneum, and bowel loop dilation) were statistically significant between groups. Colonoscopy was performed in 93.33% of the younger group compared to 72.82% of the older group, with 1 missing data set in the younger group. None of the endoscopic findings (edema, erythema, erosions or ulcerations, friability or active bleeding, fibropurulent exudate or necrosis, and stricture or stenosis) was statistically significant between age groups. Histopathology (either from endoscopic biopsy or surgery) was available for 93.33% of the patients in the younger group vs 77.67% in the older group. Histology was normal for 7.14% and 3.75%, respectively. None of the histological findings (edema, epithelium loss or ulceration, crypt loss, acute inflammation, chronic inflammation, capillary thrombosis, necrosis or fibropurulent exudate, submucosal hemorrhage, vascular congestion, mucosal or transmural infarction, and chronic ulcer) was statistically significant between the groups. There was 1 case of pancolitis, which was considered to have involved all of the segments and was counted as both right colon and left colon. There was no statistical difference between the age groups in terms of the anatomic location of ischemic colitis.

**Table 2.** Use of Medications Among Patients Diagnosed With Ischemic Colitis, Age ≥ 50 Years vs < 50 Years

| Medication | Older Group ≥50 years | Younger Group <50 Years | *P*-value |
|---|---|---|---|
| Clopidogrel | 23.76% | 0% | 0.024 |
| Aspirin | 50.50% | 13.33% | 0.006 |
| Statins | 51.49% | 6.67% | 0.001 |
| Calcium channel blockers | 38.61% | 0% | 0.001 |

## DISCUSSION

Ischemic colitis occurs infrequently before age 50; however, if it occurs in this age group, an overt precipitating condition such as shock is usually present. During the 6-year study period, ischemic colitis affected young people (< 50 years) in 12.7% of the study population, with a female predominance. This incidence did not differ from results of the other studies, which commonly ranged from 10% to 15%.[23,24] However, ischemic colitis in this younger population has been reported as high as 34%.[25] Although female predominance of ischemic colitis in general and young-onset ischemic colitis has been demonstrated in multiple studies,[4,15,23,25-28] the precise reason for its predominance is still unclear.

Many drugs have been attributed to the development of ischemic colitis including triptans, anticonstipation drugs such as tegaserod and lubiprostone, chemotherapy drugs such as bevacizumab and irinotecan, hepatitis C therapy with pegylated interferon and ribavirin, weight loss medications such as phentermine, and herbal remedies such as ma huang (ephedra) and Hydroxycut.[5-8] Certain medications have been known for their association with

**Table 3.** Laboratory, Radiology, Colonoscopy, Histopathology Findings Between Age Groups <50 years and ≥50years

| | Younger Group (<50 Years) (N=15) | Older Group (≥50 Years) (N=103) | *P*-value |
|---|---|---|---|
| Mean WBC±SD | 10.8±4.0 | 13.3±6.5 | NS |
| Mean highest WBC ±SD during hospital stay | 12.2±6.1 | 14.9±6.9 | NS |
| Mean hemoglobin ±SD | 13.9±1.3 | 12.9±2 | NS |
| *Mean lowest Hb ±SD during hospital stay | 11.3±1.5 | 10.2±2.1 | 0.0367 |
| *Mean albumin ±SD | 4±0.4 | 3.6±0.5 | 0.0064 |
| Mean bicarbonate ±SD | 26.2±3.2 | 25.2±3.8 | NS |
| Mean sodium ±SD | 139.1±3.5 | 138.3±5.3 | NS |
| *Mean creatinine ±SD | 1±0.4 | 1.4±1.0 | 0.0203 |
| Mean ALT ±SD | 31.2±17.7 | 29.7±16.8 | NS |
| Mean amylase ±SD | 60.5±23.5 | 115.8±192.0 | NS |
| Mean lipase ±SD | 148.9±107.5 | 113.4±118.5 | NS |
| Mean glucose ±SD | 114.1±17.3 | 139.2±75.4 | NS |
| Mean lactic acid ±SD | 1.5±0.9 | 5±12.3 | NS |
| **Computed Tomography (CT) Findings** | | | |
| Performed | 13 (86.67%) | 77 (74.76%) | |
| Normal CT | 1 (7.69%) | 9 (11.69%) | NS |
| Wall thickening | 12 (92.31%) | 53 (68.83%) | NS |
| Induration | 5 (38.46%) | 15 (19.48%) | NS |
| Pericolonic fat stranding | 6 (46.15%) | 48 (62.34%) | NS |
| Loss of haustra | 1 (7.69%) | 4 (5.20%) | NS |
| Free intra-abdominal fluid | 2 (15.39%) | 14 (18.8%) | NS |
| Pneumatosis coli | 0 | 7 (9.09%) | NS |
| Portal/mesenteric vein air | 0 | 4 (5.20%) | NS |
| Pneumoperitoneum | 0 | 4 (5.20%) | NS |
| Bowel dilation | 0 | 13 (16.88%) | NS |
| **Colonoscopy Findings** | | | |
| Performed | 14 (93.33%) | 75 (72.82%) | NS |
| Edema | 7 (53.85%) | 45 (60%) | NS |
| Erythema | 7 (53.85%) | 50 (66.67%) | NS |
| Erosions/ulcerations | 10 (76.92%) | 37 (49.33%) | NS |
| Friability/active bleeding | 2 (15.39%) | 22 (29.33%) | NS |
| Exudate/necrosis | 1 (7.69%) | 8 (10.67%) | NS |
| Stricture | 0 | 2 (2.67%) | NS |
| Missing data | 1 | 0 | |

| | Younger Group (<50 Years) (N=15) | Older Group (≥50 Years) (N=103) | *P*-value |
|---|---|---|---|
| **Histology Findings** | | | |
| Available | 14 (93.33%) | 80 (77.67%) | |
| Normal histology | 1 (7.14%) | 3 (3.75%) | NS |
| Edema | 3 (21.43%) | 5 (6.25%) | NS |
| Epithelium loss (ulceration) | 5 (35.71%) | 26 (32.5%) | NS |
| Crypt loss | 3 (21.43%) | 7 (8.75%) | NS |
| Acute inflammation | 7 (50%) | 61 (76.25%) | NS |
| Chronic inflammation | 3 (21.43%) | 30 (37.5%) | NS |
| Capillary thrombosis | 1 (7.14%) | 4 (5%) | NS |
| Necrosis/exudate | 4 (28.57%) | 35 (43.75%) | NS |
| Submucosal hemorrhage | 3 (21.43%) | 17 (21.25%) | NS |
| Vascular congestion | 0 | 5 (6.25%) | NS |
| Mucosal/transmural infarction | 2 (14.29%) | 5 (6.25%) | NS |
| Chronic ulcer | 0 | 10 (12.5%) | NS |
| **Location** | | | |
| Left colon | 15 (100%) | 81 (82.65%) | NS |
| Right colon | 0 | 17 (17.35%) | NS |
| Pancolitis | 0 | 1 (1.02%) | NS |
| Rectum | 0 | 4 (4.08%) | NS |
| Rectosigmoid junction | 4 (26.67%) | 11 (11.23%) | NS |
| Sigmoid | 5 (33.33%) | 45 (45.92%) | NS |
| Descending colon | 13 (86.67%) | 61 (62.25%) | NS |
| Splenic flexure | 11 (73.33%) | 48 (48.98%) | NS |
| Transverse colon | 6 (40%) | 28 (28.57%) | NS |
| Hepatic flexure | 0 | 9 (9.18%) | NS |
| Ascending colon | 0 | 14 (14.29%) | NS |
| Cecum | 0 | 13 (13.27%) | NS |
| Missing data | 0 | 6 | |

Abbreviations: ALT: alanine aminotransferase, NS: not statistically significant, WBC: white blood cells.
*signifies statistical significant values.

ischemic colitis, including alosetron and female hormones.[26-29] The role of oral contraceptives and estrogen therapy has been suggested in some studies, however in our study, owing to its retrospective nature, the information on hormonal therapy was not well documented, possibly due to under-reporting of the information.[26,27]

Vasculitis such as SLE and antiphospholipid syndrome also has been associated with ischemic colitis.[2,18] In our study, drugs and vasculitis together were the most direct predisposing factor for ischemic colitis. In the older group, constipation—a known risk factor for ischemic colitis in the younger group—was the most common predisposing factor. The postulated mechanism is that increased colonic intraluminal pressure due to constipation shunts blood flow from the mucosa to the serosa and potentially contributes to a reduction in the colonic blood supply with subsequent ischemic injury. A high frequency of constipation with ischemic colitis, especially in the elderly, has been demonstrated in other studies as well.[25,30] However, constipation was more frequent in young patients with ischemic colitis compared to the elderly in other studies.[31]

Unlike the 2012 study by Kimura et al,[23] our study did not demonstrate a difference in smokers/previous smokers vs never smokers, in either group. This might be related to the smaller numbers of subjects in our study in comparison to the larger Japanese study, which included data from 5 centers, or it might represent an actual difference in the propensity of elderly in United States to continue smoking into old age vs the elderly in Japan.

Hyperuricemia has been shown to be a risk factor for ischemic colitis in young patients;[23] however, uric acid level was not performed in most cases as it is not a routine laboratory test.

Clinical symptoms of ischemic colitis in the young patients

were comparable to the older patients except for rectal bleeding, which was significantly higher in the young group (100% vs 70.87% respectively, $P = 0.009$). It is unclear whether this represents a different pathophysiology between the groups, or it is simply explained by the avoidance of medical attention by young people until serious events such as seeing blood per rectum, occur. Presence of rectal bleeding has been reported to be high in young patients (in almost every study, rectal bleeding was present in 100% of the young patients with ischemic colitis).[23,27,28] Vital signs were not different between the age groups in our study, except diastolic blood pressure, which was lower in the older group. It is expected that the vital signs of the elderly deteriorate quicker than young people with any acute illnesses as their compensation mechanisms are suboptimal in general.

The incidences of HTN, HLD, and CAD were significantly higher in the older group than the younger group. These 3 conditions and the other cardiovascular risk factors have been associated repeatedly with ischemic colitis in the elderly.[4,9,23] It seems that ischemic colitis is a surrogate for cardiovascular diseases, and it may be worthwhile to exclude cardiovascular disease in any patients with ischemic colitis, especially the elderly.

In parallel to the high incidences of these 3 conditions in the older group, use of medications (clopidogrel, aspirin, statins, and calcium channel blockers) also was significantly higher. The association of aspirin and calcium channel blockers with ischemic colitis has been described previously.[32] It is unclear whether this association is a true association or because of the underlying diseases (HTN, HLD, and CAD).

In spite of the fact that rectal bleeding was more frequent in the young group and the admission Hb was not different between the groups, there was a statistically significant fall in Hb during hospitalization in the older group. Higher consumption of antiplatelet agents (aspirin and clopidogrel) in the older group, which predisposes to a higher blood loss with any bleeding, may explain this phenomenon.

Radiologic, endoscopic, histopathological findings were not different between both groups. Although none of the subjects in the younger group had right colon ischemic colitis, it did not reach statistical difference. The hospital length of stay was shorter in the younger group than the older group, which is consistent with other studies.[23]

Study limitations were the small number of patients in the younger group and the retrospective nature of the study, as our data was limited by the database descriptors. However, this is a 6-year experience from a community hospital setting.

## CONCLUSION

Women more commonly developed ischemic colitis in both age groups. Ischemic colitis in the younger group was associated with a higher rate of rectal bleeding and was more commonly precipitated by vasculitis or medication use. Cardiovascular risk factors were seen less frequently in the younger group. Radiological, endoscopic, and histological findings were not different between the young and elderly groups. Further elucidation of our results should be attempted on a larger study.

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# Primary Hyperparathyroidism: A Case Series

Jensena Carlson, MD; Nathaniel Schwartz, BS; Sarina Schrager, MD, MS


## ABSTRACT

**Introduction:** Primary hyperparathyroidism (PHPT) is an uncommon endocrine disorder characterized by overproduction of parathyroid hormone. It is diagnosed either due to symptoms or by noting an elevated calcium level on laboratory tests drawn for other reasons. There is a suggestion that PHPT may be related to other autoimmune disorders.

**Case Presentation:** We present four cases of PHPT with different symptomatic presentations. Three of the patients had other autoimmune disorders. Three were treated surgically and one elected watchful waiting. We also looked at the incidence rates across 20 family medicine clinics in Wisconsin to determine whether PHPT has increased in frequency.

**Discussion:** All four of our cases presented differently, and 3 had other autoimmune disorders. The incidence in our clinics did not change over the last 5 years.

**Conclusion:** PHPT is an uncommon disorder, but one that primary care clinicians will see in the office. These cases illustrate the variety of presentations of PHPT.


## INTRODUCTION

Primary hyperparathyroidism (PHPT) is an uncommon endocrine disorder characterized by overproduction of parathyroid hormone (PTH) by a parathyroid gland that has lost its normal negative feedback, thus causing hypercalcemia.[1] Here we report 4 cases of PHPT from primary care clinics and review the epidemiology, diagnosis, and treatment of PHPT, as well as discuss a potential association between PHPT and autoimmune disease. After institutional review board (IRB) approval and patient consent was obtained, a chart review on each of the 4 patients was performed. A search of the electronic health record was performed to find the annual incidence rate of PHPT in 20 academic family medicine clinics in Wisconsin.

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## CASE PRESENTATIONS

### Case 1

A 65-year-old white woman presented to her primary care clinician with progressing hand pain. She was referred to the rheumatology clinic where she was diagnosed with osteoarthritis. During that consult, a hand x-ray was taken and chondrocalcinosis was seen in the cartilage in her hand. During a subsequent workup that included laboratory studies, her serum calcium was 10.4 mg/dL (reference range 8.5-10.2 mg/dL) and serum PTH level was 72 pg/mL (reference range 14-72 pg/mL). Subsequent 24-hour urine calcium was 185.4 mg (reference range 100-250 mg). Her medications at that time included fluoxetine, trazodone, and valcyclovir. She had normal renal function. Her primary care clinician ordered a bone density scan that showed osteopenia. After being diagnosed with PHPT, she elected to pursue watchful waiting with regular lab studies to monitor her calcium and a repeat bone density scan to monitor decreases in her bone density.

### Case 2

A 34-year-old white woman with a history of juvenile rheumatoid arthritis and Crohn's disease that was discovered subsequent to her being diagnosed with PHPT presented with calcaneal and metatarsal stress fractures. Her initial evaluation included a normal serum calcium of 8.6 mg/dL, but PTH elevated at 96.3 pg/mL. Subsequent 24-hour urine calcium was normal. She had normal renal function. She elected to undergo parathyroidectomy. Her recovery was complicated by symptomatic low calcium levels caused by hungry bone syndrome, a condition where the decrease in PTH leads to reduced bone resorption and increased bone formation that increases the influx of calcium to the bones and a decreases serum calcium. The patient presented with symptoms of hypocalcemia that improved within 6 months of intravenous calcium infusions.

**Table.** Primary Hyperparathyroidism (PHPT) Cases in 20 Academic Family Medicine Clinics Around Wisconsin

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Total |
|---|---|---|---|---|---|---|---|
| Unique patients | 110,348 | 110,421 | 105,984 | 107,735 | 109,576 | 110,173 | 654,237 |
| Number of PHPT cases | 57 | 28 | 34 | 25 | 37 | 44 | 225 |
| Rate per 100,000 patients | 51.655 | 25.357 | 32.080 | 23.205 | 33.767 | 39.937 | 34.391 |

### Case 3

A 38-year-old white woman with a history of Graves' disease that was treated with a total thyroidectomy presented with repeated episodes of kidney stones with normal urinary calcium measurements and renal function. Medication at this time included levothyroxine. During an endocrine workup for her kidney stones, her serum PTH was 173.7 pg/mL, while her serum calcium was 9.4 mg/dL. She underwent parathyroidectomy. Her recovery was uncomplicated and her PTH is now in the normal range.

### Case 4

A 56-year-old white woman with a history of Sjögren's syndrome presented with hypercalcemia that was discovered during the workup of vague abdominal symptoms including abdominal pain and constipation. Her PTH level was subsequently measured at 94.4 pg/mL and her serum calcium was 10.4 mg/dL. She had normal renal function as well. She was referred to an endocrine surgeon and elected to have a parthyroidectomy. Surgery was performed, and after an uncomplicated recovery, PTH and serum calcium were in the normal range. However, her abdominal symptoms improved only marginally.

## DISCUSSION

### Epidemiology

The incidence of PHPT has varied significantly over the past 50 years. Historically, this disease has been rare. The incidence spiked in the 1970s with the introduction of automated lab assays that included serum calcium levels on common panels. After decreasing in the 1980s, the incidence again spiked in the late 1990s with the advent of bone density screenings for osteoporosis.[2]

Current estimates of prevalence of PHPT range from 182 to 672 per 100,000 people.[3-7] The yearly incidence rates vary by sex and race, with women being affected 2 to 3 times more often than men (85.3/100,000 person-years vs 29.6/100,000 person-years)[2] and black patients affected at higher rates than other races.[8]

We looked at the PHPT cases at 20 academic family medicine clinics in Wisconsin. Data was retrieved from the electronic medical record using the ICD-9 code 252.01 for PHPT in the problem list or from billing data. Dividing the number of cases by the total unique patients seen at the clinics, we found an average yearly incidence rate of 34.4 PHPT cases/100,000 patients. There was no clear trend seen in the number of cases over the 5-year period (Table).

### Clinical Presentation

Hypercalcemia is often the first laboratory abnormality detected in the majority of patients with PHPT.[9,10] If the hypercalcemia caused by PHPT is not corrected, the disease can progress to include the classic symptomatic presentation of PHPT, which is summarized in the phrase "bones, stones, abdominal moans, psychic groans." "Bones" refers to a decrease in bone density caused by PTH activating osteoclasts that can lead to pathological fractures. "Stones" refers to kidney stones caused by increased calcium excreted in the urine. "Abdominal moans" refers to indistinct abdominal symptoms such as constipation, abdominal pain, nausea, and loss of appetite. "Psychic groans" includes neuropsychiatric symptoms such as cognitive dysfunction, depression, and lethargy.[11] While PHPT is detected while asymptomatic in many patients, some patients still present for the first time with symptomatic disease. Three of our cases presented with classic symptoms of PHPT. Case 2 presented with "bones" (stress fractures), Case 3 with stones, and Case 4 with abdominal moans.

### Diagnosis

Elevated serum calcium is usually the first sign of PHPT detected. The calcium measurement should be repeated and albumin should be measured and used to calculate the corrected calcium. A history and physical exam should be done to look for the signs and symptoms of hypercalcemia. Once hypercalcemia is confirmed, intact PTH levels should be checked. If PTH is low, consider other causes of hypercalcemia, such as malignancy. If PTH is in the normal range or elevated, family history and 24-hour urine calcium concentration with creatinine clearance should be done to rule out familial hypocalciuric hypercalcemia (FHH). If the calcium/creatinine ratio is below 0.01, FHH should be considered; if not, PHPT is more likely. The primary care clinician can refer directly to an endocrine surgeon, or to an endocrinologist if the diagnosis of PHPT is in question.[12,13]

### Treatment

Medical management of PHPT can be used to prevent some of the effects of the disease. Cinacalcet is a drug that acts allosterically to increase the sensitivity of the calcium-sensing receptor in parathyroid tissue and can be used to reduce serum calcium, but has no effect on bone mineral density.[14] It can be used to reduce calcium levels in people who are not surgical candidates. Bisphosphonates have been shown to improve bone mineral

density and can be used in combination with cinacalcet.[15] The only curative treatment for PHPT is surgery. The most recent expert consensus statement includes the following as indications for surgery: (1) if a patient is symptomatic or has significant signs of disease such as decreased bone mineral density or nephrolithiasis; (2) patient age under 50; (3) serum calcium levels more than 1 mg/dl above the upper limit of normal; (4) patient is unable or unwilling to undergo medical management or surveillance.[16,17] Medical surveillance is appropriate in patients who are asymptomatic and usually involves monitoring bone mineral density and serum calcium and PTH levels at regular intervals.

### Possible Autoimmune Relationship

Three of the 4 patient cases that were reviewed also had 1 or more autoimmune diagnoses. Case 2 had a long history of juvenile rheumatoid arthritis and was diagnosed with Crohn's disease after undergoing parathyroid surgery. Case 3 has a personal and family history of Graves' disease, and Case 4 has Sjögren's syndrome.

A literature search of PubMed was performed using the MeSH headings for PHPT and autoimmune disease. The prevalence of PHPT was found to be about 4 times higher in a cohort of patients with chronic atrophic autoimmune gastritis (CAAG) than in the general population, while the prevalence of CAAG in a cohort of PHPT patients was found to be 3 times higher than the general population.[18] Another study found, in a cohort of 2267 patients with Hashimoto's thyroiditis, a PHPT prevalence of 1.89% compared to 0.182% to 0.6.72% in the general population.[19] Finally, some patients with PHPT have been shown to have anticalcium sensing receptor auto-antibodies.[20] Future research should further evaluate any relationship between PHPT and autoimmune disease.

## CONCLUSION

Here we report 4 cases of PHPT that presented to their primary care clinician. While we did not see a temporal trend in our incidence data, the incidence reported by others continues to change. The manner in which PHPT presents is also changing, from a disease that presents with the classic syndrome of "bones, stones, moans, and groans" to an asymptomatic disease presenting with hypercalcemia without other symptoms. When PHPT is diagnosed, medical treatments can limit the symptoms and effects of the disease, but parathyroidectomy is the only curative treatment. Three out of the 4 cases above had autoimmune diseases comorbid with PHPT (juvenile rheumatoid arthritis, Crohn's disease, Graves' disease, and Sjogren's syndrome). Increased coincidence for PHPT and other autoimmune diseases has been reported. More research is needed to determine if there is a link between autoimmune pathology and PHPT.

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# 'Euglycemic' Ketoacidosis in a Patient With Type 2 Diabetes Being Treated With Canagliflozin

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## ABSTRACT

**Objective:** Canagliflozin is a sodium-glucose co-transporter 2 (SGLT-2) inhibitor, one of a class of novel antiglycemic agents that are gaining in popularity in the treatment of diabetes.

**Methods:** We describe a case in which a patient experienced difficult-to-treat metabolic ketoacidosis in the setting of canagliflozin use.

**Results:** A 52-year-old man with type 2 diabetes mellitus developed profound ketoacidosis without overt hyperglycemia while taking canagliflozin. Despite initiation of an insulin infusion, the metabolic acidosis persisted for 3 days.

**Conclusion:** Treatment with canagliflozin was associated with development of euglycemic ketoacidosis.


## INTRODUCTION

Diabetic ketoacidosis (DKA) is a type of metabolic acidosis in which patients present with marked hyperglycemia, elevated anion gap acidosis and elevated plasma ketones.[1] "Euglycemic" DKA is an uncommon form of diabetic ketoacidosis without overt hyperglycemia (glucose ≤200 mg/dl).[2,3] It may occur in the setting of reduced caloric intake, alcohol use, or inadequate dosing of insulin, and can go unrecognized at initial presentation.[4,5] We report a case of euglycemic DKA in a patient who was taking canagliflozin, a sodium-glucose co-transporter 2 (SGLT-2) inhibitor. The patient had profound acidosis and ketosis, but blood glucose levels that were not overtly elevated. He was treated with a continuous insulin infusion and the metabolic acidosis slowly resolved. This case highlights an uncommon presentation of a common problem. As SGLT-2 inhibitors become more widely used, clinicians need to be familiar with this unusual complication.

## CASE PRESENTATION

A 52-year-old man presented to an outside community hospital after experiencing somnolence and fatigue for several days. Three days before admission, the patient had started quetiapine for treatment of depression and insomnia. He subsequently developed fatigue, confusion, and nausea. On the day of admission, a family friend found him sleepy but responsive and called paramedics. At the hospital, the patient reported fatigue, nausea, abdominal pain, headache, and back pain.

The patient's medical history was remarkable for depression and anxiety, chronic low back pain, and traumatic brain injury resulting from a work accident 5 years previous. He had a history of type 2 diabetes, hypertension, obesity, and paroxysmal atrial flutter. His medications included aspirin (81 mg daily), canagliflozin (100 mg daily), glipizide (10 mg twice daily), metformin (1000 mg twice daily), furosemide (40 mg daily), lisinopril (10 mg daily), metoprolol tartrate (50 mg twice daily), simvastatin (20 mg daily), quetiapine (300 mg once daily), amphetamine-dextroamphetamine (20 mg twice daily), lorazepam (2 mg every 6 hours as needed for anxiety), and oxycodone controlled-release (60 mg 3 times daily). Canagliflozin was started 3 months prior to his admission. He was a former smoker, having quit 7 years previously. He did not currently drink alcohol or use intravenous drugs. He had been receiving disability payments for 5 years due to a work injury and lived alone.

On examination, his oral temperature was 37.9°C; heart rate was 90 beats per minute (BPM); blood pressure 142/68 mmHg; respiratory rate 16 breaths per minute; oxygen saturation was 94% on ambient air; and height, weight, and body mass index were 1.68 m, 131 kg, and 46.7, respectively. His exam was remarkable for somnolence. There was nonfocal tender-

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ness of the abdomen without distension. No masses or organomegaly were noted. Laboratory studies are reported in Table 1. The patient was admitted, placed on telemetry, and the quetiapine was stopped. The other preadmission antiglycemic and antihypertensive medications, including metformin, glipizide, and canagliflozin, were continued on the same schedule. In addition, amphetamine-dextroamphetamine was continued but oxycodone and lorazepam were held.

The patient was administered intravenous normal saline at 100 ml/hour for 2 days, and had a brief initial improvement at the outside hospital. After 3 days, he developed progressive altered mentation and confusion. Laboratory studies were repeated and he was found to have new onset metabolic acidosis (Table 1). He was transferred and admitted to the intensive care unit of a community teaching hospital. The patient was afebrile, with a heart rate of 95 bpm, blood pressure 116/75 mmHg, and oxygen saturation 97% on ambient air. Physical examination revealed a restless adult male with a disheveled appearance. He was arousable to voice but his utterances were inappropriate. The cardiac examination was notable for an irregularly irregular rhythm, without murmur or gallop. The abdomen was distended with positive bowel sounds, and there was mild, nonfocal abdominal tenderness but no rebound, guarding, or palpable masses. There were no focal deficits on neurological examination. Repeat serum chemistries and laboratory testing are listed in Tables 1 and 2. All oral antiglycemic medications were stopped on transfer, and the patient was started on an insulin infusion. He also was treated with dextrose and half normal saline infusion with added bicarbonate and potassium for presumed diabetic ketoacidosis in a euglycemic state.

During the first 24 hours, the patient remained hemodynamically stable. He developed compensatory respiratory alkalosis without ventilator assistance. His cognition improved. Despite the continuous insulin infusion, he remained acidotic and had an elevated anion gap. Metformin did not appear to contribute to the development of metabolic acidosis as there was no evidence of lactic acidosis and renal function was normal. Toxins associated with the development of metabolic acidosis were not found in the serum. The beta-hydroxybutyrate level was elevated. Most of the recorded glucose levels ranged from 100 mg/dl to 200 mg/dl during this time. (Figure). On the second hospital day after transfer, between 48 and 72 hours after the patient's last dose of canagliflozin, the anion gap and serum beta-hydroxybutyrate levels normalized. The dextrose and bicarbonate infusions were stopped. His mentation and physical strength improved substantially. GAD65 antibodies were undetectable, and the c-peptide level was in the normal range (Table 2). On the third hospital day after transfer, the patient was transitioned to a subcutaneous insulin regimen and transferred to a general medical floor.

**Table 1.** Laboratory Data

| Variable | Reference Range, Adults† | Day 1, Outside Hospital | Day 3, Outside Hospital | On Admission (Day 1), This Hospital | Day 3, This Hospital |
|---|---|---|---|---|---|
| Hematocrit (%) | 41.0-53.0 | 45.0 | 45.7 | 42.4 | 40.8 |
| Hemoglobin (g/dl) | 13.5-17.5 | — | 16.3 | 14.1 | 14.0 |
| White-cell count (per mm$^3$) | 4500-11,000 | 14800 | 9800 | 6100 | 10900 |
| Platelet count (per mm$^3$) | 150,000-400,000 | 227,000 | 166,000 | 158,000 | 185,000 |
| Glucose (mg/dL) | 77-99 | 248 | 158 | 146 | 157 |
| Sodium (mmol/liter) | 136-145 | 140 | 128 | 131 | 142 |
| Potassium (mmol/liter) | 3.5-5.1 | 4.7 | 4.5 | 4.2 | 3.1 |
| Chloride (mmol/liter) | 98-107 | 103 | 106 | 109 | 108 |
| Carbon dioxide (mmol/liter) | 21-32 | 19 | 6 | <5 | 22 |
| Creatinine (mg/dL) | 0.6-1.3 | 0.9 | 1.2 | 1.2 | 0.7 |
| Alkaline phosphatase (U/liter) | 50-136 | 129 | 134 | 133 | |
| Aspartate aminotransferase (U/liter) | 15-37 | 39 | 36 | 36 | |
| Alanine aminotransferase (U/liter) | 4-65 | 59 | 46 | 42 | |
| Lactic acid (mmol/L) | 05-2.2 | 2.5 | | 1.4 | |
| Betahydroxybutyrate (mmol/L) | 0.02-0.27 | | | 6.46 | 0.50 |
| **Urinalysis** | | | | | |
| pH | 5.0-8.0 | | | 5.0 | |
| Specific gravity | 1.003-1.030 | | | 1.021 | |
| Urine protein | Negative | | | 2+ | |
| Urine ketones | Negative | | | 2+ | |
| Urine glucose | Negative | | | 3+ | |

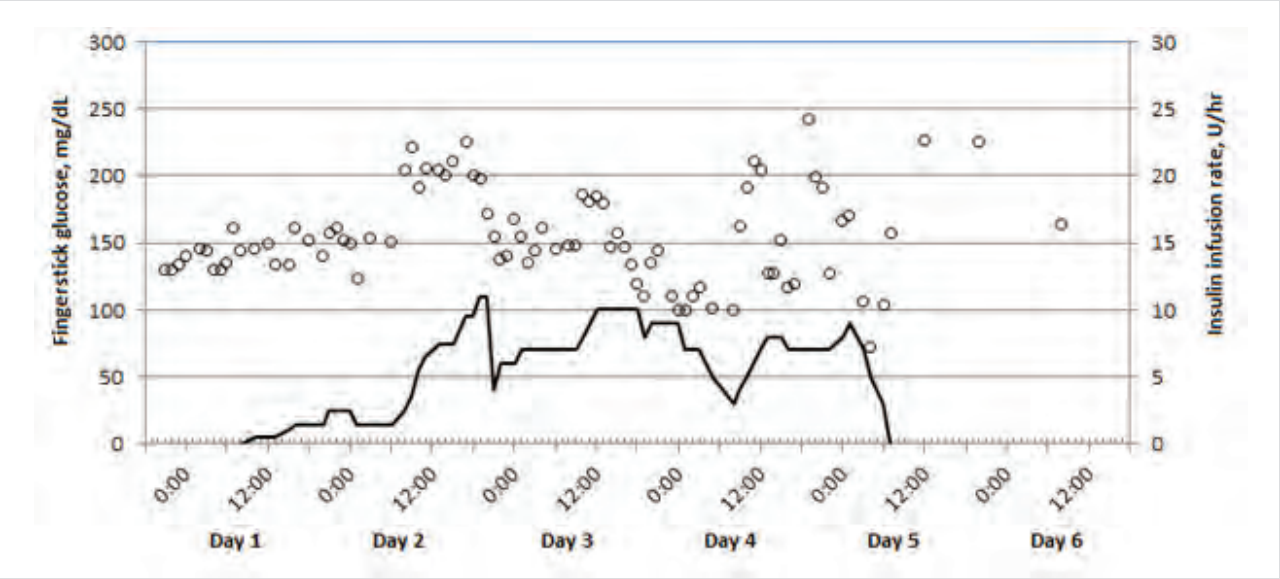
**Table 2.** Laboratory Data

| Variable | Reference Range, Adults† | On Admission, This Hospital |
|---|---|---|
| **Volatile Acids** | | |
| Methanol (mg/dL) | | Negative |
| Isopropanol (mg/dL) | | Negative |
| Ethylene glycol (mg/dL) | | Negative |
| D-lactic acid | 0.0-0.25 | 0.0 |
| Glutamic acid decarboxylase antibody (IU/mL) | 0.0-5.0 | <5.0 |
| C-peptide (ng/mL) | 0.8-3.5 | 1.1 |
| **Blood Gases and Oximetry** | | |
| pH | 7.35-7.45 | 7.13 |
| $paO^2$ (mmHg) | 80-100 | 107 |
| $paCO^2$ (mmHg) | 35-45 | 17 |
| bicarbonate (mmol/L) | 20-26 | 6 |
| Osmolality, blood (mOsm/kg) | 285-295 | 297 |
| Osmolality, urine (mOsm/kg) | | 622 |

## DISCUSSION

Sodium glucose transporter 2 (SGLT-2) inhibitors are a novel treatment for diabetes. SGLT-2 is the chief among a family of transmembrane proteins responsible for glucose reabsorption in

**Figure.** Blood Glucose After Transfer




Point-of-care and serum glucose measurements for the patient after transfer from the outside community hospital, where serum glucose measurements were 248 mg/dL at admission and 158 mg/dL at transfer. Open circles represent blood glucose measurements, and solid line represents insulin infusion rate.

the proximal renal tubule. Inhibition of SGLT-2 activity has been shown to decrease renal glucose reabsorption, leading to excretion of glucose in the urine and lowering of blood glucose levels and hemoglobin A1c.[6] Since 2013, three SGLT-2 inhibitors have been approved by the Food and Drug Administration (FDA) for use in the United States: canagliflozin, dapagliflozin, and empagliflozin. In early 2015, these agents were included in the joint American Diabetes Association and European Association for the Study of Diabetes revised position statement on management of hyperglycemia.[7] Later the same year, a randomized clinical trial of empagliflozin in patients with type 2 diabetes and pre-existing cardiovascular disease demonstrated a reduction in primary outcome of a composite of death from cardiovascular causes, nonfatal myocardial infarction, and nonfatal stroke.[8]

Euglycemic ketoacidosis is a rare form of DKA that is typified by mild elevation in glucose levels in conjunction with metabolic acidosis. It has been reported to occur with inadequate calorie ingestion, alcohol use, or reduced insulin dosing.[2-5] Recently, the FDA issued a warning regarding an association between the development of ketoacidosis and use of SGLT-2 inhibitors.[9] Shortly after, Peters et al reported a case series in which treatment with SGLT-2 inhibitors was associated with the development of euglycemic ketoacidosis in 9 patients.[10] They described 2 individuals with type 2 diabetes who experienced euglycemic DKA postoperatively and 7 patients with type 1 diabetes. The latter group either had a reduction in caloric intake, reduced insulin dose, or had alcohol intake that preceded the development of euglycemic DKA.

The patient we describe had type 2 diabetes and had poor intake of food before and after his initial admission. Polypharmacy was notable in this case, and the patient recently had started on an atypical antipsychotic. Atypical antipsychotic medications, including quetiapine, have been reported to precipitate diabetic ketoacidosis in rare circumstances.[11,12] However, to our knowledge, none of the atypical antipsychotic medications have ever been reported to cause euglycemic ketoacidosis, and in the current case, quetiapine was stopped upon admission to the first hospital. Therefore, we suspect it is possible, but unlikely, that quetiapine was a contributing factor in the development of euglycemic ketoacidosis in this case. Similarly, amphetamine-dextroamphetamine and the other medications the patient had been treated with have not been reported to cause ketoacidosis. The patient had a mild elevation in the lactic acid level upon admission to the first hospital (day 1). This was thought to be a nonspecific elevation rather than to metformin-induced lactic acidosis as the repeat lactic acid level on day 1 following hospital transfer was normal despite the patient being treated with metformin until the transfer took place.

Another notable feature of this case is that the resolution of acidosis took 3 days after initiation of insulin infusion. Despite prompt initiation of insulin therapy, the patient's blood glucose was only mildly elevated during the first 48 hours after transfer, and clinicians participating in the patient's care were hesitant to depart from the hospital insulin infusion protocol out of concern that higher insulin infusion rates would result in hypoglycemia. It is not certain that more aggressive insulin

treatment initially would have hastened resolution of acidemia, but we wish to highlight the unexpectedly slow time course of recovery according to traditional DKA management pathways as recommended by the American Association of Clinical Endocrinologists (AACE) special panel.[13] This may have been due in part to the long half-life of canagliflozin, which had been continued for 3 days during the first hospitalization, prior to transfer.

The etiology of SGLT-2 inhibitor induced-euglycemic ketoacidosis is uncertain. SGLT transporter-2 inhibition in the kidney leads to increased glycosuria and secondarily to decreased plasma glucose levels. This may lead to a reduction in insulin secretion over time. During times of stress (eg, during and after surgery, during caloric restriction, or with infections) the relative insulinopenia may contribute to increased ketone body formation by the liver and predispose to the development of metabolic acidosis in certain patients.

The AACE recently convened a special panel to review the safety of SGLT-2 inhibitors in the context of its new safety reports which stated that "the prevalence of DKA is infrequent and the risk-benefit ratio overwhelmingly favors continued use of SGLT2 inhibitors."[13] The panel made additional recommendations to consider stopping SGLT-2 inhibitors at least 24 hours prior to elective surgery and during physiologic stress, measurement of beta-hydroxybutyrate for diagnosis of SGLT-2 inhibitor associated DKA, and treatment of SGLT-2 inhibitor associated DKA with traditional DKA protocols.

Many hospitals restrict or prohibit use of oral antiglycemic agents because of the risk of acute renal insufficiency and other conditions that can lead to metabolic derangements, including metabolic acidosis. There is also a higher risk of hypoglycemia with use of oral agents in the hospital because of skipped or missed meals and worsening renal function. Due to these factors, many institutions have policies whereby insulin is the only antiglycemic medication available for treatment of hyperglycemia or diabetes.

## CONCLUSION

Euglycemic ketoacidosis recently has been recognized as an uncommon adverse event associated with use of SGLT-2 inhibitors. Salient aspects of the case are that the patient had type 2 diabetes and developed ketoacidosis with euglycemia while taking canagliflozin. This case demonstrates that euglycemic ketoacidosis can occur during treatment with canagliflozin and potentially with other SGLT-2 inhibitors. It is possible but unlikely that quetiapine played a role in the development of the euglycemic ketoacidosis in this vignette. Secondly, the use of oral antiglycemic medications in the hospital should be restricted to avoid untoward complications in patients treated for hyperglycemia and diabetes.

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**Financial Disclosures:** None declared.

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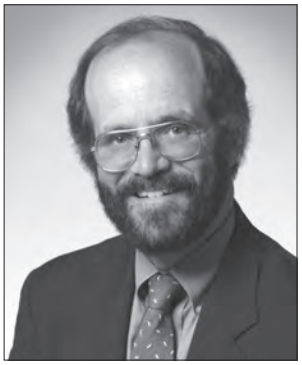
Byron Crouse, MD



Robert N. Golden, MD

# A Strategic Approach to Addressing the Rural Wisconsin Physician Shortage

Byron Crouse, MD, and Robert N. Golden, MD

Twenty years ago, Philip Farrell, MD, and Michael Dunn, MD—then-deans of the University of Wisconsin School of Medicine and Public Health (UWSMPH) and Medical College of Wisconsin (MCW), respectively—led a statewide assessment of Wisconsin's health care needs. The assessment showed that Wisconsin had a growing shortage of physicians in rural areas.

The UWSMPH began actively taking steps to address this need. Through a series of coordinated efforts, it created educational opportunities and specialized programs for individuals ranging from middle school students to established practicing physicians. The goals then, and now, include expanding the diversity and number of physicians practicing in Wisconsin, improving trainees' skills in team-based care, and preparing for ongoing changes in health care delivery systems.

• • •

Byron Crouse, MD, is the associate dean for rural and community health, University of Wisconsin School of Medicine and Public Health (UWSMPH); Robert N. Golden, MD, is dean of the UWSMPH and vice chancellor for medical affairs, UW-Madison.

**For more information**

- Wisconsin AHEC programs: www.ahec.wisc.edu
- RUSCH: www.med.wisc.edu/25063
- WARM: www.med.wisc.edu/WARM
- WRPRAP: www.fammed.wisc.edu/rural/
- WiORH: www.worh.org/

One of the resulting UWSMPH entities is the Office of Rural and Community Health, which includes the Wisconsin Area Health Education Centers (AHEC) and Wisconsin Office of Rural Health (WiORH) and provides oversight of several community-based medical education programs. The Office of Rural and Community Health immediately began efforts to analyze assets, gaps, and opportunities, and created a strategic plan to improve health and health care in rural Wisconsin.

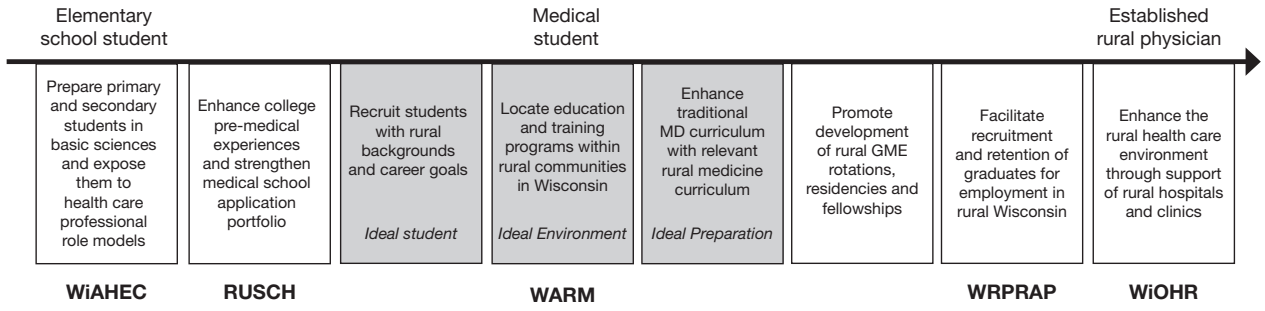
As shown in the Figure, the UWSMPH has created a continuum of "pipeline" programs—described below—that support our state's physician workforce.

Wisconsin AHEC is a statewide organization with 7 regional centers and a system office housed in the UWSMPH. It is funded by state and federal programs that focus on enrichment experiences for high school students interested in health careers, community-based training opportunities for health professions students, professional development programs for providers, and health promotion for Wisconsin residents. In 2015, 1,276 health professions students participated in AHEC-sponsored programs. Examples include the signature Community Health Internship Program (CHIP), which placed 85 students in local public health departments for 8-week experiences. Participants learn the importance of community engagement through direct experience.

Wisconsin Express is another such program. It provides 1-week cultural immersion experiences for health professions students throughout Wisconsin. They study a diverse population in a rural or urban setting by focusing on their own cultural awareness and self-reflection. During the past year, 100 students participated in Wisconsin Express.

UWSMPH faculty and staff, through their efforts to increase the number of medical students from underserved communities, noted that prospective students from disadvantaged areas often had less competitive applications. To address this disparity, the school created the Rural and Urban Scholars in Community Health (RUSCH) Program in 2006. Program staff help applicants from disadvantaged backgrounds enhance their portfolios so they can

**Figure.** University of Wisconsin Affiliated Rural Medicine Pipeline




**WiAHEC** Wisconsin Area Health Education Centers, administered through the SMPH
**RUSCH** Rural and Urban Scholars in Community Health, a pipeline program of the SMPH
**WARM** Wisconsin Academy for Rural Medicine, a program within the SMPH
**WRPRAP** Wisconsin Rural Physician Residency Assistance Program, a program within the SMPH
**WiOHR** Wisconsin Office of Rural Health, administered through the SMPH

submit stronger applications when they apply to medical school. We also assist those who are interested in working with underserved populations. The program has expanded to include partnerships with UW-Milwaukee, UW-Parkside, UW-Platteville, and Spelman College in Atlanta, Georgia. Eighty-two students have participated in RUSCH; of them, 27 (35%) matriculated into medical school, and another 34% have entered other health professions.

Aspiring physicians who have a strong desire to practice in rural Wisconsin can apply to the 4-year Wisconsin Academy for Rural Medicine (WARM). The UWSMPH increased its class size by 26 students per year to accommodate this program, which was established in 2006. Initial funding for the planning and early development of WARM was provided by the Wisconsin Partnership Program, with sustained support provided by the UWSMPH and the Wisconsin Legislature.

WARM students spend their first 2 years in the traditional MD curriculum in Madison, where they are able to participate in extra experiences to prepare them for their final 2 years of clinical training in community-based rural clinics and hospitals. These experiences support the students' goal to become rural physicians. Immersive experiences in rural areas provide positive mentors who nurture the students' passion to care for patients in medically underserved regions. To date, 102 students have graduated from WARM. Short-term outcomes show that 54% of graduates have entered primary care specialties, and 47% are completing their residency training in Wisconsin. The long-term outcomes, based on the 23 WARM graduates to date, show that 87% are practicing in Wisconsin, 52% are practicing in rural Wisconsin communities, and 30% are practicing in their hometowns.

While initiatives such as the UWSMPH's WARM Program and MCW's new campuses in Green Bay and Wausau have increased the number of medical students being trained in the state, academic leaders note that the number of residency positions in the state has not increased. Through advocacy efforts by the Wisconsin Hospital Association, the Rural Wisconsin Health Cooperative, the Wisconsin Council on Medical Education and Workforce, the Wisconsin Medical Society, and the Wisconsin Academy of Family Physicians, the Wisconsin Legislature established 2 programs to expand the state's graduate medical education offerings.

One of these programs is the Wisconsin Rural Physician Residency Assistance Program (WRPRAP), which is supporting the development of 3 new rural family medicine residency programs; new rural residency tracks in psychiatry, general surgery, and obstetrics and gynecology; 2 additional new family medicine residencies; and 2 new psychiatry residencies.

In addition to recruiting and training rural physicians, it is critical to keep them practicing here. Sustaining high-quality hospitals, emergency medical services, and rural clinics is integral to this success. The WiORH plays a vital role in supporting Critical Access Hospitals in rural Wisconsin and assists with the recruitment and retention of physicians practicing in underserved communities through its New Physicians for Wisconsin Program and loan repayment incentives.

Through this series of programs, the UWSMPH is actively working to improve the health of rural Wisconsin residents. At the same time, we are helping medical graduates pursue their dreams of caring for patients in small towns and rural areas, often in the hometowns where they grew up.

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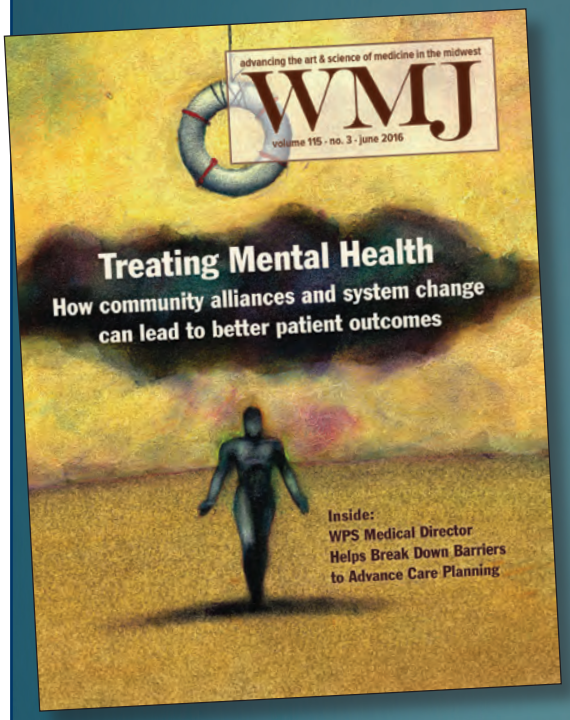


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# Certified EHRs Remain Central to Patient Care in CMS Quality Payment Program

Lori Manteufel, BBA; Jay Gold, MD, JD, MPH

## *2016 marks final Year to initiate participation in Medicaid EHR Incentive Program*

Although the term "Meaningful Use" will sunset as eligible professionals (EPs) in the Medicare EHR Incentive Program transition into the new Centers for Medicare and Medicaid Services (CMS) Quality Payment Program, the use of certified health information technology remains central to health care delivery, including the use of certified electronic health records (EHR). Meaningful Use lives on for EPs serving Medicaid patients, as 2016 is the final year to initiate participation in the Medicaid EHR Incentive Program.

### CMS Reforms Medicare Payment Through Quality Payment Program

On April 27, 2016, CMS announced the proposed rule for the Quality Payment Program, which puts the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) legislation into action. MACRA, with bipartisan support, replaces the Sustainable Growth Rate (SGR) formula in what many have called the most significant change in Medicare reimbursement in over 30 years. The Quality Payment Program represents a large step from fee-for-service payment systems to a push towards value-based payment, which specifically incentivizes quality and value.

The proposed rule includes 2 paths: (1) the Merit-based Incentive Payment System (MIPS) and (2) the Advanced Alternative Payment Models (APMs). The use of certified EHR technology is a cornerstone requirement for both paths. This reinforces CMS's stance that certified EHR technology is a critical factor for improving health outcomes. The focus on certified EHRs is pivoting from the basic movement of paper to electronic patient health records to a more comprehensive inclusion of certified information technology (IT) solutions to advance patient engagement, interoperability, and care coordination.

As the proposed rule outlines, the majority of Stage 3 Meaningful Use objectives from the EHR Incentive programs are represented in MIPS under the new Advancing Care Information category score, which accounts for a 25% weight of the Year 1 composite score. Year 1 Performance Category Weights also include Clinical Practice Improvement Activities (15%), Cost (10%), and Quality (50%). The quality measures and many of the clinical practice improvement activities rely on data generated from certified EHRs.

The use of certified EHR technology is the first criterion of an Advanced APM. It is expected that 50% of eligible clinicians in APMs would use certified EHR technology to document and communicate clinical care information in the first performance year. That number is expected to increase to 75% in subsequent years.

### Meaningful Use Still 'Meaningful' to EPs in Medicaid EHR Incentive Program

The Medicaid EHR Incentive program provides incentive payments for EPs of up to $63,750 over 6 years for adopting, implementing, upgrading, or demonstrating Meaningful Use of certified EHR technology. To date, more than 10,600 EPs have received incentive payments through this program, and incentive payments will be made through 2021. EPs include physicians, dentists, certified nurse midwives, advanced practice nurse prescribers, nurse practitioners, and physician assistants. (Physician assistants must practice at a federally qualified health center or a rural health clinic led by a physician assistant in order to be eligible for incentives.) EPs must also meet at least 30% Medicaid patient volume (20% for pediatricians) to be eligible for incentives.

### MetaStar Provides Technical Assistance

MetaStar has been involved in the EHR incentive programs since the inception of the Regional Extension Centers (RECs). In 2010, the Health Information Technology for Economic and Clinical Health Act (HITECH) provided funding for the Office of the National Coordinator for Health Information Technology

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Authors are with MetaStar. Lori Manteufel, BBA, is a project specialist; Jay A. Gold, MD, JD, MPH, is senior vice president and chief medical officer.

to establish 62 RECs. The goal of the REC programs was to support the adoption of EHRs and demonstration of Meaningful Use. In 2010, MetaStar established the federally designated Wisconsin Health Information Technology Extension Center (WHITEC), which helped more than 1400 primary care providers achieve Stage 1 Meaningful Use. The REC program recently concluded.

Many health care organizations and EPs find it challenging to understand Meaningful Use, the Physician Quality Reporting System (PQRS), and staying on top of the rapid change in health care toward payment for performance. MetaStar offers technical assistance through a variety of programs.

In early 2015, MetaStar received grant funding from the Wisconsin Department of Health Services to provide technical assistance to Wisconsin Medicaid-enrolled EPs—including primary care, specialists, and dentists—through the Health IT Extension Program. The goal of this program is to make sure EPs and the organizations where they work receive the grant-funded technical assistance needed to attest successfully to Meaningful Use. These services can be customized to meet each practice's particular needs. Once a practice is enrolled in the Health IT Extension Program, some of the most common technical assistance includes:

- Patient Encounter Volume and Medicaid EHR Incentive Program registration assistance.
- Vendor-neutral EHR selection and implementation.
- Quick answers to tough Meaningful Use questions.
- Up-to-the-minute Meaningful Use education, including provider-level or clinic-level education.
- Workflow optimization and best practices.
- Audit preparation guidance.
- Public health objective assistance—MetaStar has an expert working at the Wisconsin Immunization Registry to troubleshoot issues.
- Security risk assessment facilitation.

For more information about receiving assistance in this effort, visit www.metastar.com/healthitextension.

MetaStar also offers Meaningful Use consulting, HIPAA Security Risk Assessments, and policy and procedure services on a fee-for-service basis. To learn more about these services, visit http://www.metastar.com/services/meaningful-use-consulting/.

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The Wisconsin Medical Society invites you to explore these questions with your physician colleagues in a dynamic new program led by systems and human factors engineer Katherine Sanders, PhD. "Leading Healthy Work Systems" is designed to support you in transforming your work life to better serve patients, lead interprofessional teams and enjoy a more balanced and rewarding life as a healer.

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

### When

March 10, April 7 and May 5
9 a.m. to 3 p.m.

### Where

Wisconsin Medical Society
Headquarters, Madison, Wis.

### Who Should Attend

Physicians in current or emerging leadership roles who are committed to a systems-thinking approach in health care.

This activity has been approved for 15.0 *AMA PRA Category 1 Credits™.*

The Wisconsin Medical Society is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

The Wisconsin Medical Society designates this live activity for a maximum of 15.0 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

### Questions?

Call 866.442.3800 ext. 3749,
e-mail todd.wuerger@wismed.org.
or scan this code to visit our website.

Wisconsin Medical Society

THE PHYSICIANS FOUNDATION
Empowering Physicians Improving Healthcare

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*Developed by the Wisconsin Medical Society; Funding supported by The Physicians Foundation and the Wisconsin Medical Society Foundation.*

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