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**WMJ**

volume 121 • no. 4 • december 2022



# Snowmobile Injuries in Rural Wisconsin



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## COVER THEME

### Snowmobile-Related Injuries in Rural Wisconsin

*Snowmobiling is a popular winter activity in Wisconsin and also a source of injury. Unfortunately, due to the rural location and procedure for reporting snowmobile-related injuries, assessing the magnitude of the problem is challenging. A study in this issue of WMJ sought to accurately calculate the incidence and severity of these injuries over a 5-year period.*

Cover design by Kendi Neff-Parvin

The mission of WMJ is to provide an opportunity to publish original research, case reports, review articles, and essays about current medical and public health issues. WMJ is published through a partnership between the Medical College of Wisconsin and the University of Wisconsin School of Medicine and Public Health.

Volume 121 • December 2022 • Issue 4

# WMJ

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The *WMJ* (ISSN 1098-1861) is published by the Medical College of Wisconsin and the University of Wisconsin School of Medicine and Public Health and is devoted to the interests of the medical profession and health care in the Midwest. The managing editor is responsible for overseeing the production, business operation and contents of the *WMJ*. The editorial board, chaired by the medical editor, solicits and peer reviews all scientific articles; it does not screen public health, socioeconomic, or organizational articles. All articles and artwork published herein, including commentaries, letters to the editor, and editorials represent the views of the authors, for which neither *WMJ* nor the publisher take responsibility, unless clearly stated. Advertising content is the responsibility of the advertiser and does not imply an endorsement or sponsorship by *WMJ* or the publisher and its affiliates unless specified. *WMJ* is indexed in Index Medicus, Hospital Literature Index, and Cambridge Scientific Abstracts.

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#### SUBSCRIPTION RATES

Print subscription: \$149. Previous years' single copies, when available, \$12 each.

Published 4 times a year and online, beginning in March.

Address all correspondence to: University of Wisconsin School of Medicine and Public Health, Attn: WMJ Editor, Health Sciences Learning Center, 750 Highland Ave, Madison, WI 53705; e-mail: [wmj@med.wisc.edu](mailto:wmj@med.wisc.edu)

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ISSN 1098-1861 • Established 1903

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## Leveraging Virtual Platforms to Overcome the Minority Tax Among International Medical Students and Professionals

Dear Editor:

International students represent less than 1% of medical students in the United States and face unique obstacles when pursuing medical training. During premedical years, visa regulations limit the clinical, research, and gap-year opportunities for which they are eligible. During medical school, they qualify for few loan options, most of which do not cover full tuition. When applying for residency, visa requirements and cost negatively impact their candidacy.<sup>1</sup> Most importantly, reliable information about these nuances and programs that accept international students is lacking.

We serve as co-executive directors of F1Doctors (<https://www.f1doctor.com>), a national, student volunteer-led mentorship platform for international prehealth and medical students. It was designed to help overcome these challenges by connecting international premedical students with medical student mentors. Additionally, medical students gain access to other peer and resident/attending mentors to help navigate postgraduate training. The mentors volunteer to be listed on our platform and often hear about F1Doctors through social media, ads on partner websites, or current members. Mentees are able to filter for mentors based on location, stage in training, institution, and expertise and can send them a message directly through our website. These mentor-mentee relationships can range from addressing 1 question (eg, student experience at a specific institution) or can be more longitudinal, where the mentor guides students through medical school/residency applications. The overall objective of these relationships is to fill gaps in the current guidance available for international students and provide access to mentors who have taken a similar path.

Through our social media and email listservs, we recently asked mentees which areas of F1Doctors need improvement. This led to numerous respondents reporting problems with timely response from mentors. Given that only 15% of international applicants matriculate into medical school,<sup>1</sup> the prehealth students greatly outnumber

the medical students. As such, the 100 medical student mentors on the platform received nearly 500 requests from mentees this past year. The bottleneck narrows with postgraduate training, as F1Doctors has only 20 resident/attending mentors. This phenomenon is seen among other underrepresented minority (URM) groups, whereby a few URM faculty are tasked with mentoring many students. This requires mentors to invest a significant amount of their personal time, referred to as the “minority tax.” This model of mentorship is unsustainable.

One solution is to leverage virtual platforms to create opportunities where the few mentors can disseminate information to a large group of mentees. As such, our team spearheaded a podcast featuring a variety of medical students and doctors. In the last 10 months, the 9 released episodes were downloaded by 1068 listeners. Our social media team hosted Instagram takeovers by medical students around the country; for those 24 hours, the students shared a typical workday and answered real-time questions from mentees. These are saved on our platform. The team also posts tips-of-the-week addressing common questions and features reliable resources on the website. Finally, we coordinate various Zoom events, the most popular of which involves medical students breaking down their American Medical College Application Service applications and Q and A sessions with residents; 15 to 40 students attend each event.

While these initiatives cannot replace the connectedness of one-on-one mentoring relationships, they provide more sustainable avenues for

addressing common challenges and questions. This reserves one-on-one meetings for more personalized, targeted guidance. As an added benefit, the members utilizing our platform have an avenue to interact with each other and find camaraderie. Our work provides a framework for implementing a low-cost, virtual, and completely student-volunteer run initiative that provides mentorship for URM students throughout the country, while also limiting the minority tax placed on mentors.

—Gopika SenthilKumar, Matheus Moreira S. Peraci

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**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

**Acknowledgements:** The authors wish to acknowledge the leadership team of F1 Doctors: Shada Sinclair, Zenzhou (Zach) Zhao, Kalina Tenorio L. Machado, Nicole Martuscelli, Kamelia Drenkova, Zhengyang (Kevin) Su, Deepali Balla, Navaz Shroff, Abubakr El Sobky, Raissa Zuim Dantas de Souza, Scarlett Cheon, Sean Backer, Wendy Lee, and Venkat Suru.



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Fahad Aziz, MD, FASN

## Wisconsin Medical Journal: Past, Present, and Future

Fahad Aziz, MD, FASN, *WMJ* Editor-in-Chief

Since its establishment in 1903, the *Wisconsin Medical Journal (WMJ)* has served as an essential forum for the medical community of the Midwest. It is a peer-reviewed, indexed scientific journal that has published several important scientific manuscripts over the last 100 years, focusing on continuing education for physicians and other health care professionals and advancing scientific knowledge. Initially, it was published by the Wisconsin Medical Society (Society); however, in 2019, the Society transferred its ownership to the University of Wisconsin School of Medicine and Public Health (SMPH) and the Medical College of Wisconsin (MCW), thereby broadening its impact. Since that time, the journal has seen a sharp rise in manuscript submission—doubling from 60 to 80 per year to 130 to 150 per year. During the COVID-19 pandemic, *WMJ* published several research papers, case reports, and reviews on different aspects of the pandemic and served as an important information source for Wisconsin's medical community. It continued to be the voice of medical professionals in Wisconsin.

As editor-in-chief of *WMJ*, Sarina Schrager, MD, MS, played an important and exemplary role in increasing the journal's impact over the last 3 years. (Longtime editor-in-chief John Frey III, MD, retired as editor-in-chief in 2019 after 13 distinguished years at the helm). After Dr Schrager accepted a position as editor-in-chief of *Family Medicine*, I was fortunate enough to

be selected as *WMJ*'s new editor-in-chief. No doubt, I had big shoes to fill. But I've followed the rule, "Success is a daily thing, and you have to succeed every day to reach your goals." My first 6 months as editor-in-chief have been terrific.

only become great doctors, but doctors with the art of leadership. Young trainees are the future of medicine and will take this field to the next level.

I wish to express my gratitude to the countless  
medical professionals in Wisconsin and beyond, who  
have committed themselves to the vision of *WMJ*...

Currently, *WMJ* operations are overseen by a publishing board comprised of representatives from each school and an ex officio member from the Society. Working under the guidance of publishing board members Jonathan Temte, MD, Elizabeth Petty, MD, and Robyn Perrin, PhD, from SMPH; and Asriani Chiu, MD, Amalia Lyons, MD, Sara Wilkins, MA, MPA, from MCW, gave me a smooth start. Further, with Kendi Neff-Parvin as managing editor and Robert Treat, PhD, as deputy editor, it has been an excellent learning experience for me.

My vision for *WMJ* is to produce cutting-edge research in all areas of medicine, promote the success of medical trainees and young professionals, and extend the knowledge and its applications beyond the boundaries of any institution. Further, I believe that it's time for us to focus on training future leaders in the field of medicine who will not

### CHANGES FOR 2023

To achieve our vision and mission, under the direction of the publishing board, we are introducing some significant changes in the year ahead.

- We will increase the number of issues from 4 to 6 per year. That increase will be beneficial to accommodate the higher submission rates we have seen for the last few years.
- We will transition from offering both print and online versions to an online format only—except for "special themed issues," which will be available in both formats. With the advancement of electronic media, reader demand and expectations for print copies have waned in the past few years, and we also believe it's the need of the hour to reduce our paper usage. However, with the targeted focus of special issues on particular timely topics, we decided it will be



beneficial to continue with print versions of these issues.

- We plan to publish a special themed issue in October, 2023. The details of this special issue are included below.
- Starting in 2024, we plan to publish 2 themed issues per year. We appreciate input from *WMJ* readers and reviewers and encourage you to suggest topics for special issues. We will make a list of the fundamental problems that need to be addressed and make those issues relevant to the needs of our medical professionals.

### EXPANDING EDITORIAL STAFF

To meet the increasing editorial demands that come with additional submissions and publications, *WMJ* is currently seeking 2 to 3 more deputy editors. This will help streamline the peer review process for manuscripts and also will help to familiarize new professionals with the editorial cycle. These volunteer opportunities require about 2 to 3 hours per week.

We also are looking to add members to the *WMJ* Editorial Board. This group comprises physicians, nurses, pharmacists, and other health care professionals from across the state and different health systems who play a critical role in defining the journal's policy. Further, editorial board members assist the editor-in-chief in achieving the journal's vision and mission. With a few members reaching the end of their term, the journal is looking forward to filling these seats with new members who represent a broad base of medicine.

Equally important, reviewers for any journal play a critical role in the advancement of science. We are very grateful to all who served as reviewers for manuscripts in 2022, and we are continually looking to expand our reviewer pool to expedite the review process and provide more timely editorial feedback and decisions.

If you are interested in serving in any of these capacities, please email [wmj@wisc.edu](mailto:wmj@wisc.edu) to learn more.

### SPECIAL ISSUE IN 2023

The special themed issue planned for publication in October 2023 is titled "Post-COVID-19 Era – Lessons Learned from the Pandemic and Its Aftermath." The issue will focus on the effect of the COVID-19 pandemic on medical professionals, the psychological and financial impact of the pandemic on patients, and the long-term effects of the pandemic on medical education. In this special issue, we will analyze how ready we in health care were to deal with this pandemic and what essential steps we should take to be prepared for another pandemic. More information is available on our website: [wmjonline.org](http://wmjonline.org).

In closing, I wish to express my gratitude to the countless medical professionals in Wisconsin and beyond, who have committed themselves to the vision of *WMJ* to spread knowledge to our colleagues and our younger generations.



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# Leading by Example: How a Health Care Provider's Actions Can Impact the Public's Perspectives

Uyi Jefferson Imasuen; Sandesh Parajuli, MD

**T**he man from Clintonville, Wisconsin, and the man from Tehran, Iran, were like brothers.”<sup>1</sup>

The story of Arjang “Aji” Djamali, MD, caught the attention of multiple national media outlets, from *People* magazine to *ABC News*. Dr Djamali became a “brother” to John—one of his patients suffering from kidney disease—when he donated one of his own kidneys to John at the University of Wisconsin in July 2022. As rates of living donor donations steadily decline, Dr Djamali—a transplant nephrologist—led by example, showing that a healthy and fulfilling life is not lost after donating an organ. What’s more, he extended the gift of life to another individual. For many suffering from chronic kidney disease (CKD) waiting for a transplant, Dr Djamali’s story offers hope.

More than 800 million people globally (approximately 10%) are living with CKD.<sup>2</sup> It has become a leading cause of mortality worldwide—especially given the rising prevalence of associated risk factors, such as dia-

betes and hypertension.<sup>2</sup> Patients with CKD eventually develop end-stage kidney disease (ESKD) and require dialysis. Although lifesaving, dialysis has many consequences on quality of life. Patients often spend 9 to 15 hours a week in dialysis centers, leaving many feeling drained or depressed afterward.<sup>3</sup> Further, dialysis is very costly, being the major con-

worldwide to change the attitudes and perceptions of organ donation. Donors can opt to undergo living donation or donate after death. Although both types of donations are valuable, recipients of live-kidney donors tend to have better outcomes, such as higher graft survival and lower risk of delayed graft function.<sup>6,7</sup> Unsurprisingly, there are fewer living

...since 2004, the number of live donations  
has decreased steadily versus increasing rates  
of deceased donor transplants—  
at least within the U.S.

tributor to the cost of ESKD management, which accounted for roughly 5% (\$37.3 billion) of total Medicare expenditures in 2019.<sup>4</sup> A kidney transplant remains the best treatment modality for patients with ESKD. It is associated with increased lifespan, higher quality of life, and decreased expenditures compared to dialysis.<sup>3</sup> However, a transplant is not an option for many, as the demand for kidneys far exceeds the supply. For instance, in 2021, at least 90,000 people in the United States were on the waitlist for a kidney transplant, but only about 24,000 kidney transplants were performed.<sup>5</sup> And while 24,000 represents a new milestone in the number of kidney transplants performed each year, many patients are still left without a new kidney.

To increase the number of registered organ donors, there have been myriad efforts

donor kidney transplants performed versus the deceased donor. What’s more striking, however, is that since 2004, the number of live donations has decreased steadily compared to increasing rates of deceased donor transplants—at least within the U.S.<sup>8,9</sup> This begs the question as to why. Plenty of research has been conducted to examine and understand the attitudes and behaviors of individuals toward organ donation.

In Canada, it was demonstrated that physicians are more likely to support organ donation than the general public.<sup>10</sup> Among health care workers specifically, physicians and nurses were the most likely to support and be registered as organ donors.<sup>11</sup> However, the percentage of registered organ donors is much lower than the percentage of those who support donation, among both health care

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workers and the public.<sup>10,12,13</sup> Multiple studies correlate negative beliefs or lack of education on the safety of organ donation—specifically, that a donor's body may be disfigured during donation or fear of organs being sold on the black market<sup>13,14</sup>—with lower rates of being willing to register as a donor.<sup>13-15</sup> Some worry about the health risks associated with the donation as a barrier to the willingness to donate.<sup>16</sup> Many cite fixed religious and/or cultural beliefs for unwillingness to register for organ donation.<sup>13,14</sup> It also has been demonstrated that relationships between donor and recipient play a role in willingness to donate. For instance, nephrologists surveyed in the US were much less likely to support a living donation from themselves or close relatives if the recipient was a stranger versus a relative.<sup>17</sup> The common threads among these studies include an incongruence between support of organ donation versus registering to donate, health care workers having higher support of organ donation than the general public, and beliefs/education on donation affecting willingness to donate.

Of the factors serving as barriers to a living donation, it would be most feasible to target the lack of education and negative attitudes against organ donation. One way to target both lies within storytelling. Again, Dr Djamali's story highlights the possibility of being able to live a healthy life after donating, in addition to having exponentially improved the quality of life of another human being. This is important because, as described before, many individuals cite worries around health risks, regulations, and practices as barriers to their willingness to donate organs. With the existence of a considerable level of distrust towards physicians from the general public,<sup>18</sup> examples of physicians undergoing procedures they promote may allow a shift in public attitudes—a shift that can hopefully stop the downward trend in the amount of living organ donor transplants performed each year. With physicians being more likely to register for organ donation than the general population,<sup>10</sup> there are possibly additional powerful stories of altruism like Dr Djamali's.

Another consideration regarding Dr Djamali's story is that he was a “great match” for his recipient. However, being a great match for a recipient is not a necessity. There are now

increasingly popular exchange/swap programs that serve as a workaround for the scenario of a donor-recipient mismatch. The donor donates a kidney and their desired recipient receives the kidney of another, more closely matched, donor. To donate a kidney, one must simply be willing, healthy, and motivated. With more stories that showcase doctors “walking the walk,” there is a potential to sway the public attitudes and opinions of those opposed to organ donation. And this change in perceptions and attitudes is necessary for many awaiting a kidney transplant.

**Funding/Support:** None declared.

**Author Disclosures:** Dr Parajuli reports receiving a grant/contract from Veloxis Pharmaceuticals and serving on advisory boards for CareDX, Horizon Pharmaceuticals, and Eurofin Pharmaceuticals.

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# Analysis and Incidence Calculation of Snowmobile Injuries Identified in a Rural Wisconsin Health Care System Over Five Years

Jennifer P. King, MPH; Oluwatosin Olaiya, MBChB, MSc; Daniel C. Cullinane, MD

## ABSTRACT

**Introduction:** Current estimates of snowmobile-related injuries are largely based on inpatient data from trauma centers. These centers care for severely injured patients and may not capture treatment information and outcomes for minor snowmobile-related injuries, therefore underestimating their volume and overestimating patient acuity.

**Methods:** Medically attended snowmobile injuries were identified retrospectively from inpatient and outpatient records from a health system in north-central Wisconsin using a hierarchical method of International Classification of Diseases external cause codes and text searches for key words. Manual reviews of the medical record collected information on patient characteristics, accident details, and clinical information. Descriptive analyses, comparisons between hospital admitted and nonadmitted cases, and calculations of seasonal incidence rates were conducted.

**Results:** From November 1, 2013, through April 30, 2018, there were 1013 snowmobile-related injuries, with 264 (26%) cases hospitalized and 749 (74%) treated as outpatients. Text search alone identified 61% of all incidents and about a quarter (26%) of hospitalized incidents. Inpatients were older and a higher percentage wore helmets, sustained multisystem trauma, sustained more fractures, more organ injuries, and had higher need for surgery and intensive care. Mortality was 1%. The average annual injury incidence rate was 313 per 100,000 snowmobiles registered.

**Conclusions:** Currently available studies of snowmobile-related injuries have underestimated their number and burden. Studies combining datasets from health systems in the state and statewide mortality records for cases who died prior to care could elucidate the full statewide impact of snowmobile-related injuries in Wisconsin, leading to better assessment of prevention efforts and staffing in rural trauma systems.

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## INTRODUCTION

With an estimated 14.5 million snowmobile trips and over 1.5 million snowmobiles registered annually,<sup>1</sup> driving snowmobiles is a popular winter activity in the northern United States. However, snowmobiles are fast and heavy machines, able to operate at speeds greater than 90 miles per hour and weighing 600 pounds or more.<sup>2,3</sup> They are frequently operated off-road, on trails, or over frozen bodies of water and are used in low visibility conditions, including snow squalls and low-light conditions. These factors—alone or in combination with others, such as alcohol use and excessive speed—<sup>2,4-12</sup> contributed to an average of 106 reported snowmobile incidents involving injuries (range: 58–171) per year in Wisconsin during 2014–2018,<sup>11</sup> though this number is likely an underestimate.

Accurate calculation of the incidence of snowmobile-related injuries (SRI) is challenging due to the rural location of SRI events and the procedure for injury reporting. Current estimates are based on trauma registry data from level I and level II trauma centers, many of which are

located in urban centers distant from where recreational snowmobiling occurs.<sup>3,10,13,14</sup> Further complicating case identification is the method of injury reporting. Since 1971, in the state of Wisconsin, individuals involved in SRI events that result in medical care are required to self-report the incident to law enforcement officials and the Wisconsin Department of Natural Resources (DNR).<sup>12</sup> However, individuals may not be willing to report an SRI incident, especially if alcohol or other drugs were used at the time.<sup>15</sup>

Previous investigations of the epidemiology of snowmobile injuries also have generally focused on the most serious injuries and deaths, which are reported in trauma registries, death records, and electronic medical records from trauma centers.<sup>5,7-10,13,14,16,17</sup> Injuries severe enough for hospitalization and transfer may have a different pattern of injuries and outcomes than SRIs treated in the outpatient setting. It is also likely that hospitalized patients represent only a small portion of the number of SRIs treated (and reported) in the United States. Identifying SRI incidents from inpatient and outpatient medical records could provide a more comprehensive description of SRIs to serve as a baseline from which to judge the impact of injury prevention strategies and to inform trauma system staffing in popular snowmobiling destinations.

To address the limitations of case identification for SRI incidence calculations and describe the patterns of SRI in the inpatient and outpatient settings, we abstracted data from the electronic health records (EHR) of an integrated rural health care organization that includes a level II trauma center during 5 consecutive winters (2013-2014 through 2017-2018). SRI cases for review were identified from the EHR data repository using a combination of text searching and disease codes. We calculated the seasonal incidence rate of snowmobile injuries in north-central Wisconsin by leveraging a defined cohort of patients from a geographically defined area who obtain nearly all care within our health system and a denominator of snowmobile registrations from the same geographic catchment area.

## METHODS

### Design and Setting

This is a retrospective study examining 5 snowmobiling seasons (2013-2014 through 2017-2018) in north-central Wisconsin. Each season—November through April—was considered an independent cross-sectional sample. All injury data were extracted from the EHR contained in the research data warehouse (RDW) of the Marshfield Clinic Health System (MCHS). MCHS is a large, privately owned, multispecialty group medical practice with a level II adult and pediatric trauma center in north-central Wisconsin. The data in the warehouse include administrative and medical information documented during routine clinical encounters and entered into CattailsMD EHR in the ambulatory environment and a combination of Centricity EHR or Cerner EHR in the inpatient environment due to a change during the years under study. As a retrospective study of existing health care data, the Marshfield Clinic Research Institute Institutional Review Board deemed this study exempt.

### Sample

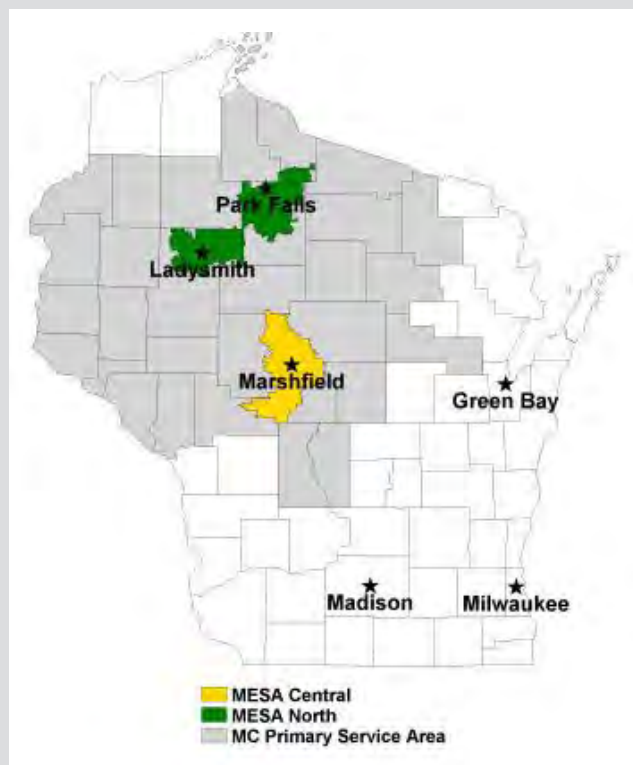
Records from both inpatient and outpatient (emergency department, urgent care, and outpatient clinic) encounters were included for analysis if the injury was medically attended and incurred while riding, being pulled, or being struck by a moving snowmobile. SRIs that occurred 6 months or more prior to the health care sys-

**Table 1.** ICD Codes and Words and Phrases Used to Identify Patient Records for Potential Inclusion in the Cohort of Snowmobile Injuries for Analysis

ICD Version 9, Billable for Dates of Service On or Before Sept 30, 2015	
Dx Code	Dx Code Description
E820.0	Nontraffic accident involving motor-driven snow vehicle injuring driver of motor vehicle other than motorcycle
E820.1	Nontraffic accident involving motor-driven snow vehicle injuring passenger in motor vehicle other than motorcycle
E820.2	Nontraffic accident involving motor-driven snow vehicle injuring motorcyclist
E820.3	Nontraffic accident involving motor-driven snow vehicle injuring passenger on motorcycle
E820.4	Nontraffic accident involving motor-driven snow vehicle injuring occupant of streetcar
E820.5	Nontraffic accident involving motor-driven snow vehicle injuring rider of animal; occupant of animal-drawn vehicle
E820.6	Nontraffic accident involving motor-driven snow vehicle injuring pedal cyclist
E820.7	Nontraffic accident involving motor-driven snow vehicle injuring pedestrian
E820.8	Nontraffic accident involving motor-driven snow vehicle injuring other specified person
E820.9	Nontraffic accident involving motor-driven snow vehicle injuring unspecified person
ICD Version 10, Billable for Dates of Service On or After Oct 1, 2015	
Dx Code	Dx Code Description
V86.02	Driver of snowmobile injured in traffic accident
V86.02XA	Driver of snowmobile injured in traffic accident, initial encounter
V86.12	Passenger of snowmobile injured in traffic accident
V86.12XA	Passenger of snowmobile injured in traffic accident, initial encounter
V86.2	Person on outside of special all-terrain or other off-road motor vehicle injured in traffic accident
V86.22	Person on outside of snowmobile injured in traffic accident
V86.22XA	Person on outside of snowmobile injured in traffic accident, initial encounter
V86.32	Unspecified occupant of snowmobile injured in traffic accident
V86.32XA	Unspecified occupant of snowmobile injured in traffic accident, initial encounter
V86.42	Person injured while boarding or alighting from snowmobile
V86.42XA	Person injured while boarding or alighting from snowmobile, initial encounter
V86.52	Driver of snowmobile injured in nontraffic accident
V86.52XA	Driver of snowmobile injured in nontraffic accident, initial encounter
V86.62	Passenger of snowmobile injured in nontraffic accident
V86.62XA	Passenger of snowmobile injured in nontraffic accident, initial encounter
V86.72	Person on outside of snowmobile injured in nontraffic accident
V86.72XA	Person on outside of snowmobile injured in nontraffic accident, initial encounter
V86.92	Unspecified occupant of snowmobile injured in nontraffic accident
V86.92XA	Unspecified occupant of snowmobile injured in nontraffic accident, initial encounter
Text Key Words	
Group 1	"Accident" or "crash" or "collided" or "collision" or "ejected" or "fall" or "fell" or "hit" or "impact" or "roll" or "struck" OR "thrown"
Group 2	"Snow" and "mobile" OR "snowmobile"
Abbreviations: ICD, International Classification of Diseases.	



**Figure 1.** Map of Marshfield Epidemiologic Study Area (MESA) and the Marshfield Clinic Health System (MCHS) Service Area



tem visit, occurred outside the snowmobiling season of November through April, or occurred from other aspects of snowmobiling that did not involve the vehicle in motion (eg, injuries during repair) were excluded. SRIs that were not the primary reason for the medical encounter and were not addressed/treated during the visit also were excluded from analysis.

### Case Identification and Data Collection

Potential cases were identified in a hierarchical manner using a combination of disease/condition codes and text searching using a similar method to VanWormer et al.<sup>18</sup> and Whiting et al.<sup>8</sup> First, records associated with SRIs were identified from the RDW using International Classification of Diseases (ICD) external cause codes from versions 9 and 10 (Table 1). We required key text words “snow” plus “mobile” or “snowmobile” to occur in free text chart notes (available in the RDW) within 3 days of the recorded ICD 9 or 10 code. This combined approach was enacted to reduce the risk of selecting patient records with miscodes. The first occurrence of an ICD code date in a given season was used to identify a unique record of injury. These cases were deemed ICD code identified. Second, additional potential cases for analysis without the ICD external cause codes were identified using electronic text searches requiring at least 1 word from Group 1 (Table 1) and either the combination of words or conjoined word from Group 2 to occur within the same encounter note. These cases were deemed text identified. To address oversensitivities of the electronic algorithm, a sample of sentences around these key words was extracted from the record and

prereviewed. The encounter was excluded if it obviously did not meet inclusion criteria (eg, reference to snowmobile accident of a family member, snowmobiling was listed in activity limitations of discharge instructions). The resulting lists of ICD code-identified and text-identified cases were combined and deduplicated. Patients involved in 2 or more separate SRI incidents could be counted multiple times in each season or in the study period.

Trained research coordinators performed manual chart reviews on the final list of potential cases to verify case status and collect information on patient characteristics, accident details, treatment course, and clinical features of the injuries. Information was collected and stored in a research electronic data capture (REDCap) database.<sup>19,20</sup>

### Analyses

We tabulated and described the demographic characteristics and contributing factors to injury—specifically age, sex, helmet use, blood alcohol level, and position of the injured (driver or passenger)—as well as the clinical characteristics of the injury associated with acuity, such as injury type, location of injury, hospitalization status, and clinical disposition at discharge. We classified cases as hospitalized if the patient was admitted to an inpatient care unit beyond the emergency department for care of their injuries.

Measures of central tendency were used to describe continuous variables, while frequencies and percentages were used to describe discrete variables. Data were tabulated for each season and overall. Statistical comparisons of differences between hospital admitted and nonadmitted cases (ie, cases treated in the outpatient setting) were performed using Student *t* test for continuous variables and Pearson chi-square analysis for discrete variables with SAS (version 9.4, Cary, NC, statistical software package). The threshold for statistical significance was set at a 2-tailed *P* value of 0.05.

To calculate the seasonal incidence rate of snowmobile injuries in north-central Wisconsin, we identified cases who were members of the Marshfield Epidemiologic Study Area (MESA). MESA is a defined geographic region of 24 ZIP codes surrounding primary MCHS service areas in central and northern Wisconsin (Figure 1).<sup>21,22</sup> Within MESA ZIP codes, the population is relatively stable and nearly all residents receive all their medical care at MCHS medical centers. From the Wisconsin DNR, we obtained counts of snowmobile registrations assigned to owners with residences in the MESA ZIP code catchment areas as of June 1 in the years 2014 through 2018. Snowmobile registrations expire June 30 each year with no penalty for registration at any point during the year. The number of MESA residents with a snowmobile injury in each of the study seasons (November–April) was divided by the total number of snowmobile registrations assigned to owners in MESA as of June 1 after the season.

### RESULTS

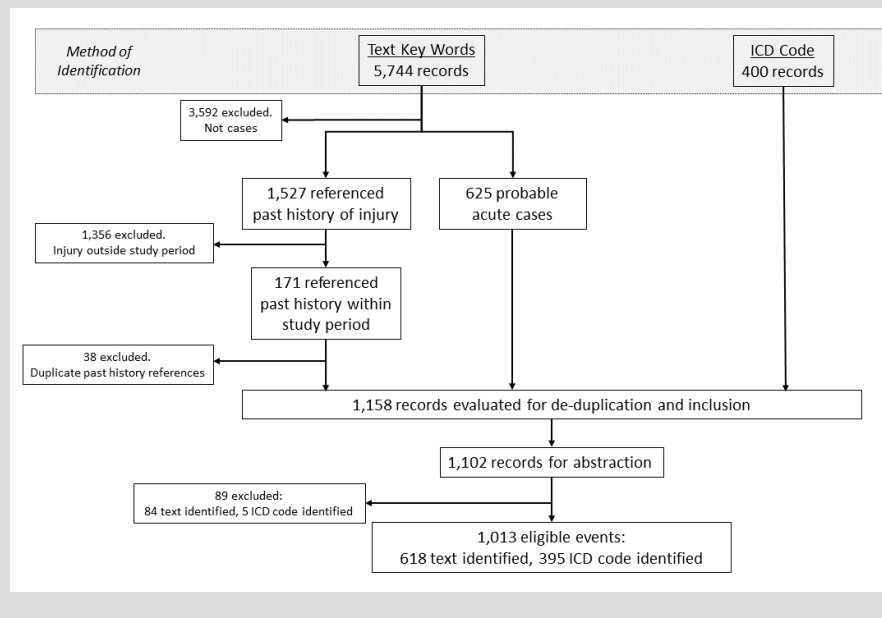
Over 5 consecutive snowmobiling seasons, there were 1013 medically attended snowmobile injury cases, with a range

of 142 to 278 cases per year. Of these cases, 39% were identified via ICD code method and 61% were identified via text method (Figure 2). Descriptive characteristics of the SRI cases are presented in Table 2. Cases were predominantly male, the driver of the snowmobile, about half were aged 40 years and over, and three quarters only required outpatient medical care. Among cases for which helmet use information was available (530 of 1013), 89% (n=471) were reported as wearing a helmet at the time of the accident. Children less than 16 years of age represented 8% (n=70) of drivers injured (data not shown).

Statistically significant differences in case age, sex, and method of case identification were noted between hospitalized and nonhospitalized cases (Table 3). Individuals aged 40 years and over represented about 70% of the hospitalizations and less than 50% of the nonhospitalized cases. A higher percentage of hospitalized cases were male. About one quarter of hospitalized cases were identified via text method without an ICD code for snowmobile injury compared to 72% of nonhospitalized cases. Hospitalized cases had helmet use evaluated significantly more frequently than nonhospitalized cases (84% of cases vs 42%) and were found to have worn helmets more frequently than nonhospitalized cases (94% vs 85%).

As expected, we observed differences in injury patterns between hospitalized and nonhospitalized cases. About 84% of those hospitalized sustained fractures; the most common were thoracic, lower extremity, and upper extremity (Table 3). Over half (54%) of hospitalized cases required at least 1 surgical repair during hospitalization. Approximately 33% of nonhospitalized cases sustained a fracture, and the most common were upper extremity and lower extremity fractures. Only 7% of nonhospitalized cases required surgical repairs. Spine fractures were relatively uncommon in both groups, although there were 18 cases among the nonhospitalized. Inpatient mortality was 1% (3 cases).

**Figure 2.** Flowchart of Medical Encounters Screened and Included in Analyses of Snowmobile Injuries, 2013-2014 to 2017-2018



**Table 2.** Characteristics of Snowmobile Injuries Occurring From November 2013 to April 2018 and Treated in the Marshfield Clinic Health System or Affiliated Hospitals/Clinics by Season

Characteristic N (%)	All Events Season n=1013	2013–2014 Season n=278	2014–2015 Season n=230	2015–2016 Season n=161	2016–2017 Season n=142	2017–2018 Season n=202
Age years, median (IQR)	41 (23–53)	41 (25–52)	42 (23–53)	38 (22–51)	38.5 (19–53)	42.5 (23–56)
Age category						
<12 years	42 (4)	13 (5)	6 (3)	5 (3)	7 (5)	11 (5)
12–19 years	145 (14)	30 (11)	33 (14)	26 (16)	29 (20)	27 (13)
20–29 years	159 (16)	46 (17)	38 (17)	25 (16)	25 (18)	25 (12)
30–39 years	137 (14)	40 (14)	29 (13)	28 (17)	11 (8)	29 (14)
40–49 years	194 (19)	63 (23)	49 (21)	30 (19)	23 (16)	29 (14)
50–59 years	208 (21)	55 (20)	48 (21)	28 (17)	29 (20)	48 (24)
≥60 years	128 (13)	31 (11)	27 (12)	19 (12)	18 (13)	33 (16)
Male	703 (69)	189 (68)	171 (74)	116 (72)	98 (69)	129 (64)
Role of patient						
Driver/operator	876 (86)	231 (83)	209 (91)	143 (89)	115 (81)	178 (88)
Passenger	48 (5)	13 (5)	10 (4)	5 (3)	12 (8)	8 (4)
Rider, specific position unknown	60 (6)	28 (10)	5 (2)	8 (5)	11 (8)	8 (4)
Pulled behind snow- mobile	20 (2)	4 (1)	5 (2)	3 (2)	2 (1)	6 (3)
Other	9 (1)	2 (1)	1 (0.4)	2 (1)	2 (1)	2 (1)
Helmet use <sup>a</sup>						
No	59 (6)	12 (4)	19 (8)	13 (8)	5 (4)	10 (5)
Yes	471 (47)	122 (45)	110 (48)	71 (44)	64 (45)	104 (51)
Unknown	474 (47)	140 (51)	100 (44)	76 (48)	71 (51)	87 (43)
Admitted to hospital						
No	749 (74)	212 (76)	164 (71)	117 (73)	98 (69)	158 (78)
Yes	243 (24)	63 (23)	60 (26)	36 (22)	43 (30)	41 (20)
Unknown	21 (2)	3 (1)	6 (3)	8 (5)	1 (1)	3 (1)
Case ID method						
ICD code	395 (39)	87 (31)	89 (39)	60 (37)	70 (49)	89 (44)
Text	618 (61)	191 (69)	141 (61)	101 (63)	72 (51)	113 (56)

Abbreviations: IQR: interquartile range; ID, identification; ICD, International Classification of Diseases.

<sup>a</sup>Injured bystanders (not riding on vehicle) are not shown in helmet use data (n=9). 2013-2014 season (n=4), 2014-2015 season (n=1), 2015-2016 season (n=1), 2016-2017 season (n=2), 2017-2018 season (n=1).

**Table 3.** Characteristics of Snowmobile Injuries Occurring From November 2013 to April 2018 and Treated in the Marshfield Clinic Health System or Affiliated Hospitals/ Clinics Stratified by Hospitalization Status

Characteristic	Non-Hospitalized, n = 749 N (%)	Hospitalized, n = 243 N (%) <sup>a</sup>	P value
Age years, median (interquartile range [IQR])	37 (21–52)	49 (37–56)	< 0.0001
Age category			0.0001
<12 years	40 (5)	2 (1)	
12–19 years	115 (15)	29 (12)	
20–29 years	137 (15)	19 (8)	
30–39 years	110 (15)	22 (9)	
40–49 years	133 (18)	55 (23)	
50–59 years	126 (17)	78 (32)	
≥60 years	88 (12)	38 (16)	
Male	501 (67)	187 (77)	0.003
Helmet use <sup>b</sup>			< 0.0001
No	47 (6)	12 (5)	
Yes	269 (36)	193 (79)	
Unknown	424 (57)	38 (16)	
First facility of care			< 0.0001
Emergency department	343 (46)	237 (98)	
Urgent care	172 (23)	2 (1)	
Clinic	196 (26)	2 (1)	
Telephone	30 (4)	2 (1)	
Other	8 (1)	0 (0)	
Number of injured areas per event (among head, face, spine, neck, thorax, abdomen, lower extremity, upper extremity)			
0	10 (1)	1 (0.4)	
1	529 (71)	89 (37)	
>1	210 (28)	153 (63)	
Number of body areas with fractures per event (among face, spine, thorax, lower extremity, upper extremity areas)			< 0.0001
0	501 (67)	41 (17)	
1	235 (31)	133 (55)	
2	11 (1)	53 (22)	
3	2 (0.3)	11 (5)	
4	0 (0)	5 (2)	
Fracture type(s)			
Facial	7 (1)	12 (5)	
Spinal	18 (2)	38 (16)	
Thoracic (ribs, sternum)	52 (7)	89 (37)	
Lower extremity	59 (8)	85 (35)	
Upper extremity	127 (17)	68 (28)	
Organ injuries			
Brain	1 (0.1)	20 (8)	
Lung/heart	24 (3)	70 (29)	
Abdominal organ	0 (0)	25 (10)	
Number of surgically repaired areas per event (among head, face, spine, neck, thorax, abdomen, lower extremity, upper extremity)			
0	701 (94)	112 (46)	
1	47 (6)	109 (45)	
>1	1 (0.1)	22 (9)	
Surgical repairs			
Lower extremity	11 (1)	74 (30)	
Upper extremity	35 (5)	39 (16)	
Other surgery (head, face, spine/neck, thoracic, abdominal)	3 (0.4)	43 (18)	
Hospital length of stay, median (IQR)	Not applicable	3 (1–6)	
Discharge location	Not applicable		
Home		217 (89)	
Transferred to another hospital		1 (0.4)	
Skilled nursing facility		9 (4)	
Inpatient rehab/designated unit		12 (5)	
Deceased		3 (1)	
Other		1 (0.4)	
Admitted to intensive care unit	Not applicable		
No		174 (72)	
Yes		62 (26)	
Unknown		7 (3)	
Case identification method			< 0.0001
International Classification of Diseases code	211 (28)	180 (74)	
Text	538 (72)	63 (26)	

<sup>a</sup> Events were classified as hospitalized if they were admitted to an inpatient care unit beyond the emergency department for care of their injuries.

<sup>b</sup> Injured bystanders (not riding on vehicle) are not shown in helmet use data (n=9); 7 were non-hospitalized; 2 unknown hospitalization status.



On average, about 25 of the total injury cases each year occurred to MESA residents, with a range of 14 in 2016–2017 to 35 in 2013–2014 (Table 4). The average injury incidence rate was 313 per 100,000 snowmobiles registered in the MESA area over the study period, with a range from 248 per 100,000 in 2015–2016 to 374 per 100,000 in 2017–2018.

## DISCUSSION

In previous studies, SRI data were collected from trauma registries,<sup>13</sup> EHR data,<sup>23</sup> death registries,<sup>7,9</sup> state databases (hospital discharge, injury surveillance),<sup>16,24</sup> voluntary reports of recreational activity injuries provided by health providers or victims to state agencies,<sup>6,15</sup> or a combination of these sources.<sup>3-5,8,10,14,17</sup> However, these data sources are limited due to the exclusion of less severe injuries, the method of case ascertainment, and reliance on passive reporting of SRIs.<sup>6,12,17</sup> Evaluation of mortality or severe injuries alone underestimate the full impact of the injuries on patients, their families, and health systems that provide care. In this study, since MCHS is an integrated health care system, we were able to abstract data from both inpatient and outpatient departments using a strategy combining ICD coding and text screening tailored to our EHR to provide a comprehensive summary of medically attended injuries.

We calculated an average annual injury rate of 313 per 100,000 registered snowmobiles among a geographically defined population-based cohort included in the study. This is likely a conservative estimate, as some with injuries may have sought care outside our health system and some registered snowmobiles may not have been used in a season, reducing the denominator at risk. The average number of snowmobiles registered annually in Wisconsin during 2013–2018 was 214,109. Assuming our injury rate to be representative of injury occurrence in the state, we would expect approximately 670 injuries statewide each season. The Wisconsin DNR recorded between 58 and 171 incidents involving injuries annually over a similar time period (2014–2018) or only between 10% and 20% of the total number of injuries we would expect given our data.<sup>11</sup> These discrepancies in injury reporting between health care organizations and state agencies represent an opportunity for future improvements in injury reporting and surveillance associated with recreational vehicle use.

Compared to other studies, our study showed fewer of the highest acuity injuries, such as spinal fractures and traumatic brain injuries (TBI), but showed similar presence of extremity and thoracic fractures. In our study, 16% sustained spine fractures, similar to the 21% found by Plog et al<sup>14</sup> but lower than 29% for Beilman et al<sup>10</sup> and 28% for Whiting et al.<sup>8</sup> TBIs, which are common in all-terrain vehicle and motorcycle crashes and previously noted in over a third of snowmobile injuries,<sup>8,14</sup> were also relatively rare in our study, with only about 8% of cases suffering this injury. We speculate that helmet use is at least partially related to mitigating the cold and wind experienced while snowmobiling; and where helmet use was assessed in our study,

**Table 4.** Incidence of Snowmobile Injuries

Season	Injuries Among MESA Residents	Snowmobile Registrations Among MESA Residents	Injury Rate per 100,000 Registrants
2013–2014	35	10,486	334
2014–2015	32	10,065	318
2015–2016	23	9,262	248
2016–2017	14	4,802	292
2017–2018	20	5,341	374

Abbreviation: MESA: Marshfield Epidemiological Study Area.

Seventeen of the 42 total ZIP codes were excluded from MESA beginning in Oct 2016.

it was quite high, which may have reduced the number of both facial fractures and brain injury we observed. Despite having a robust neurosurgical service, we also speculate that our level II trauma status at our main referral hospital may have decreased the number of cases observed compared to level I trauma centers featured in other studies. In contrast to spinal fracture and TBI, thoracic injuries and lower extremity injuries in our hospitalized population were in line with observations from prior studies, while upper extremity injuries appeared to be slightly more common and were the most frequently fractured area among the outpatients.

The 1% fatality rate found in our study is also lower than previous studies<sup>10,17</sup> and we, along with other studies utilizing medical record data, may be limited by the inability to count those who were deceased prior to making it to care. We expect the Wisconsin DNR would receive more complete reporting of fatalities compared to underreporting expected for less severe medically attended snowmobile-related injuries. Fatality reports or death records would be an important addition to understanding the full scope of snowmobile injuries in the state.

While our study has many strengths, including a large number of cases included over the 5-year period and use of text searching to identify SRIs in the EHR, it has some limitations. Due to its retrospective nature, we relied on chart abstraction to provide details of medical care. Exact details of the crashes were difficult to obtain, as was data on helmet use—especially in the nonhospitalized population. We believe that patients seen in the outpatient setting are more likely to have a more focused assessment of their injuries versus the more comprehensive assessment of a trauma evaluation. This may have led to discrepancies in data collection between inpatient and outpatients, particularly with regard to helmet and alcohol use. Another limitation is exclusion of cases who sought care outside of our health system or died before arrival to a medical facility, but given the extensive network of regional facilities in our system, we likely captured most of the SRI injury cases that sought care in the service region. Though the denominator of our incidence calculation has the strength of including snowmobile registrations from a 24 ZIP code area where the majority of residents receive nearly all their care from our health system, the calculation is still quite

limited. We did not have access to direct identifiers for registrations to link our patients to registrations and develop a defined cohort at risk.

Since MCHS is an integrated health care system, we were able to abstract data from both inpatient and outpatient departments using a strategy combining ICD coding and text screening in our EHR. We propose that a similar approach could be enacted in other health care organizations to enhance injury reporting and surveillance of SRIs to better inform prevention efforts and staffing of rural trauma systems. While the acuity of injuries treated in the outpatient setting are not as high as those hospitalized, many still involved broken bones and were plaguing enough that patients sought care. The total number of injuries we found were significantly more than recognized through reports made to the Wisconsin DNR. All medically attended injuries, whether requiring a hospital stay or not, represent a potentially significant burden to the patient in terms of missed work and decreased quality of life due to pain or morbidity and burden to rural health care systems.

## CONCLUSIONS

Using a combination search strategy of ICD codes and text searching to identify patient records from an integrated health care system, we were able to abstract SRI data from both outpatient and inpatient departments. We found the majority of patients suffering from SRIs (74%) sought treatment as outpatients and never sought treatment in the hospital. Currently available studies of SRIs focused on inpatients appear to have underestimated the number and burden of SRIs. Outpatients with SRIs differ significantly with regard to the types and severity of injuries compared with inpatients with SRIs. Our methods allowed us to examine a larger number of SRIs and identify the true number of SRIs in our health system. Further studies combining datasets from the other health systems in the state and statewide mortality records for patients who died before arrival to the hospital could elucidate the full statewide impact of SRIs in Wisconsin. This could lead to further education for snowmobile enthusiasts regarding the significance of SRIs and their prevention, as well as improved staffing for rural trauma systems.

**Acknowledgements:** The authors acknowledge the following individuals from the Marshfield Clinic Research Institute: Emily Andreae, PhD, for manuscript editing assistance; Elizabeth Armagost, Julie Karl, Karen McGreevey, Madalyn Palmquist, and Martha Presson for medical record abstraction; and Erica Scotty for data acquisition, programming, and natural language processing development.

**Funding/Support:** This study was funded by philanthropic support to the Marshfield Clinic Research Institute, led by the Marshfield Clinic Health System Foundation.

**Financial Disclosures:** None declared.

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# Missing Out: Underutilization of Primary Care by Wisconsin Patients Who Smoke and Its Implications for Tobacco Treatment Access

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## ABSTRACT

**Introduction:** Tobacco dependence treatment is usually offered in primary care settings. Yet, if many patients who smoke do not access primary care, cessation interventions may be missing those who most need them. This study describes Wisconsin adults' health care utilization by smoking status.

**Methods:** Data were analyzed from 1726 individuals participating in a population-based, cross-sectional, in-person health survey of Wisconsin residents (2014-2016). Demographic characteristics were compared across smoking status using Wald chi-square tests weighted for the complex survey design. Odds ratios were calculated using multivariate logistic regression models.

**Results:** Of 1726 respondents, 15.3% reported current smoking, 25.4% former smoking, and 59.4% never smoking. Those currently smoking were more likely than former- or never-smoking respondents to report emergency departments as their "usual place to go when sick" (12% vs 3%) or report they had "no place to go when sick" (16% vs 7%). People who currently smoke also reported more emergency department visits during the past year (mean=1.4 visits) than did others (mean=0.4,  $P<0.01$ ). Among those currently smoking, 18% reported that they "needed health care but didn't get it" over the past year, compared to 6% of others ( $P<0.01$ ). Those currently smoking also were more likely to report a "delay in getting care" (16% vs 9%,  $P=0.02$ ) and were less likely to have had a "general health checkup" within the past year (58% vs 70%,  $P<0.02$ ). These relationships persisted in logistic regression models controlling for variables related to smoking status and health care utilization, including health insurance.

**Conclusions:** These findings suggest that more than a quarter of Wisconsin adults who smoke do not receive primary care every year and that they delay care or seek care in emergency departments more frequently than do those who never smoked or who quit smoking. As a result, such individuals may be missing out on evidence-based tobacco cessation treatment.

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## INTRODUCTION

Despite large-scale public health campaigns and extensive evidence-based treatment options for tobacco dependence, approximately 14% of US adults currently smoke cigarettes,<sup>1</sup> and smoking remains the leading preventable cause of death and a driver of health care expenditures.<sup>2</sup> Health care system changes that institutionalize the delivery of evidence-based smoking-cessation interventions have been shown to be both clinically and cost-effective.<sup>3-6</sup> Moreover, guideline reviews have identified primary care settings, in particular, as a target – given that over 75% of smokers visit a primary care clinician each year.<sup>7</sup> On the strength of this evidence, accreditation bodies have encouraged health care systems to adopt system changes to promote the identification and treatment of patients who smoke during health care visits.<sup>8</sup>

Although primary care is well-suited to preventive care, including smoking cessation treatment, 1 in 4 adults who smoke report not receiving primary care in the past year.<sup>9</sup> Some people use emergency departments (ED) or urgent care as their usual source of care, and others

go without.<sup>10</sup> Even among insured members of a health cooperative, roughly 17% of adults who smoke do not see their primary care clinician in a given year.<sup>11</sup> To design health system changes and outreach efforts to have the greatest impact on patients who smoke, it is important to explore how they obtain health services. Knowing where patients seek care will inform efforts to integrate smoking cessation advice and treatment or referral (eg, Ask,



Advise, Refer) into workflows and care models tailored to these settings and may inform direct-to-patient outreach efforts. This information is critical to meeting patients where they are, rather than expecting them to proactively seek smoking cessation care in particular settings.

This is especially important because evidence suggests that many of the marginalized communities that now suffer the greatest burden from tobacco use (ie, people with limited education or low socioeconomic status, minoritized racial groups, people with mental illness<sup>12</sup>) are also less likely to seek primary care and/or more likely to seek care in other venues, such as emergency departments.<sup>13,14</sup> Research on differences in usual sources of care by smoking status is quite limited, however. Given that roughly 23% of patients without health insurance smoke,<sup>12</sup> there are likely many socioeconomically disadvantaged people who smoke who cannot afford preventive or primary care. Disparities in usual sources of care may drive disparities in access to smoking cessation treatment and downstream disparities in health outcomes. As such, designing outreach efforts to reach patients with limited access to primary care may be one strategy to enhance health equity.

This study sought to address this gap in our knowledge using representative data from the Survey of the Health of Wisconsin (SHOW).<sup>15</sup> We examined differences in usual sources of care among adult respondents who reported current smoking, former (past, but not current) smoking, or never smoking. In addition, we examined differences in patient-rated health care quality and health by smoking status. Patient ratings of care quality and self-rated health are known to be lower among those without a usual source of care<sup>13</sup> and are important secondary outcomes of interest, given their relations with future care-seeking and mortality.<sup>16,17</sup>

## METHODS

### Measures

Data were analyzed from 1,726 individuals who reported smoking status while participating in SHOW between 2014 and 2016. SHOW is a population-based cross-sectional health examination survey of civilian, noninstitutionalized residents of Wisconsin. Detailed survey methods have been described previously by Nieto et al.<sup>18</sup> Survey components relevant to the current analysis included an in-home interview and a self-administered questionnaire. All study protocols were approved by the University of Wisconsin Health Sciences Institutional Review Board, and all participants provided written informed consent as part of the initial home visit.

Self-reported demographic characteristics included age (coded as 18-39, 40-64, or  $\geq 65$  years), race (coded as White not Hispanic or African American/Hispanic/Other), sex (coded as male or female), level of education completed (coded as high school or less, or at least some college), urbanicity (coded as urban, suburban, or rural as defined by rural-urban commuting area codes),<sup>19</sup> unemployment, insurance status (coded as Medicaid/no insurance

vs other), food insecurity (worried food would run out always or often in the last 12 months, endorsed or not), and poverty level (above vs at or below 100% poverty level). Poverty level was calculated using the poverty guidelines from the US Department of Health and Human Services.<sup>20</sup> Categories were combined when possible to accommodate smaller sample sizes, at the expense of more granular description. To better characterize the sample, in addition to smoking status (former, current, never), additional self-reported health characteristics were measured, including self-reported health (coded as fair/poor vs good/very good/excellent), depression (as measured by the Patient Health Questionnaire-2 [PHQ-2], 2-item depression screening questionnaire),<sup>21</sup> and alcohol consumption (with heavy alcohol consumption defined as  $> 14$  drinks per week for men or  $> 7$  drinks per week for women).

Care seeking was assessed with questions asking about usual place of care when sick ("Do you have a place to go when you feel sick or need advice about your health?, ED as usual place to go, no place to go, or other place to go—ie, community health center, hospital outpatient clinic, or doctor's office), number of trips to the ED in the past year, experiencing a delay in receiving care, and not receiving care when needed. Subjects were asked if they had "a general medical checkup in the past 1 year," as well as if they "had a physical exam" in the past year. The latter question aimed to capture any medical visit, including acute visits (urgent care or ED visits), while the "general medical checkup" was designed to capture preventive health visits or "annual physicals" where preventive services and health behavior counseling would more likely be offered. Perceptions of quality of care were measured on a 5-point Likert scale from "excellent" to "poor" and grouped by excellent/very good/good versus fair/poor for analysis. The full list of questions and possible responses is available in the Appendix.

### Data Analysis

Data analyses were completed using SAS 9.4 software (Cary, NC). First, demographic characteristics were compared across smoking status using Wald chi-square tests and weighted for the complex survey design. Survey weights attempted to make estimates representative of the state. Simple logistic regression models were run to examine potential associations between smoking status, care-seeking behavior, and quality-of-care perceptions that may be independently associated with smoking behavior. Crude odds ratios (OR) and adjusted ORs were calculated using simple logistic regression models weighted for the complex survey design to examine differences in care seeking and experience across smoking status, with never-smoking as the reference. Adjusted models were designed based upon similarly weighted multivariate logistic regression models, in order to control for age, sex, and insurance status.

## RESULTS

Of the 1726 individuals included in the analysis, 15.3% reported current smoking, 25.4% former but not current smoking, and

59.4% had never smoked. A larger proportion of people who reported current smoking (vs former or never-smoking) were young (age 18-39), male, members of minority racial groups, with less than a high school education. A higher proportion of those who reported current smoking also reported poverty, heavy alcohol consumption, symptoms of depression, and a lack of health insurance. There was no difference by smoking status in the proportion of participants living in rural versus urban areas or being unemployed (Table 1).

People who reported current smoking were more likely than those who formerly or never smoked to report the ED as their “usual place to go when sick” (12% vs 3%) or to report they had no place to go when sick (16% vs 7% and 8%, respectively). People who currently smoke also reported more ED visits during the past year than people who formerly or never smoked (mean of 1.4 visits for current vs 0.5 for former- and 0.4 for never-smoking adults,  $P<0.01$ ). In addition, 18% of people who currently smoke responded that they had “needed health care but didn’t get it” over the past year, compared to 8% of those who formerly smoked and 6% of those who never smoked ( $P<0.01$ ). They were also more likely to report a “delay in getting care” (16% vs 8% former and 9% never,  $P=0.02$ ). There was no statistically significant difference by smoking status for having had a physical exam during the past year (75% for current, 85% former, and 80% never,  $P=0.11$ ), but significantly fewer people who currently smoke reported having a “general health checkup” within the past year (58% current vs 73% former and 68% never,  $P=0.01$ ) (Table 2).

Perceptions of care quality, though not the primary focus of this paper, may provide additional insight into care-seeking practices. People who currently smoke were more likely to rate the quality of their last physical exam as fair/poor as opposed to good/very good/excellent (21% current vs 13% former and 12% never,  $P=0.01$ ). They also were more likely to rate their overall quality of care as fair/poor (47%

**Table 1.** Demographic Characteristics of SHOW Participants by Smoking Status, 2014-2016<sup>a</sup>

	Smoking Status						P value
	Current (n = 231; 15.3%)		Former (n = 485; 25.4%)		Never (n = 1010; 59.4%)		
	n	% (SE)	n	% (SE)	n	% (SE)	
Age					0.01		
18-39	79	44.3 (4.2)	94	28.1 (3.7)	322	38.6 (2.0)	
40-64	130	49.5 (3.8)	179	39.5 (1.9)	424	43.1 (1.7)	
≥ 65	22	6.2 (1.5)	212	32.4 (2.7)	264	18.3 (1.5)	
Sex							0.01
Male	106	55.5 (3.4)	253	55.3 (1.9)	398	44.7 (1.2)	
Female	125	44.5 (3.4)	232	44.7 (1.9)	612	55.3 (1.2)	
Race							<0.01
Non-Hispanic White	164	70.8 (3.6)	424	87.0 (1.6)	886	88.0 (1.8)	
Non-Hispanic Black	34	11.8 (2.1)	13	3.0 (1.0)	52	5.2 (1.2)	
Hispanic (Any Race)	15	9.4 (2.5)	16	3.9 (0.9)	30	2.8 (0.7)	
Other	17	8.1 (1.1)	31	6.2 (0.7)	42	4.0 (0.6)	
Education							0.01
<High school	35	15.2 (2.2)	34	7.3 (1.4)	42	4.1 (1.0)	
High school diploma or GED	69	32.5 (4.6)	94	19.5 (1.9)	165	16.5 (1.7)	
At least some college	127	52.3 (5.9)	357	73.2 (1.6)	803	79.5 (1.4)	
Urbanicity							0.17
Urban	130	61.4 (13.0)	248	53.9 (15.3)	555	57.2 (12.1)	
Suburban	34	13.4 (4.9)	76	15.1 (3.3)	171	16.1 (3.4)	
Rural	67	25.2 (13.5)	161	30.9 (15.7)	284	26.7 (14.1)	
Poverty							<0.01
Below	53	26.3 (3.4)	34	7.7 (2.6)	81	9.7 (1.1)	
Above	165	73.7 (3.4)	429	92.3 (2.6)	886	90.3 (1.1)	
Insurance							<0.01
No insurance	27	12.6 (2.2)	11	3.8 (1.4)	22	2.4 (1.1)	
Medicare/Medicaid	96	40.6 (3.4)	252	44.5 (3.5)	355	30.3 (2.3)	
Private/employer/other	106	46.8 (3.4)	222	51.7 (3.6)	631	67.3 (2.1)	
Unemployment							0.12
Employed	207	89.8 (10.1)	472	96.7 (1.0)	1648	95.9 (0.8)	
Unemployed	22	10.1 (2.4)	11	3.3 (1.0)	70	4.1 (0.8)	
Depressive symptoms	44	20.0 (3.8)	31	8.0 (1.2)	70	7.0 (0.6)	<0.01
Heavy alcohol use	46	20.5 (3.6)	93	19.3 (1.6)	92	9.5 (0.8)	<0.01
Self-reported fair/poor health	68	28.6 (3.3)	64	12.6 (1.9)	81	8.0 (0.8)	<0.01

Abbreviations: SHOW, Survey of the Health of Wisconsin; SE, standard error; GED, General Educational Development.

<sup>a</sup>Percentages shown reflect weighted values for the state of Wisconsin.

**Table 2.** Access and Quality of Care by Smoking Status

	Current		Former		Never		P value
	n	% (SE)	n	% (SE)	n	% (SE)	
Usual place to go when sick							
No place to go	29	15.6 (3.3)	30	7.1 (1.4)	76	8.3 (1.6)	0.03
ED as usual place	25	11.7 (2.2)	11	3.0 (0.9)	31	3.2 (0.8)	
Other place to go (health center, clinic)	171	72.7 (3.9)	434	89.9 (1.7)	882	88.5 (1.8)	
Number of ED visits, past year (mean, SE)	1.37	(0.2)	0.47	(0.1)	0.43	(0.0)	<0.01
Needed care but did not get it	36	18.0 (2.1)	36	8.2 (1.6)	61	6.4 (0.7)	<0.01
Delay in getting care	36	16.1 (3.1)	38	8.1 (1.7)	95	9.1 (1.0)	0.02
Had physical exam, past year	176	75.0 (3.0)	421	84.8 (2.6)	829	79.8 (1.9)	0.11
Had general checkup, past year	135	57.7 (3.8)	348	73.4 (2.2)	694	67.7 (1.8)	0.01
Poor quality of care, physical exam	44	20.9 (3.0)	62	13.1 (1.7)	119	12.1 (1.1)	<0.01
Poor quality of care, overall	99	46.7 (5.2)	117	27.4 (2.6)	485	28.6 (2.3)	0.01

Abbreviations: ED, emergency department; SE, standard error.

<sup>a</sup>Percentages shown reflect weighted values for the state of Wisconsin.

**Table 3.** Multivariable Logistic Regression of Health Care Utilization Practices and Perceptions by Smoking Status

	Poor Quality of Care Overall (n=1722)			Needed Care But Did Not Get It (n=1720)			Delay in Getting Care (n=1721)			Self-Reported Health Fair/Poor (n=1713)		
	Point Estimate	95% Confidence Limits	P value	Point Estimate	95% Confidence Limits	P value	Point Estimate	95% Confidence Limits	P value	Point Estimate	95% Confidence Limits	P value
Current Smoking (ref=never)	1.81	1.27, 2.59	0.00	2.34	1.61, 3.40	<0.001	1.79	1.08, 2.97	0.03	4.78	3.33, 6.88	<0.001
Former Smoking (ref=never)	1.07	0.71, 1.59	0.75	1.47	0.84, 2.57	0.18	0.96	0.61, 1.51	0.84	1.59	1.20, 2.10	0.00
No insurance/Medicaid <sup>a</sup>	1.39	1.11, 1.73	0.00	3.08	2.07, 4.59	<0.001	1.48	0.98, 2.22	0.06	—	—, —	—
Age	0.97	0.97, 0.98	<0.001	0.98	0.97, 1.00	0.06	0.99	0.98, 1.01	0.36	1.01	1.00, 1.01	0.04
Sex (ref=female)	1.52	1.09, 2.13	0.02	0.62	0.34, 1.11	0.10	0.57	0.42, 0.79	0.00	0.92	0.59, 1.44	0.71

<sup>a</sup> Reference = Private, Medicare, other.

— Insufficient sample size to make comparison.

of people who currently smoke vs 27% former and 29% never,  $P=0.01$ ) (Table 2).

There are many factors associated both with smoking and use of health care services, such as socioeconomic barriers to health care access and differences in health status.<sup>12-14</sup> After adjustment for age, sex, and insurance status, people who currently smoke were still more likely to report their health care quality was poor overall (47% vs 29%, adjusted OR [adjOR] 1.8 (95% CI, 1.3-2.6);  $P<0.01$ ), to delay seeking health care services (16% vs 9%; adjOR 1.8; 95% CI, 1.1-3.0;  $P<0.03$ ), to not get care when needed (18% vs 6%; adjOR 2.3; 95% CI, 1.6-3.4;  $P<0.01$ ) and to report fair/poor health (28.6% vs 8.0%; adjOR 4.8; 95% CI, 3.3-6.9;  $P<0.01$ ) (Table 3).

## DISCUSSION

The results from this study of a representative sample of Wisconsin residents collected between 2014 and 2016 indicate that those who smoke are more likely to use the ED as their usual source of care or lack a usual source of care, report lower health care quality, and delay or avoid health care compared to those who have never smoked and those who have quit smoking. These findings suggest patients who smoke may use health care services differently than do nonsmoking patients and may skip care more often and rely more heavily on acute care services than do nonsmoking adults. Moreover, a lack of insurance did not account for this finding—the difference persisted after controlling for insurance status/type and demographics that are also associated with usual source of care, such as race.

These data suggest that offering smoking cessation treatment in EDs may be one way to extend the reach of smoking cessation treatments, given that 12% of adults currently smoking reported receiving their health care in ED settings. Secondary analysis of audiotapes from ED patient/clinician encounters suggest that many ED clinicians gather information about smoking behav-

ior, but few counsel or advise patients to quit.<sup>22</sup> Best practices for doing so in the emergency setting have not yet been established.<sup>23</sup> A randomized trial<sup>24</sup> that compared enhanced care (advice, brief behavioral counseling, and provision of free nicotine patches with telephone follow-up) versus usual ED care (brief advice and a pamphlet) found no significant difference in 3-month abstinence between the groups. However, an unexpectedly high cessation rate in the control group suggested that even brief advice during an ED visit may be helpful (14.7% intervention and 13.2% control).<sup>24</sup> A 2017 systematic review and meta-analysis of 11 randomized control trials of ED-initiated tobacco interventions reported a combined RR of 1.40 (95% CI, 1.06-1.86,  $P=0.02$ ) for point-prevalence abstinence from tobacco up to 12 months postintervention.<sup>25</sup> The authors concluded that ED-initiated tobacco interventions may be critically important for engaging hard to reach patients who smoke, but essential components of successful ED cessation interventions have not yet been identified. Interventions that rely upon referral from the ED to an outside smoking cessation program, for example, have not been shown to be very effective,<sup>26</sup> underscoring the importance of understanding health care-seeking behaviors and motivations when designing tobacco cessation interventions for acute care settings.

Finding effective ways to expand health care system changes to emergency care is a high priority for smoking cessation research, but the current data suggest that this may still miss a substantial minority (16%) of adults who smoke.<sup>11</sup> Delaying and skipping care were more common among patients who smoke than those who do not, and many more patients who smoke reported having no usual source of care in Wisconsin than their nonsmoking peers. These data highlight the need for innovative population health strategies to bring smoking cessation more directly to patients. Proactive outreach via mail, phone, and digital means has the potential to increase demand for smoking cessation treatment and help more people



quit. Studies of proactive outreach in the Veterans Affairs and primary care settings support the promise of such approaches,<sup>27-29</sup> but the extent to which they will reach patients with no usual source of care is not yet known. Retail health services, which are becoming more widely available in some major retail stores and pharmacies, may also help to fill this gap. Evidence suggests that retail clinics typically serve younger adults without a usual source of primary care, and most visits are for preventive services (90% of visits) or simple acute issues.<sup>30</sup> This “on-demand” model could potentially provide an opportunity for preventive care interventions, such as tobacco treatment services, in a more familiar and accessible setting than an ED or urgent care center.<sup>31</sup> More research is needed to understand how preventive services, in general, might play a role at retail health systems. Finally, individuals who smoke are more likely to suffer from mental health diagnoses and/or poverty. Thus, ensuring that settings that care for such individuals (mental health treatment settings, community service agencies)<sup>32,33</sup> offer cessation treatment may further expand reach.

Disparities in ratings of health care quality also were observed for Wisconsin adults who smoke versus those who do not. Lower perceptions of general health care quality among patients who smoke could occur for a variety of reasons, including the fact that more of their encounters may be for acute needs in an urgent care or ED setting. Urgent and ED care tends to be narrowly focused on the acute presenting concern, as opposed to well-visits or chronic disease management visits in primary care. The fact that there is no difference in the proportion of patients who report having a physical exam in the past year but there is a significant difference in those reporting a general health checkup is consistent with the finding of acute care-seeking behavior being more common among patients who smoke. Physical exams occur with any type of health care encounter, including ED or urgent care visits, whereas general medical checkups imply preventive care or maintenance of chronic disease visits. If patients who smoke are also more likely to delay care until it becomes imperative, greater use of the ED or urgent care would also make them less likely to forge a consistent relationship with a primary care clinician who might provide pharmacotherapy and behavioral support for smoking cessation.

If patients who smoke do not perceive that their health care is of good quality, then their trust in the value of general medical exams and/or preventive screening services may likewise be low. It could be argued that people who continue to smoke do so because they have not yet suffered from the health consequences of smoking (the so-called “healthy smoker effect”),<sup>34</sup> but a higher proportion of currently smoking patients in this study reported fair/poor health compared to former and nonsmoking patients, leading to the more troubling conclusion that those who currently smoke may be in worse health and less likely to seek care. This is consistent with some utilization research in primary care settings. For

example, Smith et al<sup>35</sup> found that among patients who reported cough and hoarseness within the past month, current smoking was associated with a reduced likelihood of help-seeking (OR 0.44; 95% CI, 0.23-0.83), even after adjusting for demographic factors.<sup>35</sup>

The consistent finding that people who quit smoking are more similar to those who never smoked than those who continue to smoke suggests that the differences in health care utilization, quality, and health observed are not due to sociodemographic or etiological factors associated with starting smoking. It may be either that smoking causes the differences observed or that the causal agents driving health care utilization, quality perceptions, and self-rated health are associated with factors (ie, third variables) that also promote success in maintaining abstinence from tobacco. An encouraging implication of this result is that a history of smoking is not necessarily associated with worse access to or trust in care or worse health. Instead, it is current smoking (or the factors that maintain smoking) that signals problems in health and health care quality and access.

This study has several limitations, most notably its reliance on retrospective self-report for care-seeking behaviors and perceptions of care quality. Data were also collected in a single state—one that has not adopted Medicaid expansion—so these results may not generalize to other states and health policy contexts. This is secondary analysis of a survey that had already been administered, so we were not able to ask additional questions about the motivation behind certain care-seeking behaviors. Such insights would greatly enrich our understanding and better inform the design of future smoking cessation intervention programs that can better meet the needs of patients who smoke. Finally, no interactions between variables shown to be different by smoking status were examined, such as the interaction between poor quality of care and use of the ED for primary care. In order to make assumptions about why care patterns and quality may differ by smoking status, an analysis that better accounts for the interaction and relative contributions of each predictor is warranted.

## CONCLUSIONS

Wisconsin adults who currently smoke cigarettes are more likely to skip health care and less likely to have a usual source of care other than the ED than those who do not smoke. These disparities in primary care access and care quality persist after controlling for insurance and demographics. These findings suggest that efforts to address smoking need to extend beyond adult primary care to reach a substantial proportion of adults who smoke and to prevent smoking-related morbidity and mortality.

**Acknowledgements:** The authors would like to thank Parvathy Pillai, MD, MPH, for her review of the data and abstract, and Michael Fiore, MD, for his review and comments on this manuscript. Kristen Malecki, MD, is the Principal Investigator for the Survey of the Health of Wisconsin grant.

**Funding/Support:** The data source, the Survey of the Health of Wisconsin, is funded by the Wisconsin Partnership Program PERC Award (233 PRJ 25DJ).

**Financial Disclosures:** None declared.

**Appendix:** Available at [wmjonline.org](http://wmjonline.org)

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# Increased Alcohol-Related Mortality in Wisconsin Pre-COVID: A Two-Decade Trend

Lynne Cotter, MPH; Thomas Bentley, MS; Pamela Imm, MS; Paul D. Creswell, PhD

## ABSTRACT

**Introduction:** Alcohol-related mortality is increasing nationally, but state-specific trends still need to be explored. This paper reviews the patterning of alcohol-related deaths among Wisconsin residents in the 2 decades prior to the COVID-19 pandemic.

**Methods:** Data are from death certificates for state residents from 2000 through 2019. We used underlying cause of death codes (ICD-10) to classify deaths as 100% attributable to alcohol (ie, acute, chronic liver, and other chronic). Demographic characteristics were available for the most recent decedents (2015-2019). We assess trends in alcohol-related mortality and used chi-square tests to assess demographic differences compared to deaths from all other causes.

**Results:** The number of alcohol-related deaths more than doubled from 2000 through 2019 in Wisconsin, rising from 394 in 2000 to 857 in 2019. In the 5 most recent years (2015-2019), the populations with significantly higher rates of alcohol-related deaths included men, middle-aged adults, Black residents, and those of Hispanic descent. Education level also was significantly related to alcohol-attributable mortality, as those with the highest and lowest education levels were the least likely to die from this cause.

**Discussion/Conclusions:** Results of these analyses show that the number of deaths due to alcohol-related diseases has risen significantly since 2000, and this trend preceded the COVID-19 pandemic. These rising mortality rates deserve the attention of the medical and public health communities. Our findings show that, in recent years, Hispanic individuals, men, and middle-aged adults are at a higher risk for alcohol-related deaths. Stakeholders may wish to consider interventions targeted to these groups.

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## INTRODUCTION

Alcohol-related mortality is increasing in the United States.<sup>1,2</sup> A national review of death certificates found that alcohol-induced deaths from both chronic and acute causes nearly doubled from 1999 to 2017<sup>3</sup> while they generally declined in Europe.<sup>4</sup> In addition, national rates of high-risk drinking and the number of individuals with alcohol use disorder have both increased in recent years.<sup>5</sup>

Wisconsin leads the United States in excessive drinking per capita.<sup>6</sup> Results from the National Survey on Drug Use and Health (NSDUH) show that 64% of Wisconsin adults drank alcohol in the past 30 days and 32% binge drank (ie, drank 5 or more drinks at least once per week).<sup>7</sup> By comparison, in the United States as a whole, 56% of adults reported drinking alcohol in the past 30 days, and 27% reported binge drinking.<sup>7</sup> Perceptions of drinking as a health risk behavior are also lower in Wisconsin. According to

NSDUH, only 39% of Wisconsin adults consider it risky to binge drink; nationally, 45% of adults consider binge drinking risky.<sup>7</sup>

Alcohol consumption is a risk factor for mortality and has other serious consequences for health.<sup>8,9</sup> While the proportion of Wisconsin residents who report drinking has held steady in recent years (at roughly 66%),<sup>10</sup> the national trends in alcohol-related mortality are alarming for a state that is known for its culture of drinking.<sup>11</sup> However, national statistics often disguise nuances at the state level and may not reveal trends for subpopulations. The goal of this study is to explore the alcohol-related mortality trends

**Table.** Demographic Characteristic of Wisconsin Residents Who Died From Alcohol-Related Causes, 2015-2019

	Alcohol-Related Deaths (N)	Proportion of Alcohol-Related Deaths (%)	Deaths From All Other Causes (N)	Proportion of Deaths From Other Causes (%)	Chi-square Test
	3,772	100%	256,722	100%	
Race and ethnicity					$P < 0.002$
Black, non-Hispanic	248	6.57%	12,797	4.98%	
Hispanic	138	3.66%	3,817	1.49%	
Other, non-Hispanic	146	3.87%	4,241	1.65%	
White, non-Hispanic	3,240	85.90%	235,867	91.88%	
Age					$P < 0.002$
18-34	153	4.06%	6,530	2.54%	
35-44	324	8.59%	5,534	2.16%	
45-54	922	24.44%	12,508	4.87%	
55-64	1,360	36.06%	29,345	11.43%	
65+	1,013	26.86%	202,805	79.00%	
Sex					$P < 0.002$
Female	1,069	28.34%	127,735	49.76%	
Male	2,703	71.66%	128,986	50.24%	
Missing	—	—	1	0.00%	
Department of Health Services region					$P = 0.54$
Northeastern	825	21.87%	57,923	22.56%	
Northern	393	10.42%	25,376	9.88%	
Southeastern	1,379	36.56%	91,701	35.72%	
Southern	664	17.60%	46,325	18.04%	
Western	511	13.55%	35,331	13.76%	
Missing	—	—	66	1.01%	
Urbanicity					$P = 0.23$
Rural	1,160	30.75%	81,311	31.67%	
Urban	2,612	69.25%	175,349	68.30%	
Missing	—	—	62	0.02%	
Educational attainment					$P < 0.002$
High school or less	2,320	61.51%	169,521	66.03%	
College/Undergrad	1,259	33.38%	71,424	27.82%	
Graduate school	137	3.63%	12,941	5.04%	
Unknown	56	1.48%	2,836	1.10%	

in Wisconsin prior to the COVID-19 pandemic. We sought to assess: (1) trends over time and (2) how alcohol-related mortality may differ for demographic groups within the state.

## METHODS

### Data Source

This study analyzed Wisconsin vital statistics data provided by the Office of Vital Records at the Wisconsin Department of Health Services (DHS). Our sample included resident deaths from January 2000 through December 2019 (N=299,425). The underlying cause of death was used to identify alcohol-related deaths. This code is filled out on the death certificate by the attending medical examiner or coroner. Only deaths that were fully attributable to alcohol were retained for these analyses. Alcohol-related deaths included both acute causes and chronic conditions.

### Classification of Deaths

Acute causes of alcohol-related death include: (1) alcohol poison-

ings, (2) excessive blood alcohol, and (3) alcohol-related suicide. Chronic causes of alcohol-related death include: (1) mental disorders related to alcohol, (2) chronic liver disease (eg, cirrhosis), and (3) all other health disorders due to alcohol (ie, polyneuropathy, myopathy, cardiomyopathy, gastritis, liver disease, and pancreatitis). Underlying cause of death ICD-10 codes include F10.0, F10.1, F10.[3-9] I426, F102, G312, G621, K860, K292, K70, G721, O354, P043, Q860, R780, T51. [0,1,9], X45, X65, Y15.<sup>12,13</sup>

### Demographic Variables

Demographic variables have only recently been captured electronically in vital records. Thus, race and ethnicity, age, sex, DHS region, geographic location (ie, urban vs rural classification), and educational attainment are available only for 2015 through 2019 (Table). Urban and rural classifications were based on the US Office of Management and Budget designations of metropolitan statistical areas, as categorized by the Wisconsin Office of Rural Health.<sup>14</sup>

### Statistical Analysis

Rates were calculated based on Wisconsin resident population data provided by the Wisconsin Interactive Statistics on Health.<sup>15</sup>

Trend tests were used to determine if changes in alcohol-attributable mortality were statistically significant. Chi-square tests were used to determine significant differences in the proportion of deaths by demographic factors in the most recent years (2015-2019).

## RESULTS

### Demographic Analysis (2015-2019)

From 2015 through 2019, Black and Hispanic residents made up a significantly higher percentage of alcohol-related deaths when compared with deaths from all causes (Table). Males also made up a disproportionate percentage of alcohol-related deaths when compared to deaths from all causes (71.7% vs 50.2%, respectively;  $P < 0.002$ ). Additionally, some differences by education were notable. Only 3.6% of individuals with an alcohol-related cause of death had graduate-level education, compared with 5% of individuals who died from other causes ( $P < 0.002$ ). Decedents with an alcohol-related cause of death were more likely to be college educated and less likely to have only a high



school degree than those who died from other causes ( $P < 0.002$ ).

There were also significant differences by age. Middle-aged individuals were disproportionately likely to die from an alcohol-related cause. The largest proportion of alcohol-related deaths was among individuals aged 55-64 (35.1%), followed by individuals 45-54 (24.4%) ( $P < 0.002$ ). The mean age at death for decedents who died of an alcohol-related cause was 57.8 (SD, 11.9) years old, compared with 76.2 (SD, 16.0) for those who died from other causes ( $P < 0.002$ ) (data not shown). Finally, this study did not find any statistically significant differences in alcohol-related mortality by geographic region or urbanicity. This included both differences by DHS region ( $P = 0.54$ ) and rural-urban county classification ( $P = 0.23$ ).

### Trends Over Time (2000-2019)

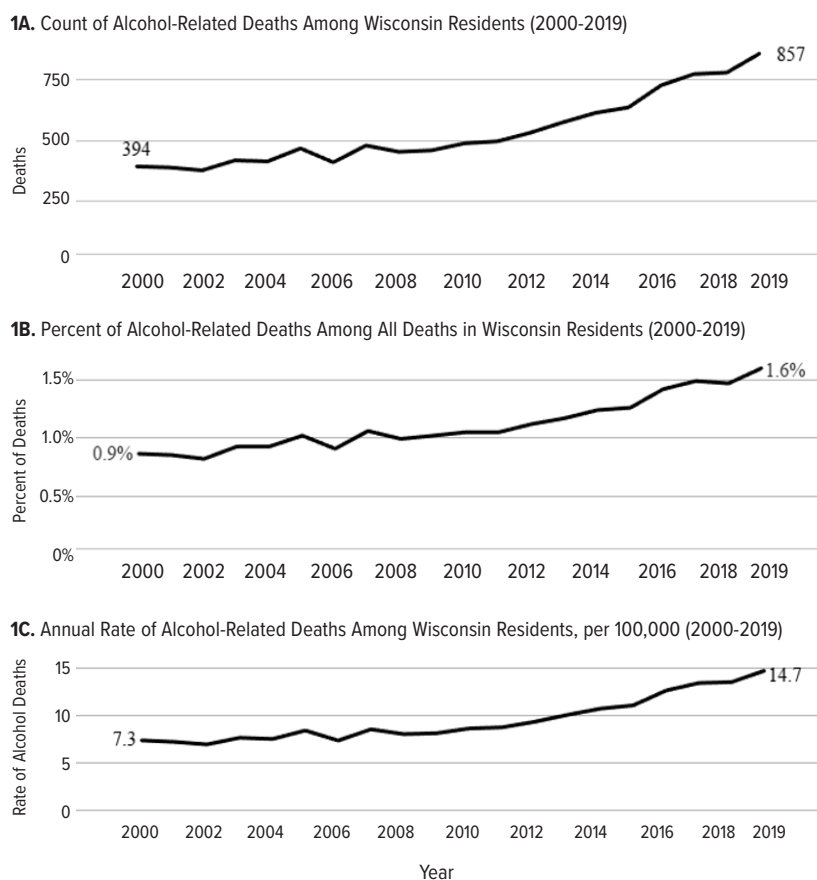
The total number of alcohol-related deaths in Wisconsin more than doubled from 394 in 2000 (less than 1% of all deaths) to 857 in 2019 (1.6% of all deaths) (Figures 1A and 1B). The rate of alcohol-related mortality more than doubled as well, from 7.3 deaths per 100,000 residents in 2000 to 14.7 in 2019 (Figure 1C).

These data also show differential trends for age groups. Alcohol-related mortality was most prevalent for those individuals in the oldest age categories (ie, 65 and older and 55-64 years of age). The 55-64 age group had the highest percentage increase in mortality over the time period, with a more than 3-fold increase in the number of cases (from 90 to 297 deaths, a 230% increase) (Figure 2). The 65+ age category also more than doubled in this time period (from 92 to 243 deaths, a 164% increase) (Figure 2). Alcohol-related deaths remained more stable for individuals in the 35-44 and 45-54 age ranges, with a small increase (8%) in the former and a somewhat larger (62%) increase in the latter. The most dramatic increase was among those in the 25-34 age range. While the absolute numbers were low, they more than tripled over the period, from only 11 deaths in 2000 to 41 deaths in 2019 (a 272% increase) (Figure 2).

### DISCUSSION/CONCLUSIONS

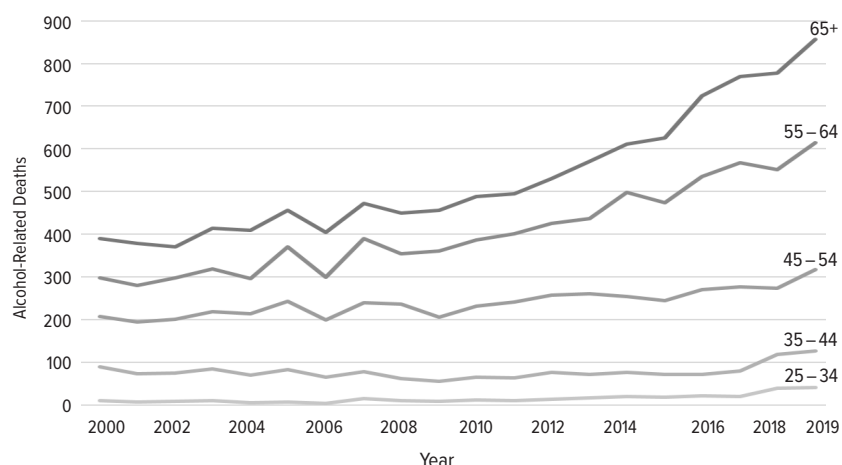
Our findings confirm recent reports<sup>16,17</sup> that show stark increases in alcohol-related deaths in Wisconsin and demonstrate differences across demographic groups. We show that alcohol mortality has been trending upward for 20 years prior to the COVID-19

**Figure 1.** Counts, Proportions, and Rates of Alcohol-Related Deaths Among Wisconsin Residents, 2000-2019



pandemic. Particularly shocking is the 272% increase in alcohol-related deaths for those in the 25-34 age category. It is possible that deaths among these younger adults may be related to alcohol use patterns established in youth. The Centers for Disease Control and Prevention reports that Wisconsin youth are less likely to see binge drinking as a risky behavior compared to youth nationwide and that binge-drinking among Wisconsin youth outpaces the rest of the nation.<sup>18</sup> However, it also may be later in life when alcohol use patterns are established. Our findings show that college-educated individuals had the highest likelihood of alcohol-related mortality. It is important to note that the relationship between education and alcohol use is potentially complex. For example, data from the Behavioral Risk Factor Surveillance System show that whereas education is positively correlated with binge-drinking (up to college), intensity and frequency of binge drinking is inversely correlated with education.<sup>19</sup> As such, our data are unlikely to reveal the full story. Still, given our findings and the well-known culture of drinking on college campuses,<sup>20</sup> future research should consider a deeper exploration of the relationships between age, education, and alcohol use.

**Figure 2.** Alcohol-Related Mortality by Age Category in Wisconsin by Age, 2000-2019



Dramatic increases in the higher age categories in our analyses are also a cause for concern. Gender differences, with males more likely to die of alcohol-related causes than females, and differences by race and ethnicity should be kept in mind for targeting interventions and public health messaging. Organizations around Wisconsin have identified excessive drinking as a public health concern. DHS continues to choose alcohol as a priority in the Healthy Wisconsin plans.<sup>21</sup> The Wisconsin Cancer Coalition has pointed out the association of alcohol with cancer deaths and, as such, has made it a priority to “create environments that discourage excessive alcohol use” and to promote policies and practices to do the same.<sup>22</sup> The Wisconsin Association of Local Health Departments and Boards also has identified alcohol as a key improvement area, making alcohol-related grants and resources available to its members.<sup>23</sup>

Wisconsin has less restrictive alcohol use policies than many other states. The state ranks 45th in the United States when compared to other states on policies including impaired driving, youth drinking, and restricting alcohol sales.<sup>24</sup> If state policies remain static, the number of alcohol-related deaths may continue to increase. To avoid this outcome, Wisconsin should consider creating policies to discourage excessive alcohol use. Policy changes can reduce unsafe access to alcohol and improve cultural norms to prevent excessive and harmful drinking.<sup>25</sup> For instance, a significant body of evidence exists that shows reductions in consumption when taxes on alcohol are increased.<sup>26</sup>

A recent report from the State Council on Alcohol and Other Drug Abuse reviewed state and national efforts and recommends several evidence-based policies that can reduce excessive alcohol use.<sup>27</sup> These include: (1) raising the price of alcohol (which can reduce youth consumption and curb binge drinking); (2) reducing density of alcohol outlets (which can reduce access to alcohol); (3) creating alcohol compliance checks to ensure outlets are not selling to minors; (4) instituting Place of Last Drink (POLD) policies to

help stakeholders understand where excessive alcohol drinking is happening within their communities; and (5) screenings and brief interventions by medical providers (which can help reduce binge drinking and identify those drinkers who should be referred for treatment). All of these policies are potential avenues to curb excessive alcohol consumption in Wisconsin which, in turn, could lessen the future burden of alcohol-related morbidity and mortality in the state.

### Limitations

Determining the degree to which alcohol plays a part in a death is difficult, particularly because alcohol use—both long

term and acute—is not always apparent at the time of death. The Centers for Disease Control and Prevention uses Alcohol-Related Disease Impact (ARDI) fractions to estimate alcohol deaths based on epidemiological studies of the underlying cause of death.<sup>13</sup> As the goal of our study was not to estimate the true rate of alcohol-related mortality in the state, but rather to assess trends and differences of deaths directly related to alcohol by demographic groups, we chose not to use the ARDI fractions (which try to estimate the contribution of alcohol to deaths of multiple causes) but, rather, to use only deaths that are fully attributable to alcohol in our analyses. This likely means that our estimates of the rates of alcohol-related deaths in the state are conservative and that this cause of mortality is more widespread than we show here. Readers interested in comparison estimates of alcohol-related deaths for Wisconsin using ARDI fractions can find recent years on the Alcohol: Attributable Deaths by County Dashboard from DHS.<sup>28</sup>

Wisconsin deaths are collected and recorded by individual coroners and medical examiners at the county level. In Wisconsin, 31 counties have elected coroners and 40 have appointed medical examiners. Training and education requirements are different for coroners and medical examiners and may result in differences in classification of the underlying cause of death. Still, if there was a trend toward improved reporting on alcohol-related mortality, it could be that some of the increases are related to that improved reporting. However, we are unaware of any evidence that suggests such a trend has occurred in Wisconsin. Moreover, the mixed system of elected coroners and appointed medical examiners – paired with the differences in training and education – does not suggest a high likelihood of systematic bias stemming from reporting within this group. Finally, early evidence suggests that during the COVID-19 pandemic consumption of alcohol increased in both frequency and quantity for Wisconsin residents who drink.<sup>16,29</sup> Future research will be needed to see if – and how – this unprec-

edented scenario effects alcohol-related mortality in the state. This study represents a vital step in our continued understanding of alcohol-related mortality in Wisconsin.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

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# Adherence to Clinical Practice Guidelines for Treatment of Bell's Palsy

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## ABSTRACT

**Introduction:** Bell's palsy is the most common cause of acute facial nerve paresis and paralysis with devastating disability yet high rate of spontaneous recovery. Patients who do not fully recover have functional disability that may require reconstructive surgery. The Clinical Practice Guideline: Bell's Palsy recommends treatment with high-dose steroids as it shows a higher likelihood of complete recovery. However, guideline adherence rates are inconsistent and unstudied.

**Objective:** To identify the frequency at which hospital-based clinicians at the University of Wisconsin-Madison follow recommended clinical guidelines and prescribe high-dose steroid medication.

**Methods:** Charts were reviewed from a single hospital (University Hospital) to evaluate Bell's palsy guideline adherence. All hospital-based encounters from 2008 through 2018 with primary diagnosis of Bell's palsy (ICD-9 351.0 and ICD-10 G51.0) were identified. Encounters were excluded if they had a diagnosis of Bell's palsy within 1 year prior (n=250) and did not have a medication list available (n=353). We examined patient demographics, common comorbidities, and any radiology and lab orders.

**Results:** We identified 565 patients with a primary diagnosis of Bell's palsy with available medication lists; 77.70% received the recommended treatment. The patients' median age was 47 (interquartile range 34-59), 52.16% were male, and 82.46% were treated by emergency medicine clinicians. Other treating clinicians were hospital-based primary care, otolaryngology and plastic surgery, and others. Multivariate analysis showed that treating clinician specialty was the only significant positive predictor.

**Conclusions:** A significant portion of clinicians followed treatment guidelines for Bell's palsy. Further and larger research is needed to better identify points of intervention to improve guideline adherence.

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## INTRODUCTION

Bell's palsy is the most common cause of acute facial nerve paresis (weakness), and paralysis, which can lead to devastating disability and disfigurement. The incidence of Bell's palsy is 15 to 30 new cases per 100,000 people annually,<sup>1,2</sup> including approximately 875 to 1,750 cases in Wisconsin. Based on population estimates, Wisconsin clinicians will diagnose between 1,150 and 1,700 patients with Bell's palsy annually. Bell's palsy causes dysfunction of the facial nerve, which carries neurons to various muscles and salivary glands of the face, and it most often presents unilaterally. While 80% to 90% of patients will recover fully, this leaves a significant group with residual deficits for which patients may seek care, such as difficulty with eye closure, asymmetric smile, nasal breathing dysfunction, eyebrow droop, or trouble eating. Consequential facial disfigurement may impair interpersonal relationships, contribute to anxiety and depression, and require chronic therapy or complex reconstructive surgery.<sup>1,3,4</sup>

To increase the likelihood of improved facial function outcomes and decrease

the need for therapy or surgical intervention, clinicians should prescribe steroids at the time of diagnosis.<sup>5,6</sup> The etiology of Bell's palsy is unknown, making it a diagnosis of exclusion. However, it is commonly thought to be due to inflammation of the facial nerve, potentially explaining the role of steroids to reduce inflammation and limit nerve damage. Madhok et al showed that patients with Bell's palsy who received steroids expe-



rienced less facial spasm, less motor synkinesis (unwanted facial movements), and less crocodile tears (watering eyes when eating or chewing) when compared to patients who received placebo alone.<sup>2</sup> A prospective randomized control trial by Sullivan et al found recovery at 3 months significantly higher following recommended steroid treatment versus placebo (83.0% vs 63.6%), with the number needed to treat to achieve 1 additional recovery of 6 (95% CI, 4-9).<sup>5</sup> Similarly, Engström et al found shorter times to recovery, as well as a significant increase in complete facial nerve recovery in patients treated with high-dose burst and taper prednisolone versus placebo.<sup>6</sup> The randomized control trials done by Sullivan et al and Engstrom et al are the 2 studies referenced in the American Academy of Otolaryngology-Head and Neck Surgery 2013 published Clinical Practice Guideline: Bell's Palsy (Guideline), which strongly recommends high-dose steroids within 72 hours of symptom onset to increase the likelihood of complete facial nerve recovery, with benefit of treatment after 72 hours less clear.<sup>5,6</sup> The Guideline recommends a 10-day course of oral steroids with at least 5 days at a high dose (either prednisolone 50 mg for 10 days or prednisone 60 mg for 5 days with a 5-day taper). Modifications are made for patients with diabetes, morbid obesity, previous steroid intolerance, and psychiatric disorders; pregnant patients should be treated on an individualized basis.<sup>3</sup> The Guideline lists an optional recommendation for prescribing antivirals as a supplement to steroids because of the possible role of herpes simplex virus type 1 in the etiology of Bell's palsy. However, in prospective control trials, the addition of the antiviral acyclovir to steroid treatment group showed no significant improvement in recovery rates above steroid treatment alone.<sup>1</sup>

Despite available evidence and the published Guideline, clinicians may fail to prescribe high-dose steroids for patients with newly diagnosed Bell's palsy. Clinical guidelines, in general, are often overlooked and may have poor adherence by clinicians across all medical conditions and specialties. Reasons may include lack of familiarity or agreement, self-efficacy to inquire or manage, and outcome expectancy. The presence of patient barriers like comorbidities and contraindications to guideline recommendations also may restrict clinician adherence.<sup>7,8</sup> These factors may result in clinicians prescribing too low of a steroid dose or no steroids at all. As a result, patients with Bell's palsy will have lower likelihood of complete recovery.

Proper treatment of Bell's palsy depends on accurate diagnosis. Because it presents similarly to Lyme disease, stroke, and other conditions, the diagnostic workup may include lab tests and imaging to exclude other causes. A study from New York suggests that in highly endemic areas, Lyme disease can account for 25% cases of Bell's palsy.<sup>9</sup> To cover for the possibility of Lyme disease, some clinicians may order a Lyme disease serology and prescribe antibiotics in addition to steroids. However, the Guideline recommends against labs, including Lyme testing,

imaging, and antibiotics. It states that patients at risk of Lyme disease are better identified by history than Lyme disease serology test results, but there are circumstances where specific testing may be indicated.<sup>3</sup> Atypical presentations—such as a recurrent or bilateral facial paresis, slow or gradual onset—and concurrent neurological findings should be further evaluated with an urgent stroke evaluation and referral to neurology, neurosurgery, head and neck surgery, or otology.

At University Hospital in Madison, Wisconsin (part of UW Health), clinician adherence to the Bell's palsy Guideline is unknown. This study sought to quantify how often hospital-based clinicians prescribe steroids at the recommended dosage as a primary endpoint and to examine adherence to Guideline recommendations for proper diagnostic workup. We performed a chart review and discharge medication list review of hospital patients diagnosed with Bell's palsy from 2008 through 2018. The available data set did not include patients seen in UW Health community primary care clinics and included only hospital-based primary care clinicians. To identify associations with Guideline nonadherence, this study evaluated identifying patient factors including demographics and comorbidities and the treating clinicians' specialty. Imaging studies, lab orders, or additionally prescribed medications (antivirals, antibiotics) also were reviewed. By studying the rate at which clinicians follow the Bell's palsy Guideline and potential influencing factors, this study serves as a foundation for potential interventions that increase Guideline adherence, improve outcomes, and avoid the need for additional treatment, such as reconstructive surgery.

## METHODS

Patient charts were reviewed retrospectively for those who received the primary diagnosis of Bell's palsy (ICD-9 351.0 and ICD-10 G51.0) at University Hospital during 2008-2018. Patients were excluded from the study cohort if they had a prior Bell's palsy diagnosis within the past year or did not have a discharge medication list available for review. Age, sex, comorbidities, and treating clinicians' specialty were reviewed. Per Guideline recommendations, patients were included if they were age 16 or older. Existing medication lists were pulled using Rx Drug Class Grouper (Thera Class) for 1001-Anti-Infective Agents, 1004-Endocrine and Metabolic Drugs, 1015-Miscellaneous Products. Qualifying patients were evaluated to find the frequency at which clinicians prescribed high-dose steroids. Due to the inability to reliably determine if each patient presented within the 72-hour window of symptom onset, all available medication lists were included in this study. Prescribed steroids must have met a dosage equal to or greater than 50 mg of prednisolone daily to meet Guideline recommendations.

Next, we evaluated antiviral and antibiotic prescriptions and imaging and lab orders—specifically Lyme disease testing. We also reviewed and ranked the most common patient comorbidities.

**Table 1.** Demographics and Treating Clinician Specialty for Patients With Primary Bell's Palsy Diagnosis and No Previous Bell's Palsy Diagnosis Within 1 Year Prior, N=918

Variable	No Medication List Available n (%)	Medication List Available n (%)	P value
Number of patients	353 (38.45)	565 (61.55)	
Age	Median 47, IQR 29–61	Median 49, IQR 33–60	0.194
Sex <sup>a</sup>			0.025
Male	146 (41.36)	277 (46.03)	
Female	207 (58.64)	288 (50.97)	
Specialty of treating clinician <sup>a</sup>			<0.001
Emergency medicine	34 (9.63)	419 (74.15)	
Primary care (hospital-based)	53 (15.01)	58 (10.27)	
Otolaryngology and plastic surgery	122 (34.56)	23 (4.07)	
Neurology	69 (19.55)	48 (8.50)	
Neurosurgery	7 (1.98)	3 (0.53)	
Eye	61 (17.28)	11 (1.95)	
Medicine specialties	7 (1.98)	3 (0.53)	

Abbreviations: IQR, interquartile range.

<sup>a</sup>Significant difference at  $\alpha=0.05$  level. The testing done to measure association between specialty of treating clinician and presence of medication list was done excluding the specialties neurosurgery, medicine specialties, and advanced practice provider. Stata/SE software could not find statistical power for these categories because their N values were too small in value for Fisher exact test.

**Table 2.** Most Frequent Comorbidity Diagnoses Found in Patients With Primary Bell's Palsy Diagnosis and Existing Medication List, N=565

Common Secondary Comorbidity Diagnoses	ICD-10 Codes	N (%)
Long-term use of steroids and other medications	Z79	80 (14.01)
Tobacco use	Z72.0	57 (9.98)
Hypertension	I10	53 (9.28)
Diabetes mellitus	E08-E13	37 (6.48)
Hyperlipidemia	E78	31 (5.43)
Headache	R51	29 (5.08)
Disturbance of skin sensation	R20	16 (2.63)

Common secondary comorbidities given an ICD-9 code was cross walked to ICD-10 and similar comorbidities were group together. Synonyms of facial paresis and paralysis were excluded.

ties to evaluate potential influences they may have had on steroid prescription; comorbidities that were shared between more than 2 patients were considered. The most common comorbidities included long-term use of steroids and other medications, tobacco use, hypertension, diabetes mellitus, hyperlipidemia, headache, and disturbance of skin sensation.

We compared patients who had an existing medication list and those who did not by age, sex, common comorbidities, treating clinician specialty, imaging, and lab orders to determine if these 2 groups were significantly different. Age was examined using Mann-Whitney U test for median, and the remaining variables were examined using Fisher exact test. Comparison testing was performed to compare patients who received high-dose steroids and those who did not; analysis of additional antiviral or antibiotic prescriptions was included in this comparison. In doing statistical analyses, specialties were separated for univariate analysis and then reorganized into emergency medicine and

nonemergency medicine groups for multivariate analysis. This was performed to identify any trends or associations between subspecialties. However, as there were significantly more emergency medicine clinicians than the other subspecialties combined, it was decided to compare clinicians this way to identify larger associations. The nonemergency medicine group included clinicians from primary care, otolaryngology, plastic surgery, neurology, neurosurgery, eye specialties, and medicine specialties (hematology, infectious disease, medical oncology). All statistical tests were done with the Stata/SE software, version 16.0 and assessed at the  $\alpha=0.05$  level.

## RESULTS

We found 1168 distinct patient encounters with the primary diagnosis of Bell's palsy from 2008-2018. After removing 250 patients who had an encounter with a primary diagnosis of Bell's palsy within the previous year, 918 patients remained: 495 females and 423 males. However, no medication list was available for review for 353 patients. There was a significant difference between the patients with a medication list ( $n=565$ ) and those without ( $n=353$ ) regarding sex and clinician specialty; those with a medication list were more often female and more often treated by emergency medicine clinicians.

The 565-patient cohort had a median age of 49 (interquartile range [IQR] 33-60), 50.97% patients were female, and 74.15% of patients were treated by emergency medicine clinicians. In descending order of frequency, the remaining patients were treated by primary care, otolaryngology and plastic surgery, neurology, neurosurgery, eye specialties, and other medicine specialties (Table 1). As noted, the available data set did not include patients seen in community primary care clinics and included only hospital-based primary care clinicians. The most common comorbidities were organized by frequency, and if more than 1 patient shared the same comorbidity, it was included. These comorbidities are long-term use of steroids and other medications, tobacco use, hypertension, diabetes mellitus, hyperlipidemia, headache, and disturbance of skin sensation (Table 2). From the group with an existing medication list, 180 patients had 1 of the identified common comorbidities. From the same group, 380 patients additionally received antivirals, 216 received imaging, and 306 received lab orders.

Most of the 565-patient cohort (77.70%) received high-dose steroids; however, 22.30% received low-dose steroids or none. Patients who received high-dose steroids had an older median age than those who did not (49 years; IQR, 34.00-59.00 vs 46 years;

IQR, 23.75-62.75, respectively), were more often male (52.16% vs 38.10%), were more often treated by emergency medicine clinicians (82.46% vs 45.24%), and more often received antivirals (73.35% vs 46.03%), imaging (41.16% vs 26.98%), and lab orders (58.77% vs 38.10%) (Table 3). These differences were found to be significant. However, there was no significant difference when the presence of comorbidities was compared.

Univariate analyses were used to find associations with prescription for high-dose steroid medication. Males were 1.77 times more likely than females to receive high-dose steroids ( $P=0.006$ ). Patients treated by emergency medicine clinicians were 5.56 times more likely to receive high-dose steroids than other treating specialties ( $P<0.001$ ). Patients who received antivirals were 3.23 times more likely to receive steroids ( $P<0.001$ ) than those who did not. Patients who received imaging were 1.92 times more likely to receive steroids ( $P=0.004$ ). Those who had lab orders were 2.32 times more likely to receive steroids ( $P<0.001$ ). Those who received antibiotics were less likely to receive steroids (OR, 0.21; 95% CI, 0.13-0.35) (Table 4).

Variables that were found to have significant odds ratios following univariate analysis were then used for multivariable logistic regression analysis. Thus, sex, treating specialty, antibiotic and antiviral prescriptions, and lab order groups were evaluated. Treatment by an emergency medicine physician, not receiving an antibiotic prescription, and receiving lab orders were significant positive predictors of Guideline adherence. When controlling for other variables, patients treated in the emergency department were 4.00 times more likely to receive steroids (95% CI, 3.90-4.16); patients with lab orders were 2.32 times more likely to receive steroids (95% CI, 1.13-4.15); and patients who received antibiotics were 0.25 less likely to receive steroids (OR, 0.25; 95% CI, 0.14-0.44) (Table 5). Sex and antiviral prescription were not significant predictors for prescription of high-dose steroids.

## DISCUSSION

The primary purpose of the latest Bell's palsy clinical practice guideline is to improve the care and outcomes for patients and to reduce the harmful consequences that come with delayed treatment. However, adherence to Guideline recommendations should be measured. While the majority of University Hospital clinicians followed the Guideline treatment recommendation for Bell's palsy,

**Table 3.** Demographic and Clinical Data for Patient Cohort With a Primary Diagnosis of Bell's Palsy (N=565), Divided Into Two Groups: Those Who Received High-Dose Steroids per Guideline Recommendation (N=439), and Those Who Did Not Receive Sufficient/Any Steroids (N=126)

Variable n (%)	Received High-Dose Steroids n (%)	Did Not Receive High-Dose Steroids n (%)	P value
Number of Patients	439 (77.70)	126 (22.30)	
Age	Median 49, IQR 34–59	Median 46, IQR 23.75–62.75	0.367
Sex <sup>a</sup>			0.004
Male	229 (52.16)	48 (38.10)	
Female	210 (47.84)	78 (61.90)	
Specialty of treating clinician <sup>a</sup>			<0.001
Emergency medicine	362/419 (86.40)	57/419 (13.60)	
Primary care	33/58 (56.90)	25/58 (43.10)	
Otolaryngology, plastic surgery	5/23 (21.74)	18/23 (78.26)	
Neurology	34/48 (70.83)	14/48 (29.17)	
Neurosurgery	1/3 (33.33)	2/3 (66.67)	
Eye	3/11 (27.27)	8/11 (72.73)	
Medicine specialties	1/3 (33.33)	2/3 (66.67)	
Received antivirals <sup>a</sup>	322 (73.35)	58 (46.03)	<0.001
Received antibiotics <sup>a</sup>	42 (9.59)	42 (33.33)	<0.001
Received imaging <sup>a</sup>	182 (41.46)	34 (26.98)	<0.001
Received lab orders <sup>a</sup>	258 (58.77)	48 (38.10)	<0.001
Received lyme testing <sup>a</sup>	103 (23.46)	18 (14.29)	0.029
Presence of common comorbidities	139 (31.7)	41 (32.54)	1.00

Abbreviations: IQR, interquartile range.

<sup>a</sup>Significant difference at  $\alpha = 0.05$  level.

The "specialty of treating clinician" row reflects what portion of patients treated by the specific specialty received high-dose steroids and what portion did not.

there should be an ongoing process of improving adherence to fully realize the Guideline's potential.

In this study, clinician specialty, additional antibiotic prescription, and imaging orders were significant predictors of whether a patient received steroids. These findings warrant further investigation and future intervention to avoid long-term consequences and more complex interventions.

Extensive research has been done to identify barriers to guideline adherence. A systematic review done by Cabana et al grouped barriers based on whether they were attributable to physician knowledge, physician attitude, or restriction of a physician's ability.<sup>8</sup> Physician knowledge includes lack of familiarity to guidelines due to volume of information, the time needed to stay informed, and guideline accessibility. For physician attitude, barriers include lack of outcome expectancy and lack of motivation to change practice habits. Clinicians' ability to follow guideline recommendations may be limited by patient factors; patients may be resistant to guideline recommendations or have comorbidities that contraindicate them to the recommended treatment. In our study, comorbidities obtained from the medical record diagnosis co-coding did not have a significant influence on proper steroid prescription, but other patient-centered barriers may have influenced inconsistencies in Bell's palsy treatment, such as patient demographics and specialty of treating clinician.

Bell's palsy presents acutely; therefore, emergency medicine cli-

nicians are more likely to see these patients than medicine subspecialists. Emergency medicine clinicians' higher rates of Guideline adherence can be explained by their higher rates of exposure to Bell's palsy, helping them become more comfortable with its diagnosis and treatment. Exposing medicine subspecialists to Bell's palsy is a potential intervention that could improve Guideline adherence. Patients evaluated in community primary care clinics or urgent care were not included in this study, such that rate of Guideline adherence by community-based primary care clinicians were not studied.

Patients who received antibiotics were less likely to receive steroids. This suggests that treating clinicians were confident that the cause of the patient's facial disfigurement was bacterial in origin. Historically, there has been support for a nonviral cause of Bell's which led many clinicians to prescribe antibiotics.<sup>10</sup> Clinician lack of outcome expectancy and poor motivation to change historical practices is a well-studied barrier to guideline adherence, which may explain why providers are prescribing antibiotics over steroids.

Clinicians who diagnosed Bell's palsy after ordering labs were more likely to prescribe steroids. The Guideline recommends against lab orders due to the lack of specific findings. However, Bell's palsy may mimic other diagnoses such as stroke, multiple sclerosis, Guillain-Barre syndrome, meningitis, Lyme disease, sarcoidosis, or different neoplasms.<sup>11</sup> Therefore, many clinicians may order labs to exclude other diagnoses with more confidence. The reassurance provided by normal lab results may explain how lack of self-efficacy serves as a barrier to Guideline adherence. Additionally, this may explain why patients who were prescribed steroids also received imaging; the additional but unnecessary imaging orders provide clinicians with the confidence that they are not missing a different, more life-threatening diagnosis.

Despite barriers to Bell's palsy guideline adherence, University Hospital clinicians had high rates of Guideline adherence. Efforts can be made to further identify areas of intervention to improve the overall care and experience for patients with Bell's palsy. A manuscript discussing primary care clinicians' adherence to the otitis media with effusion clinical practice guideline adopted by the American Academy of Otolaryngology—Head and Neck Surgery Foundation had a statistically significant increase in guideline adherence after presenting mock cases and diagnosis and management were taught with simulation.<sup>11</sup> Clinicians who may care for patients with Bell's palsy may benefit from workshops with case-based learning, where they can practice applying the Bell's palsy Guideline to different scenarios involving patients presenting with facial paresis. By implementing case-based learnings, several of the barriers to guideline adherence can be addressed simultaneously.

Raising Guideline awareness among Wisconsin clinicians and planning for interventions to improve adherence can increase the rates of complete recovery for Bell's palsy patients and reduce the

**Table 4.** Univariate Analysis with Odds Ratios Showing How Patient Demographics and Clinical Workup May Have Influenced Receiving Appropriate Treatment

Variable	Odds Ratio	95% CI	P value
Male (Baseline: female)	1.77	1.18 – 2.66	0.006
Emergency medicine (Baseline: nonemergency medicine)	5.56	5.49 – 5.65	<0.001
Received antivirals (Baseline: did not)	3.23	2.14 – 4.86	<0.001
Received antibiotics (Baseline: did not)	0.21	0.13 – 0.35	<0.001
Received imaging (Baseline: did not)	1.92	1.24 – 2.97	0.004
Received lab orders (Baseline: did not)	2.32	1.54 – 3.48	<0.001
Received lyme testing (Baseline: did not)	1.84	1.07 – 3.17	0.029
Presence of common comorbidities (Baseline: no comorbidities present)	0.96	0.63 – 1.47	0.852

Univariate analysis odds ratios were calculated using patient demographic and clinical data to determine the associations they have with receiving high-dose steroids. When examining specialty of treating physician, we specifically looked only at emergency medicine because they made up the dominant specialty of treating clinician that did prescribe high-dose steroids.

**Table 5.** Multivariable Logistic Regression Predicting Receiving High-Dose Steroids Among Patients Who Had an Available Medication List

Variable	Odds Ratio	95% CI	P value
Male (Baseline: female)	1.57	0.99 – 2.5	0.056
Emergency medicine (Baseline: nonemergency medicine)	4.00	3.90 – 4.16	<0.001
Received antivirals (Baseline: did not)	1.50	0.92 – 2.44	0.100
Received antibiotics (Baseline: did not)	0.25	0.14 – 0.44	<0.001
Received imaging (Baseline: did not)	1.30	0.72 – 2.37	0.385
Received lab orders (Baseline: did not)	2.16	1.13 – 4.15	0.02
Received lyme testing (Baseline: did not)	1.22	0.59 – 2.49	0.591

need for more complex interventions, such as therapy and reconstructive surgery.

A significant limitation of this study is that 353 (38.4%) of the 918 distinct patient encounters did not have an available medication list for review. This decrease in the cohort size may be due to errors in data entry or data pull. While this study pulled primary diagnosis, it could have been inadvertently coded, even after an alternate clinical diagnosis was made. Age, sex, and treating clinician specialty were compared and found to have no significant difference between the group that had an available medication list and the group that did not. This suggests that while our final cohort was smaller than expected, it was still representative of



the group as a whole. Another study limitation is that data were extracted from a large academic institution and, therefore, it may be not representative of the state of Wisconsin. Clinicians at larger centers may or may not be more familiar with current practice guidelines than clinicians in smaller hospitals. These findings may not be generalized to all large institutions nationally.

A future direction of this study would seek to study patients seen in UW Health community primary care clinics and other Wisconsin populations. Additionally, the influence of Lyme disease in endemic areas like Wisconsin could be further explored by examining the trend of Lyme testing in patients with facial paralysis.

## CONCLUSIONS

Wisconsin clinicians and their patients may benefit from further education regarding Bell's palsy management. High-dose steroids have been shown to accelerate recovery time and increase complete recovery rates. By increasing clinician awareness and comfort with the Bell's palsy clinical practice guideline, patients will receive better care with reduced long-term consequences. Interventions can be done at the institutional and national levels to increase Guideline visibility by taking advantage of hospital communication methods, providing hands-on learning opportunities, and hosting lectures and workshops. If these educational interventions are successful, we may see decreased rates for further complex management, surgical intervention, and, ultimately, higher rates of complete recovery.

**Acknowledgements:** The authors wish to acknowledge Nicholas A. Marka, MS, Department of Biostatistics, University of Wisconsin School of Medicine and Public Health.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

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# Does a Change in Physician Compensation Lead to Changes in Care Delivery in Family Medicine Clinics?

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## ABSTRACT

**Introduction:** Many highly capitated systems still pay physicians based on relative value units (RVU), which may lead to excessive office visits. We reviewed electronic health records from the family medicine clinic panel members of 97 physicians and 42 residents to determine if a change from RVUs to panel-based compensation influenced care delivery as defined by the number of office visits and telephone contacts per panel member per month.

**Methods:** A retrospective analysis of the electronic health records of patients seen in 4 residency training clinics, 10 community clinics, and 4 regional clinics was conducted. We assessed face-to-face care delivery and telephone call volume for the clinics individually and for the clinics pooled by clinic type from 1 year before to at least 1 year after the change.

**Results:** Change in physician compensation was not found to have an effect on office visits or telephone calls per panel member per month when pooled by clinic categories. Some significant effects were seen in individual clinics without any clear patterns by clinic size or type.

**Conclusions:** Change in physician compensation was not a key driver of care delivery in family medicine clinics. Understanding changes in care delivery may require looking at a broad array of system, physician, and patient factors.

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## INTRODUCTION

Physician compensation is an important aspect of primary care clinic operations that has the potential to influence care delivery. Physicians who are paid more to deliver more services typically do so.<sup>1</sup> This method of compensation rewards physicians who see a higher volume of patients and deliver a higher complexity of services. In some situations, this incentivizes desirable behavior to deliver comprehensive care to patients in need. This method, however, has the potential to incentivize overutilization and inefficient care.<sup>2-4</sup> In contrast, value-based or capitated health systems receive per-member-per-month payments that are not dependent on the patient coming into the office to receive care. A 2022 study of physician compensation arrangements in the United States

found that despite a move towards value-based reimbursement from payers, physician compensation remains largely based on volume-related incentives.<sup>5</sup>

While many advocate for a shift in physician compensation approaches,<sup>6,7</sup> little is known about how a change to physician compensation affects care delivery in outpatient primary care clinics. A 1990 Danish study<sup>8</sup> showed that general practitioners who moved from a capitated system to a part capitation, part fee-for-service compensation system provided a larger number of contacts with patients (both telephone and face-to-face) with fewer referrals to specialists and hospitals.<sup>9</sup> A 2021 study found no difference in the delivery of preventive services for productivity-based versus mixed compensation plans.<sup>10</sup> Our previous work showed that a shift from compensation based on relative value

units (RVUs) towards compensation based on panel size resulted in an increase in panel size for family physicians, with variable changes in physician RVU productivity.<sup>11</sup> Our other previous work has shown increased physician satisfaction and retention with a similar change in compensation structure.<sup>12</sup> We did not find any literature exploring the impact of physician compensation changes on patient-level outcomes (number of visits and telephone calls per patient) rather than physician-level outcomes (RVUs per physician).

The purpose of this paper is to assess the impact of a change in family physician compensation on care delivery in the outpatient setting as measured by office visits and telephone call encounters per panel member per month, trended over time. We hypothesized that with this change in compensation, physicians would adopt a practice style in which patients are seen in the office less often and more care is provided via telephone.

## METHODS

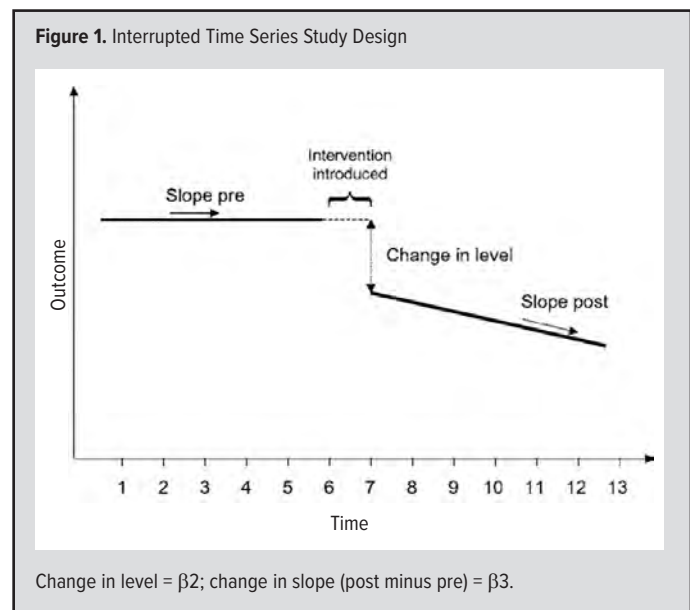
### Setting

The University of Wisconsin (UW) Department of Family Medicine and Community Health (DFMCH) is one of the largest family medicine departments in the US, with sites in urban and rural communities throughout Wisconsin. The data analyzed in this study include 4 residency training sites (42 residents and 32 faculty physicians), 10 community practices (52 physicians) in Dane County, Wisconsin, and 4 regional sites (13 physicians) in nearby counties. Sources of revenue in these clinics in 2014 were 60% fee-for-service and 40% capitation. The DFMCH is part of UW Health, a public academic health system consisting of a school of medicine and public health, a nonprofit hospital, and a large multispecialty physician practice group. At the time of this study, the health system was growing with no major changes to relationships to local payers. This project was considered exempt from human subject review under the quality improvement designation.

In 2013, based on the large capitated population relative to fee-for-service and an increasing focus on managing populations, as well as a realization that salaries had fallen behind the local market rates, the DFMCH abandoned its RVU-based physician compensation plan in favor of one based primarily on panel size.<sup>11</sup> Physicians working at residency clinics adopted a plan in which 80% of their compensation was panel based and 20% was RVU based. The community and regional clinic faculty opted to allocate 50% to each of the two components. With the adoption of this new compensation structure, all but 2 physicians saw an increase in their salary, with an average increase of 23%.

### Data and Variables

Data were extracted from the electronic health record (EHR) from 2012 through 2016 (Epic Systems Corporation, Verona, Wisconsin). We defined office visits as any face-to-face clinic

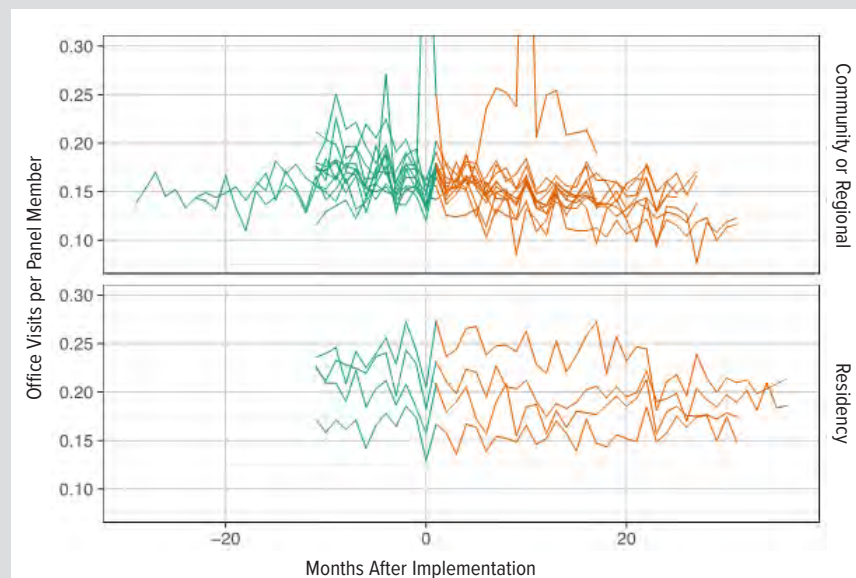


encounter with a physician (including residents), physician assistant, or nurse practitioner. We defined telephone encounters as any telephone calls documented in the EHR, whether initiated by the patient or the clinic and whether handled by a physician, nurse practitioner, physician assistant, nurse, or medical assistant. In some cases, if there was more than 1 call regarding the same topic documented in the same encounter in the EHR, these encounters were counted as 1 encounter. During the study period, our organization did not offer scheduled, billable telephone (telehealth) encounters with patients in primary care, thus, these visit types were not included in this study. At the start of our study, less than 20% of family medicine patients had an active patient portal account; thus, patient portal messages were excluded from our analysis based on the low volume of patient portal messages at that time. Clinic panel members were defined as patients who were assigned to a primary care physician at the clinic and had been seen anywhere within UW Health within the past 3 years.

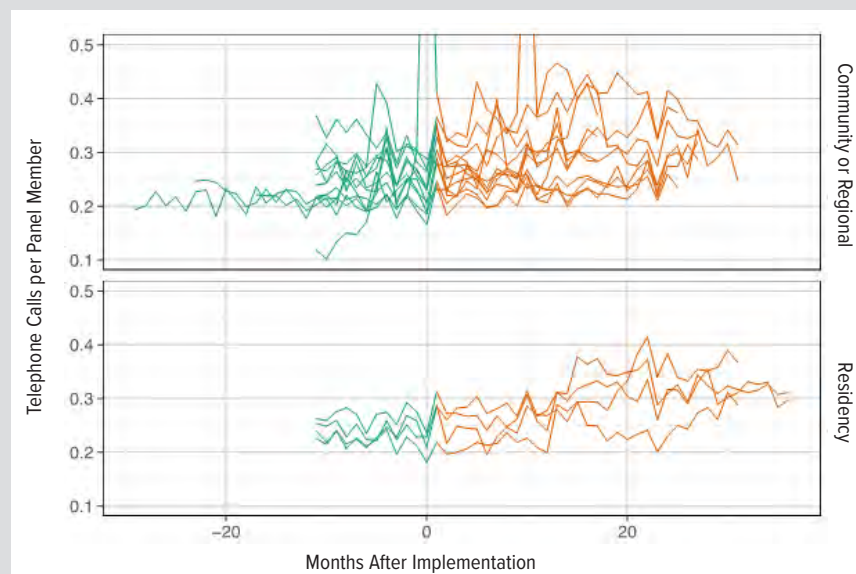
### Data Analysis

We performed a utilization analysis of office visits and telephone encounters trended over time for each of our family medicine clinics. DFMCH clinic visits and telephone encounters were stratified into 2 groups based on which compensation plan they adopted: residency clinics (80-20 panel-RVU) or community/regional clinics (50-50 panel-RVU). Utilization was recorded as office visits per panel member per month and telephone encounters per panel member per month. The study period began in January 2012 and ended in December 2016. We excluded a 6-month intervention phase-in after the rollout of physician compensation change. The physician compensation change occurred in January 2013 for residency and community clinics and at later dates (between July 2013 and July 2014) for each of the regional clinics. We included data until the date of the next major system change (UW Health's

**Figure 2.** Office Visits per Panel Member per Month



**Figure 3.** Telephone Calls per Panel Member per Month



practice redesign), which occurred at a different time for each clinic but was at least 1 year after the physician compensation change at each site.

Statistical analysis was conducted in a 2-stage process. In the first stage, the effects of the compensation plan deployment on each outcome were estimated for each clinic separately. For each clinic and each outcome, a time series linear model was used to predict the number of encounters per patient in that clinic's patient panel per month. Seasonal and linear time trends were accounted for in the models. The effects of compensation plan deployment considered changes in level and/or in slope after deployment. After an

initial model fit, observations with residuals greater than 3 standard deviations from the mean were assessed and found to represent error and, thus, were excluded and models were refit. Wald tests were used to assess significance of both change in level and in slope of compensation plan deployment. We note that both the overall level and the amplitude of month-to-month variability in response was quite heterogeneous across clinics. We determined that a single model comprising data from all clinics—even adjusting for clinic—would not be adequate to capture this between-clinic heterogeneity. Therefore, we took the approach of fitting separate models to each clinic as if each clinic was its own individual intervention study. This represents the first stage.

The second stage utilized these individual clinic estimates in a pooled estimate across clinics. By analogy to meta-analysis, we combined the fitted model results across clinics to obtain overall effects on level and on slope and jointly on the 2 parameters simultaneously. A visual representation of this statistical model is seen in Figure 1.

## RESULTS

Office visits per panel member per month in the pooled data were not significantly affected by the change in compensation for either the residency clinics or the community clinics/regional clinics (Figure 2). Neither the difference in the intercept ( $\beta_2$ ) nor the slopes ( $\beta_3$ ) were large or significant. Telephone calls per panel member per month were similarly unchanged in the pooled data with the implementation of

the new compensation plan (Figure 3). There was no difference noted between residency clinics and community/regional clinics.

Some individual clinics had significant changes, as can be seen in Figures 4 and 5. Out of 16 total clinics, 3 had a significant increase in the number of office visits at 6 months after the change compared to baseline. Ten clinics had no change, and no clinics had a significant decrease. Six clinics had a significant increase in office visits per member per month over time, from 6 months after the compensation change to the end of data collection. Two clinics had a decrease, and 8 clinics had no change. With respect to telephone calls per panel member per month, 4 clinics had a significant drop in the level after the compensation change, 2 had a sig-



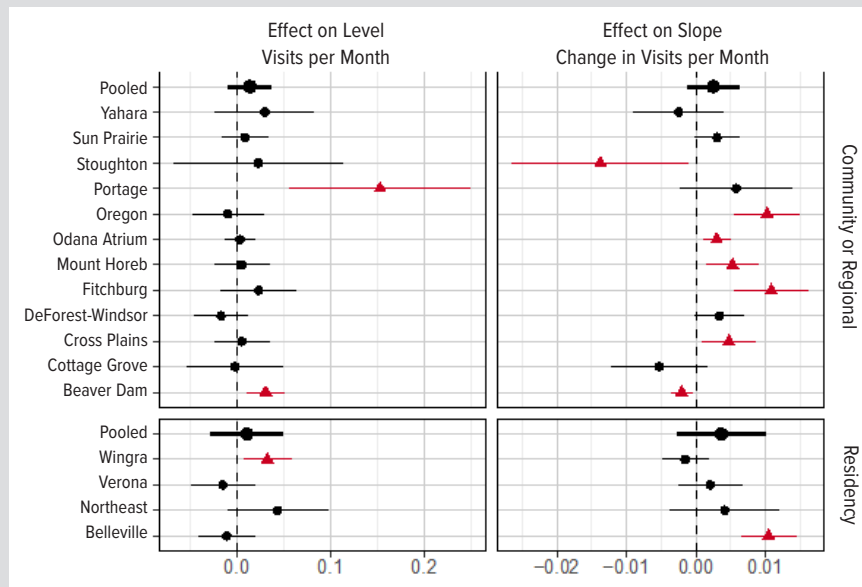
nificant increase, and 10 were unchanged. Three clinics had an increase in the slope for telephone calls per panel member per month, 2 had a decrease, and 11 had no significant difference.

## DISCUSSION

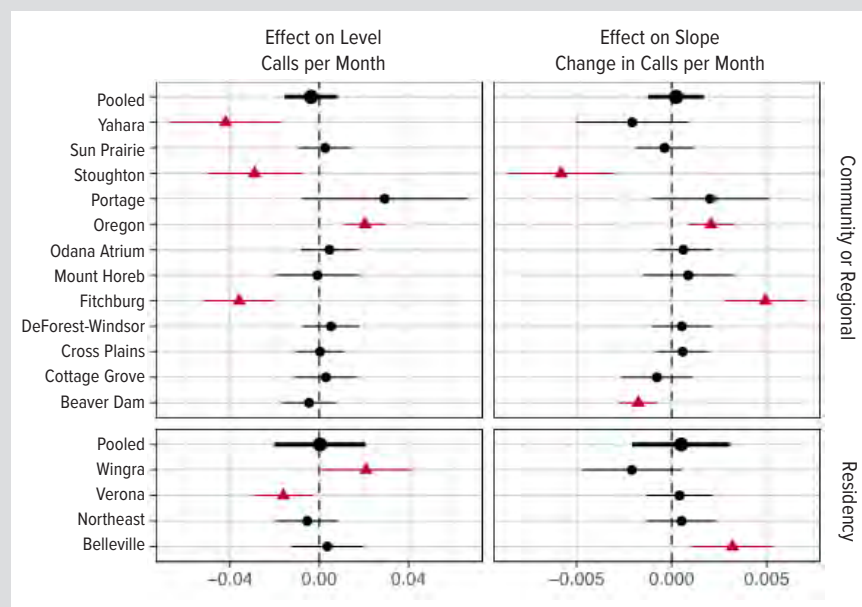
A change from a physician compensation plan based on RVUs to one based primarily on panel size at UW DFMCH clinics was not found to impact care delivery as assessed by changes in pooled office visits and telephone calls per panel member per month. We had hypothesized that physicians may either consciously or subconsciously choose to provide more care via telephone and less via office visits in response to a change in financial incentives de-emphasizing in-person care versus non-face-to-face care, but our results did not confirm this hypothesis. This was in some ways unsurprising, given that our previous study showed variable effects of a change in compensation model on RVU productivity for this physician group.<sup>11</sup> The literature overall has yielded conflicting results in this regard, with some studies showing a significant change in care delivery and others showing no significant change.

There are several possible reasons for our findings. First, our study may have been underpowered to detect an effect. Second, practice patterns may be deeply ingrained in physicians and not easily changed within the first year of implementation of a new compensation plan. Follow-up studies after more years of experience working within this system could yield a different result, though longer studies also are more susceptible to confounding from other changes that may occur in the health care system. In our case, we ended data collection before the next major rollout of practice redesign at our organization. Another consideration is that if a physician wanted to make a change to their practice to emphasize non-face-to-face care, there may not be adequate clinic staff and protocols to support such a change. In addition, in the community and regional clinics, there remains a significant portion of salary that is linked to RVU productivity such that the amount of productivity-based compensation was attenuated but not eliminated. Our results also may have been influenced by the significant heterogeneity of clinic types in our study, ranging from

**Figure 4.**  $\beta_2$  and  $\beta_3$  Results for Office Visits per Panel Member per Month



**Figure 5.**  $\beta_2$  and  $\beta_3$  Results for Telephone Calls per Panel Member per Month



a small community clinic with 2 physicians to a large Federally Qualified Health Center with 7 faculty physicians, 3 physician assistants, and 12 residents.

There are several limitations to our study. Many patient, clinic, and system factors may have influenced ways of seeking and receiving care from our system during our study period. There were several ongoing practice changes that occurred during the transition in our compensation model. For example, we have been implementing telephone triage protocols and medication refill protocols that likely influence how our patients seek advice from our prac-

tice, whether it be in person or in non-face-to-face circumstances. Additionally, there were substantial changes in insurance starting in 2010 with the Affordable Care Act legislation.<sup>13</sup> Preventive services were covered that had not been covered previously, medication prescription costs changed, and accountable care organizations came into existence. The Health Insurance Marketplace began in October 2013 and, by 2014, many patients who were previously uninsured acquired some form of insurance. These insurance changes likely influenced how many of our patients were in capitated and fee-for-service insurance agreements and, as a result, how our primary care panel members accessed us for their primary care needs. While these complexities may limit the ability to separate out the impact of our compensation change from other aspects of our care delivery system, we would also argue that primary care delivery is inherently complex and ever-changing.

This study is a pragmatic real-world analysis and may be of assistance to those who seek to make similar changes in their own organizations. In particular, this study of care delivery pre-pandemic was not affected by the dramatic changes to health care delivery that have occurred as a result of the pandemic. It may offer some insights to health systems currently contemplating compensation plan changes and in some ways provide reassurance that major shifts were not seen in the first year after change.

## CONCLUSIONS

Physician compensation was not found to be a key driver of in-clinic versus non-face-to-face care delivery in our family medicine clinics. As compensation plans evolve to align with how practices are paid, it is important to understand what impact, if any, these changes have on care delivery.

**Acknowledgements:** The authors wish to thank Peter Nordby and Mindy Smith for editorial support and comments on earlier drafts.

**Funding/Support:** This project was supported by the Health Innovation Program, the University of Wisconsin School of Medicine and Public Health, from The Wisconsin Partnership Program, and the Community-Academic Partnerships core of the University of Wisconsin Institute for Clinical and Translational Research (UW ICTR) through the National Center for Advancing Translational Sciences (NCATS), grant UL1TR000427.

**Financial Disclosures:** None declared.

**Presentations:** North American Primary Care Research Group Annual Meeting, November 2018.

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# Documenting Patient Interaction: Emergency Medical Services Report Reader Expectations and Improvements for Providers

Elizabeth L. Angeli, PhD; Julia Jezykowski, EMT-B; Patrick Sinclair, DO; Tom Grawey, DO; James T. Poltrock, MA, CPM, EMT-P; Ben Weston, MD, MPH

## ABSTRACT

**Introduction:** Patient care reports contain critical elements related to interventions rendered and medical decision-making. Yet, little consensus exists around reader expectations, leaving emergency medical services (EMS) providers unaware of critical content.

**Objectives:** This 2-phase study aimed to answer the questions “What do EMS providers know about report readers?” and “What do report readers expect from reports?” through surveys and interviews. In doing so, this study gauged EMS providers’ audience awareness of report readership and determined what readers expected from reports.

**Methods:** A prospective survey was conducted with 57 EMS providers to gauge their level of audience awareness or how often they thought of specific report reader groups when writing reports. Interviews were conducted with 14 report readers following retrospective think-aloud protocol, where participants verbalized their questions, comments, and concerns about reports while reading.

**Results:** Surveys indicate participants lacked a full, accurate sense of audience awareness. When writing reports, they thought of audiences, such as patients, who do not regularly read reports, while reporting not thinking of actual report readers—such as billing specialists—often or at all. Interview analysis indicated that report readers looked for 21 elements in high-quality, effective report narratives.

**Conclusions:** These data formalize and reinforce what a high-quality narrative should include, with “high-quality” meaning the narrative allows readers to do their jobs without follow-up or an amendment needed to the report.

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## INTRODUCTION

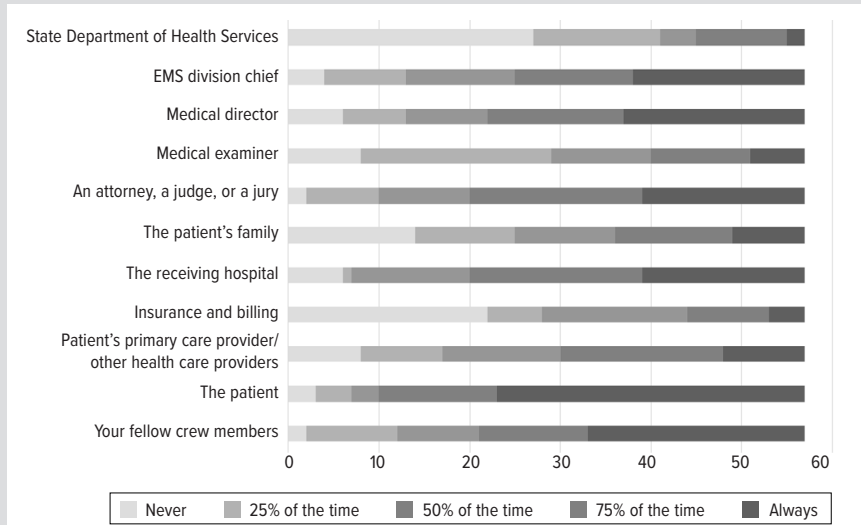
Patient care reports contain critical elements related to interventions rendered and medical decision-making. In the hospital setting, multiple reports from a variety of health experts help to paint this picture. However, in the prehospital setting, a single report often accounts for the entire clinical experience, and this single report is used to inform medical, financial, and legal decisions. Much can be garnered from these emergency medical services (EMS) reports, and much is demanded from them by their readers. Yet, little consensus exists around reader expectations, leaving EMS providers unaware of critical content report readers require.

EMS reports have 2 sections: dropdown sections that contain short text boxes where providers input quantitative information, such as a patient’s vital signs or medical condition, and the narrative section, a free-text entry box where providers type their decision-making and observations. The narrative section contextualizes quantitative information in the dropdown

menus because it requires EMS providers to capture details and intricacies the dropdown section cannot. Unlike the dropdown sections that have detailed prompts like “primary assessment,” the narrative section often lacks clear instruction for what EMS providers should document. Our study aimed to raise awareness of what report readers need and why.

There is a lack of research regarding EMS report writing, with the current data being outdated, emphasizing effectiveness

**Figure.** The Frequency That Providers Thought of Each Audience Segment When Writing Reports



Abbreviation: EMS, emergency medical services.

of documentation platforms instead of quality itself, or drawing from hospital settings.<sup>1-4</sup> Furthermore, much knowledge about report writing is based on anecdotes and expert opinion<sup>5,6</sup> rather than peer-reviewed research.<sup>7,8</sup> A recent review found that allied health reports are not written in ways that readers find accessible, and more research is needed to determine how reports can be improved.<sup>9</sup> In response to these gaps, this study aimed to answer the questions “What do EMS providers know about report readers?” and “What do report readers expect from reports?” through surveys and interviews.

## METHODS

This was a prospective survey and structured interview study with 2 phases. This research project was approved July 30, 2019, through the Marquette University Institutional Review Board, protocol number HR-1903029221. All participants signed an informed consent form. Because our study aimed to capture the EMS report lifecycle, we started with the report writers—EMS providers—in Phase 1 to gauge their knowledge about how reports are used. Then, in Phase 2, we focused on the people who read reports to learn about what they need from writers. These 2 phases, then, put report writer and reader perspectives in conversation with each other.

### Phase 1: EMS Provider Knowledge About Readership

To answer our first research question, “What do EMS providers know about report readers?”, a prospective survey for internal assessment was deployed through Qualtrics to emergency medical technicians (EMT) and paramedics at a Midwest suburban fire-based EMS department. Part of the survey asked department members about their understanding of who read reports and the frequency that readers use their reports (Appendix 1).

### Phase 2: Report Reader Interviews

To answer our second research question, “What do report readers expect from reports?”, think-aloud protocol interviews were used—a method used in human computer interaction,<sup>10</sup> clinical decision-making,<sup>11</sup> and literacy studies.<sup>12</sup> People who utilize completed EMS run reports in their daily work read a patient care report while verbalizing their answers to the following interview questions (Appendix 2): “Why and when would you use this report?”, “What information do you look for?”, “What information do you use?”, and “What questions does this report leave you with?” This method provided insight into decision-making and reading practices that cannot otherwise be made visible.

Twelve interviews were conducted with 14 participants; interviews lasted 45 to 90 minutes and were recorded. Participants held a range of roles in emergency medicine and EMS: 1 EMS coordinator, 1 billing specialist, 1 city attorney, 1 medical examiner, 5 EMS medical directors (2 critical care flight medical directors, 3 ground transport medical directors who are “medical directors A, B, C”), 1 organ procurement coordinator supervisor, 1 prosecuting attorney, a manager for a trauma program, and a team of emergency department (ED) providers. This ED team included the ED manager, trauma coordinator, health information management supervisor, and a physician who also worked as a medical director but was speaking from his role as an ED physician. Participants worked in the same region of the state, were recruited directly by the division chief of EMS and author 1, and were recruited because they read and used EMS reports as part of their role in health care. This controlled for a few variables, eg, the attorneys were licensed in the same state and the medical directors worked in the same county under the same system medical director. Attempts were made to have at least 2 participants from each audience group, but participation depended on participants’ willingness and availability to be interviewed.

During the think-aloud portion of interviews, participants read 2 to 3 real EMS reports. They had not read these reports prior to the interview. Reports were selected by the fire department’s division chief of EMS and were selected based on the participants’ occupations so that they would read a report that they would use, instead of using a hypothetical situation or a fictional report. For example, the organ procurement specialist read reports from patients who died from cardiac arrest and were organ donors, and the medical examiner read reports of patients who were pronounced dead on scene. Participants who were in the same reader group, such as medical directors and attorneys, read the same reports to learn what similarities and differences



**Table 1.** Taxonomy of Report Reader Expectations

Category	Code: Element Readers Expect in Narratives	Definition	Example
Scene details: Elements outside of and around patient, elements included in initial scene arrival and scene size-up	Environmental surroundings	Weather, other units on scene, location, initial scene descriptions	"We got on scene, PD said they were giving CPR. They put an AED on. They did all these kinds of things before we got there." — <i>Medical Director C</i>
	People/bystanders and their (3rd-person) statements	People on scene who were not the patient, such as other units, family members, and witnesses	"But you get on the scene and a family's saying oh, well they have this, this, and this, you have to go by what they say, obviously." — <i>Organ Procurement Specialist</i>
	Initial patient position	What patient looked like upon arrival, not during assessment	"Patient was found down on the ground in their own mess." — <i>EMS Coordinator</i>
	Times	Timestamps or time of events. Refs to medication times or times taken during certain interventions, like CPR, were coded under "interventions" bc times are part of intervention protocol.	"So you arrived at 2:28, so you were with them for 14 minutes." — <i>Billing Specialist</i>
Patient details: Information about patients themselves, patient-EMS interaction, and info EMS gathers during a response; info that leads to care details and treatment plan, patient details lead to refusal decision by patient; refers to patient-EMS interaction only, not bystanders, which are captured under "scene details"	Assessment	Medical, trauma, primary, or secondary assessments and signs and symptoms	"53-year-old female with chief complaint of smoke inhalation." — <i>Prosecutor</i>
	Patient history	Patient's medical history, medications, last oral intake, allergies. If bystanders added information germane and directly related to these elements, these refs were coded as part of patient history.	"Her history is renal failure." — <i>Billing Specialist</i>
	Vitals	Taking of vital signs and vital signs themselves. Heart rate, blood pressure, blood glucose, respiratory rate, oxygenation, pulse, temperature, Glasgow coma scale.	If you notice it [the narrative] says something about blood "pressure, heart rate, regular at 18, normal 88, at room air 116." — <i>EMS Coordinator</i>
	Patient statements	Statements articulated by patient unrelated to patient history, such as description leading up to event and refusal decisions. These were separated bc some statements were not related to patient history and bc anecdotes that inform current report writing practices instruct providers to include direct patient statements.	"Child denied any pain or loss of consciousness." — <i>Medical Director B</i>
Care details: Actions, decisions taken by EMS crews as part of patient care, movement, transport	Interventions	Actions taken to follow and deviate from treatment plans and protocols. Times that medications were administered or specific actions were performed were included under interventions.	"The medications are actually listed in a couple places. So it shows the 500 mL bolus, it shows the epi. Looks like epi was given twice." — <i>Organ Procurement Specialist</i>
	Moving patient	Moving patient to stretcher, from initial location to the ambulance, and extrication details	"Because it looks like they didn't even attempt resuscitation" — <i>Medical Director A</i> "They, the paramedics, then removed the patient from the hazard and placed him in that position on the ground." — <i>Medical Examiner</i>
	Transport information	Scene to hospital or interfacility transport	"We move the patient to the back of the ambulance." — <i>Medical Director A</i>
	Handoff information	EMS-hospital staff interaction during patient transfer of care	"List provided to ED." — <i>CC Flight Medical Directors</i>
Report quality: Elements of a report that helped participants determine if a report or provider was credible. These elements were less tangible than the other refs in that coders deliberated more about these codes than others	Accuracy/inaccuracy		"Where they can try to be more accurate at the documentation for especially the first 5 minutes where there's a lot of things going on." — <i>Medical Director C</i>
	Pertinent/nonpertinent information		"Because I've also seen very long reports that really don't tell me anything." — <i>Medical Director A</i>
	Consistent/inconsistent information		"We want to make sure everything's consistent bc sometimes the history we're given doesn't always match what's in the medical records." — <i>Medical Examiner</i>
	Spelling/misused abbreviations		"One thing, the 'OA,' that's not a typical appropriate abbreviation." — <i>ED Team</i> "Grammatical errors that make it hard to read." — <i>CC Flight Team</i> "I don't know that that has to be in quotes." — <i>City Attorney</i>
	Clarity		"I think you should use that narrative part and assessment part to paint a picture and tell a story. So that someone who reads that report or history can clearly... it forms a picture in their mind of the patient and what's happening and what's going on." — <i>Medical Director A</i> "It's just a very nondescriptive term." — <i>Medical Director C</i>

Abbreviations: EMS, emergency medical services; CPR, cardiopulmonary resuscitation; refs, references; bc, because; w, with.

Table continued on page 288

**Table 1.** Taxonomy of Report Reader Expectations (continued from page 287)

Category	Code: Element Readers Expect in Narratives	Definition	Example
Report quality (cont'd)	Completeness and specificity		<p>"So for me, I don't know if the blood pressure, if they even attempted to take it or they just didn't because it's blank. So blank, to me, is either not done or not documented, but I can't tell." — <i>Trauma Nurse</i></p> <p>"I would expect a little bit more description on the exam." — <i>Medical Director B</i></p> <p>"Don't leave any piece out from the moment you have contact w the patient until you transfer them over, we need your entire care, your entire visual report transposed onto the EPCR." — <i>Billing Specialist</i></p>
	Concise/succinct		<p>"A lot of times, you can see here, documentation that has very redundant information. It tells you a whole lot of things that we already know from other places in the chart." — <i>ED Team</i></p> <p>"The narrative is really overly wordy and I find that you have to read it a couple of times. I think it probably has double the number of words that it needs to get across." — <i>CC Flight Medical Directors</i></p>
	Justification/rationale		<p>"But there's decent justification that the patient's able to make a sound, mental decision." — <i>Medical Director C</i></p>

Abbreviations: w, with; EPCR, electronic patient care record; ED, emergency department; CC, critical care.

existed within these groups. Participants were presented the entire report, which included electrocardiogram printouts, the narrative, and information completed in dropdown menus and text entry boxes, so that the researchers could observe their reading habits and actions.

Analysis of interview transcripts involved grounded theory where researchers build a theory from repeated themes across data that inform a coding structure to analyze results.<sup>13</sup> In this iterative process, 3 raters reviewed the transcripts using Nvivo (QSR International, Burlington, Massachusetts), a qualitative data analysis program used for unstructured data. Raters read transcripts for common themes and patterns and then met to discuss their findings for commonalities and differences. Codes were developed from this discussion and then were used in subsequent rounds to analyze the transcripts. Data saturation was met when no new codes or patterns emerged across transcripts. The raters' coding patterns were then analyzed for agreement and disagreement, as well as the frequency of the codes used. To ensure coding fidelity, the raters discussed each individual reference throughout all transcripts, totaling 1932 unique references.

## RESULTS

Of the 150 EMS providers invited to take the Phase 1 survey, 57 EMS providers completed it (Figure). Respondents had 0.5 to 38 years of experience in EMS working with their current or other departments. Of note, 60% of respondents reported that they "always" think of the "patient" audience group when writing their narrative. Conversely, for the audience group "insurance and billing," 38% of respondents reported that they "never" think of this audience group. Likewise, 42% of respondents report that they always think of their crew members when writing reports.

In Phase 2, grounded theory analysis of the interview transcripts generated a coding taxonomy of 4 categories that held 21 codes total (Table 1). Using Cohen's Kappa for interrater reliability, an average kappa score of 0.65 was attained across transcripts, suggesting "substantial reliability." The generated codes represented the 21 elements readers expected to see in report narratives. The top 3 most-referenced codes were completeness/details, assessments, and interventions, which occurred concurrently (Tables 2 and 3). The 3 least-referenced codes were grammar, handoff information, and moving the patient. All report readers referenced environmental surroundings, scene times, and patient history to some degree, although some referenced them more than others.

## DISCUSSION

Results from this study offer insight into provider audience awareness and report readers expectations.

EMS providers lack a full picture of who reads reports: Findings from Phase 1 indicated a disconnect between who EMS providers think read reports and who report readers are. At this agency, insurance and billing specialists read nearly all reports, yet 38% of respondents reported "never" thinking of this audience. Conversely, 60% of respondents reported "always" thinking of the patient audience group; however, out of 12,336 reports written in 2021, fewer than 10 reports were requested by patients or their family members. This disconnect was striking—if a provider is unaware of who reads reports, their ability to write effective reports is compromised.

**Readers value completion over concision.** Our findings suggest that readers do not value concise writing. In fact, that element was one of the lowest across all codes in all categories, with

only 17 codes across all interviews. During interviews, participants stated, “I don’t know what that means” when reading narratives that were considered “concise” but lacked necessary information about scene details, patient details, and interventions. We anticipated that “concise” would be one of the highest referenced codes given the frequency with which EMS providers are told to not overwrite.<sup>5,6,14</sup> Questions like “I don’t know what that means” are signs of unclear writing and indicate the writer did not properly anticipate readers’ questions.<sup>15</sup> Interviews showed that participants relied heavily on narratives to guide their own decisions and actions regarding patient care, legal action, insurance claims, and financial reimbursement. When reading reports, they skimmed over information they did not need, but they could not fill in information that was not included in a narrative.

***Job role was partially indicative of what readers look for but did not account for variance among same group members, especially among medical directors.*** In some cases, lack of references to codes could be attributed to the participant’s purpose for reading the report. For example, the organ donation specialist referenced “interventions” most, because the interventions EMS providers performed directly affected her job.

Notably, within the medical directors, there was little variance in reference frequency regarding “assessment,” “vitals,” “consistency,” and “patient details.” However, variability was prominent in report quality. Within the larger category, reference totals ranged from 47 to 147. For “spelling/misused abbreviations” and “grammar/mechanics,” the critical care flight medical directors had the greatest number of references to this element (8 and 4, respectively), while the other 3 medical directors interviewed had zero references to these elements. Within “justification” and “rationale,” 1 medical director referred to it 45 times, while 2 others referred to it only twice.

These findings can guide curriculum enhancement and training programs and better prepare EMS providers to meet readers’ expectations. The importance of audience and the effective devel-

opment of a writer’s sense of audience awareness is well documented in writing studies.<sup>16-19</sup> A core component of effective written communication, audience awareness can help EMS providers both respond to and relate to whom they are communicating. Because written reports are read asynchronously, EMS providers are responsible for anticipating and answering readers’ questions in a format that is clear, well organized, persuasive, and accurate;<sup>15,20</sup>

**Table 2.** Total Number of Code References and the Readers Who Referred to Each Code the Most and Least

Category/ Code	Refs	Interviews With Most Refs: Participant/s — No. of Refs	Interviews With Least Refs: Participant/s — No. of Refs
Scene details			
Times	102	Organ Donation Specialist — 26	Medical Director A — 1
Environmental surroundings	81	Prosecutor — 18	Medical Directors A, B, C — 1 each
People/bystanders and their (3rd-person) statements	28	EMS Coordinator — 5	Billing Specialist, CC Flight Medical Directors, Medical Director A, Trauma Nurse — 0
Initial patient position	22	Medical Examiner — 9	City Attorney, CC Flight Medical Directors, Medical Directors B, C — 0
Patient details			
Assessment	301	Prosecutor — 41	City Attorney — 4
Patient history	125	CC Flight Medical Directors — 20	Medical Director A, City Attorney — 1
Patient statements	95	Medical Director C, Prosecutor — 16 each	Organ Donation Specialist — 0
Vitals	78	Billing Specialist — 12	City Attorney, ME — 0
Care details			
Interventions	173	Organ Donation Specialist — 43	City Attorney — 0
Moving patient	14	Billing Specialist, ME — 6 each	City Attorney, EMS Coordinator, Medical Director C, Organ Donation, Prosecutor, Trauma Nurse — 0
Transport info	18	Medical Director A — 5	City Attorney, EMS Coordinator, ME, Organ Donation, Prosecutor — 0
Handoff info	10	Billing Specialist, ED Manager — 3 each	City Attorney, ME, Prosecutor, Medical Directors A, B, C — 0
Report quality			
Completeness/specificity	451	Medical Director C — 78	ME — 19
Justification/rationale	150	Medical Director C — 45	City Attorney — 0
Clarity	82	Medical Director C — 18	ME — 0
Pertinent/nonpertinent information	73	City Attorney, ED Team — 19 each	Medical Director C, Trauma Nurse — 0
Consistent/inconsistent information	58	Organ Donation Specialist — 11	Billing Specialist — 0
Accuracy/inaccuracy	29	Prosecutor — 6	Medical Director A, Billing Specialist, City Attorney — 0
Spelling/misused abbreviations	18	CC Flight Medical Directors — 8	Billing Specialist, City Attorney, ED Team, EMS Coordinator, Medical Directors A, B, C, Organ Donation Specialist, Trauma Nurse — 0
Concise/succinct	17	ED Team — 9	Billing Specialist, City Attorney, EMS Coordinator, Medical Directors B, C, ME, Organ Donation Specialist, Prosecutor, Trauma Nurse — 0
Grammar/mechanics	7	CC Flight Medical Directors — 8	Billing Specialist, ED Team, EMS Coordinator, Medical Directors A,B, C, Organ Donation Specialist, Trauma Nurse — 0

Abbreviations: ME, medical examiner; ED, emergency department; EMS, emergency medical services; CC, critical care.

**Table 3.** Code References by Participants

Participants	Scene Details	Patient Details	Care Details	Report Quality	Total Refs/ Transcript
Billing Specialist	12	68	15	57	152
City Attorney	14	11	0	65	90
Emergency Department Team	19	60	30	134	243
Emergency Medical Services Coordinator	36	62	21	38	157
Critical Care Flight Medical Directors	6	54	6	71	137
Medical Director A	4	45	12	93	154
Medical Director B	11	57	7	48	123
Medical Director C	28	70	18	147	263
Medical Examiner	27	25	14	31	97
Organ Donation	35	27	44	71	177
Prosecutor	24	69	26	76	195
Trauma Nurse	17	51	22	54	144
<b>Total refs/category</b>	<b>233</b>	<b>599</b>	<b>215</b>	<b>885</b>	<b>1932</b>

Abbreviations: refs, references.

a report writer with a highly developed sense of audience awareness can do that.

Findings from our study support a key tenet of writing studies research—that audience is not generalizable, but rather a more complex combination of readers with varying roles and expectations.<sup>16</sup> To prepare EMS providers to manage these conflicts and expectations, they need to develop strategies to meet them. One strategy that can meet audience expectations is to help EMS providers understand the relationship among the elements they are writing in the narrative, not only the elements themselves. For example, participants noted that narratives should have “justification,” and they expected references to assessments and interventions to be followed by explanations and rationales for those actions. Narratives that merely listed assessments and interventions were less effective for readers; the value was in the justification EMS providers included in the narratives.

One challenge in training EMS providers is the lack of report writing standards and pedagogical resources in the field. Current approaches to report writing training are not informed by pedagogical research or best practices in teaching writing, leaving EMS educators to rely on anecdotes, their own experience, and, potentially, their own ineffective writing habits. Furthermore, our study confirms that variability exists in how people read reports, and provider awareness does not reflect reality about report readership, which, to date, has not been confirmed or integrated into training. Results suggest the field needs a standardized, research-informed way to evaluate narratives, much in the same way cardiopulmonary resuscitation and intubation skills are assessed in skills labs. In addition to report elements, effective writing standards should reflect the actual, real-life context in which writing is used.<sup>21–23</sup> The current 2021 EMS Standards document moves in this direction. Although a stark departure from the 1998 standards that focused on spelling and grammar,<sup>24</sup> the 2021 EMS Standards

does not go far enough in its recommendations. In part, they reinforce what participants noted was the least useful—a listing of findings for the emergency medical responder training level—while adding decision-making for EMT levels.<sup>25</sup> To more accurately reflect the real contexts in which reports are used, report writing standards should include explicit criteria about how information should be synthesized and organized so that the document is usable for intended audiences.

### Limitations and Future Directions

This study has limitations in that a small sample size of interviewees from 1 particular region of the United States was inter-

viewed. There is utility in repeating this study on a broader scale to learn if report reader expectations vary across jurisdictions. Further study also may be needed by focusing more on individual audience groups, especially medical directors and attorneys. Furthermore, some interviews had multiple participants being interviewed and, therefore, coding was only done on the collective interview and not by the specific participant in these cases. We believe the Kappa was lowest in the ED team due to the poor quality of audio recording and, thus, transcription; we chose to include findings from this interview, though, because of the novel nature of this study and the insights gleaned from the interview itself.

The power of grounded theory lies in multiple iterations to refine the coding scheme and results. By adding more interviews and applying this or a revised coding scheme, future researchers could refine the results even further and develop a more specific taxonomy. It is also important to note that further research may develop other coding schemes and identify different concepts of narrative writing.

### CONCLUSIONS

Ultimately, this is the first study of its kind in this field and offers a framework for further investigation and, we hope, advance the profession. These data formalize and reinforce what a high-quality narrative should include, with high-quality meaning the narrative allows the reader to do their job without follow-up or an amendment needed to the report. Initial training and continuing education need to be modified to account for these findings, thus better preparing EMS providers to write a usable, complete narrative.

**Funding/Support:** Marquette University’s Public Health and Equity Fellowship and Summer Undergraduate Research Fellowship supported funding for data analysis.



**Financial Disclosures:** Elizabeth Angeli has a consulting business in report writing training.

**Appendix:** Available at [wmjonline.org](http://wmjonline.org)

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# Intractable Seizures in Children With Type 1 Diabetes: Implications of the Ketogenic Diet

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## ABSTRACT

**Introduction:** The ketogenic diet is prescribed for seizures in some children with epilepsy. Children with type 1 diabetes are at risk for diabetic ketoacidosis caused by ketosis due to decreased insulin effect. Currently there are no clinical guidelines regarding the safety and efficacy of the ketogenic diet in patients with concurrent epilepsy and type 1 diabetes.

**Objectives:** This review examines the current literature regarding the association between type 1 diabetes and epilepsy, proposed mechanisms for the observed relationship, risks and benefits of the ketogenic diet, and clinical applications of the ketogenic diet in the context of type 1 diabetes and epilepsy.

**Methods:** PubMed was used to identify relevant articles. Key search terms included, “type 1 diabetes,” “ketogenic diet,” “seizure,” “epilepsy,” and “autoimmunity.”

**Results:** There is an observed association between type 1 diabetes and epilepsy, with proposed mechanisms including genetic predisposition, anti-glutamic acid decarboxylase (GAD) antibodies, metabolic derangements and cerebrovascular damages. Case reports describe the use of the ketogenic diet for epilepsy management in children with diabetes with mixed results; however, there are no large, randomized controlled trials to evaluate the broader application of these findings.

**Conclusions:** In summary, there is inadequate evidence to support the use of the ketogenic diet in patients with coexisting epilepsy and type 1 diabetes in clinical practice. Further research is needed to determine the effectiveness, safety, and monitoring parameters of the ketogenic diet for these patients. The risks and benefits of the ketogenic diet as medical nutrition therapy for patients with both type 1 diabetes and epilepsy should be considered on an individualized basis.

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## INTRODUCTION

There is a dearth of literature investigating the relationship between type 1 diabetes (T1D) and epilepsy. Several studies demonstrate that T1D is more common in patients with epilepsy when compared to the general population.<sup>1-5</sup> However, 1 study reported a similar prevalence of epilepsy in youth with T1D compared to the general population, refuting the suggestion that there is a relationship between these conditions.<sup>6</sup> That said, there are significant limitations in studying this relationship. First, missing laboratory and clinical data make determination of epileptiform versus secondary etiology (eg, hypoglycemia) of seizures difficult. Additionally, individuals with T1D may interface with health care more frequently, resulting in more readily diagnosed seizure disorders when compared to the general population. Regardless, the literature largely supports an association between these conditions; the exact underlying mechanism remains unclear.

The ketogenic diet is a well-studied, efficacious treatment for seizure disorders in a subset of pediatric patients.<sup>7</sup> It exhibits its antiseizure effects through multiple mechanisms that are poorly understood but include direct antiseizure effects of ketone bodies, ion channel regulation, mitochondrial changes, glycolytic restriction, fatty acid oxidation, and anapleurosis.<sup>8</sup> There is also limited evidence that a low carbohydrate diet in a subset of T1D patients may improve glycemic control; the ketogenic diet is essentially a very low carbohydrate diet classically carried out in a 4:1 ratio of

fat to protein and carbohydrates.<sup>9</sup> This evidence raises the intriguing question of whether the ketogenic diet could be a safe and efficacious therapy to treat pediatric patients with a seizure disorder and concurrent T1D, while considering increased risk of diabetic ketoacidosis in a ketotic state. The purpose of this literature review is to (1) examine the current literature on the etiology of the association between T1D and epilepsy, (2) explore the risks and benefits of the ketogenic diet in pediatric patients with T1D, and (3) provide an overview of studies that have evaluated the ketogenic diet as concurrent treatment of epilepsy and T1D.

## METHODS

The primary database used for this review was PubMed. All selected articles were written in English. There were no restrictions on publication dates of articles, but all selected articles were published within the last 15 years. Articles were identified using the search terms “type 1 diabetes,” “ketogenic diet,” “seizure,” “epilepsy,” and “autoimmunity.”

## RESULTS

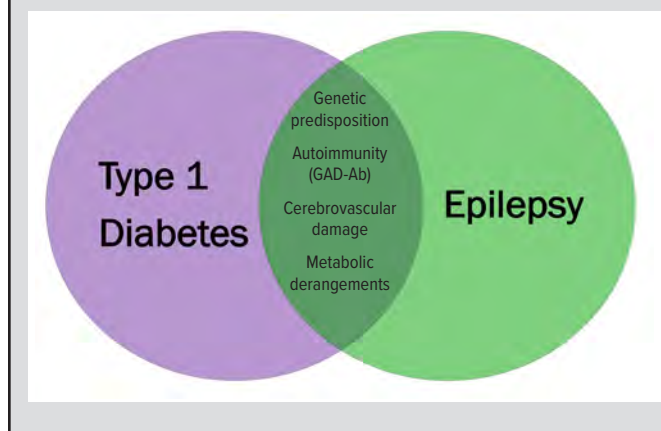
### T1D and Epilepsy

There are 4 leading pathological mechanisms postulated to explain a relationship between T1D and epilepsy (Figure 1): genetic predisposition, anti-glutamic acid decarboxylase (GAD) antibodies, metabolic derangements (eg, hypoglycemia and hyperglycemia), and cerebrovascular damages.<sup>10</sup>

Epilepsy can be caused by either acquired or genetic pathologies (eg, receptor, ion channel defects).<sup>11</sup> T1D also is more common in individuals with first degree relatives with autoimmunity. A variable temporal sequence of T1D and epilepsy has been observed, suggesting a bidirectional relationship or a shared risk factor, such as genetic predisposition or autoimmunity.<sup>12</sup>

Shared autoimmunity between T1D and epilepsy, specifically anti-GAD antibodies (GAD-Ab), may play a role in the pathogenesis of these 2 conditions. GAD is an enzyme that catalyzes the conversion of glutamate, the primary excitatory neurotransmitter in the brain, to gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter. GAD is expressed in the brain as well as in pancreatic beta cells, where GABA is secreted as a paracrine signal molecule.<sup>13</sup> GAD-Ab are common in patients with T1D, detected in up to 80% of patients at diagnosis. Interestingly, GAD-Ab also are found in patients with neurological conditions, including stiff-person syndrome and epilepsy.<sup>14</sup> However, there are important antigenic differences identified between the epitopes recognized by GAD-Ab of diabetic patients and those of patients with neurological disorders.<sup>15</sup> A 2018 study analyzed GAD-Ab titers, epitope specificity, and enzyme inhibition in patients with several conditions, including epilepsy and T1D. Results showed some overlap among individuals with T1D and epilepsy, which could represent a more complicated continuum of autoimmunity.<sup>16</sup> Larger, longitudinal studies are needed

**Figure 1.** Potential Mechanisms for Association Between Type 1 Diabetes and Epilepsy



to better understand the interaction among GAD-Ab, T1D, and epilepsy.

Metabolic derangements (eg, hypoglycemia and hyperglycemia) are common in T1D. These changes in blood glucose levels are thought to alter the balance between inhibitory and excitatory neuronal networks, ultimately predisposing these individuals to subsequently developing a seizure disorder.<sup>14</sup>

Lastly, the cerebrovascular changes in T1D and subsequent ischemia could predispose these individuals to seizures; however, this would predict an increased incidence of epilepsy in older type 2 diabetics, which has not been observed.<sup>12</sup> Additionally, many cases of epilepsy occur prior to T1D diagnosis, which is not consistent with a vascular etiology.<sup>12</sup> The underlying pathophysiology for the observed relationship between epilepsy and T1D remains unclear and continues to be an active area of research.

### Benefits of the Ketogenic Diet in T1D

There are robust data to support the use of the ketogenic diet as treatment of epilepsy syndromes in patients >2 years old who have failed at least 2 antiepileptic drugs. The only absolute contraindications to the ketogenic diet are a limited number of metabolic diseases, including carnitine deficiency, beta-oxidation defects, and pyruvate carboxylase deficiency, among a few others.<sup>17</sup> Of note, T1D is not a standard contraindication to this dietary antiepileptic intervention despite obvious potential risks. In fact, the ketogenic diet has shown some promise in a subset of patients with nonautoimmune metabolic and endocrine disorders, including type 2 diabetes, obesity, metabolic syndrome, and polycystic ovarian syndrome. The ketogenic diet has been shown to have a favorable effect on caloric intake, body weight, lipid levels, glycemic indices, and insulin sensitivity.<sup>18</sup> It has not been extensively studied in pediatric populations with T1D, but a review article did look at the effects of a low carbohydrate diet (<45%) in individuals with T1D.<sup>19</sup> Three of the 8 studies that reported HbA1c found a statistically significant reduction, and 2

**Table.** Summary of Four Case Reports on Pediatric Patients with Type 1 Diabetes on Ketogenic Diets

Patient Description	Treatment Goals/ Insulin Regimen	HbA1c	Seizures on KD?	DKA on KD?	Other Clinical Outcomes
4-year-old girl with pyruvate kinase deficiency, static encephalopathy, seizure disorder. She was on KD > 1 year prior to T1D diagnosis (Henwood et al, 2006 <sup>21</sup> )	Serum ketones $\leq 2.5$ mmol/L; glargine 0.3–0.53 U/kg at bedtime; lispro boluses as needed to maintain glycemic control	6.9% to 5.1% after 10 months on KD	Yes	No	Significant linear catch-up growth from <5% to 50%; achievement of new developmental milestones
3-year-old girl with epilepsy and T1D. Presented with right-sided spastic hemiparesis, tonic seizures, and developmental delay at 9 months. Diagnosed with T1D at 18 months (Dressler et al, 2010 <sup>20</sup> )	Unspecified ketosis goal 0.38–0.45 IU/kg insulin daily (unspecified formulation)	7.9% to 6.2% after 13 months on KD	No <sup>a</sup>	No	Advancement in developmental milestones; eventually stopped due to child refusal
2-year-old girl with epilepsy diagnosed at 4 months treated with KD; presented to ED in DKA, diagnosed with T1D (Aguirre et al, 2012 <sup>23</sup> )	Moderate urine ketones; glargine 0.3 U/kg at bedtime, aspart before meals if glucose > 200 mg/dL	7.3% to 7.2% after 10 months on KD	No	No	Difficulty managing hypoglycemia
3-year-old male diagnosed with T1D, subsequently presented with generalized tonic-clonic seizure 1 week later; KD initiated via gastrostomy tube (Aylward et al, 2014 <sup>22</sup> )	Blood ketones $\geq 4.0$ mmol/L, Target capillary glucose 4–10 mmol/L; unspecified insulin regimen	5.7% to 6.4% while on KD	Yes <sup>b</sup>	No	Improved cognitive functioning

Abbreviations: KD, ketogenic diet; DKA, diabetic ketoacidosis; T1D, type 1 diabetes; ED, emergency department.

<sup>a</sup>4-month follow-up EEG showed no evidence of seizures, although future electroencephalograms showed subclinical seizure patterns.

<sup>b</sup>Patient had no observed drop attacks or myoclonic astatic seizures on KD but continued to have occasional brief nocturnal seizures.

of 5 studies that reported daily insulin usage reported significant reductions in total daily dose in the low carbohydrate groups. In addition, 4 case reports exhibited favorable effects on blood sugar control.<sup>20–23</sup> More research is needed to clarify the effects of a low carbohydrate diet and specifically the ketogenic diet on blood sugar control in T1D.<sup>19</sup> If the ketogenic diet is found to improve HbA1c levels in certain patients without adding too much risk (diabetic ketoacidosis, poor growth, etc) it could decrease the need for insulin and one could potentially treat T1D and epilepsy with 1 intervention.

### Risks of the Ketogenic Diet in T1D

The ketogenic diet was feasible and efficacious as an antiepileptic in 4 case reports (Table). However, the authors also report significant risks, citing hypoglycemia, diabetic ketoacidosis, poor palatability, and attenuated growth and development.<sup>20–23</sup>

### Hypoglycemia

By nature of the therapy, the ketogenic diet is a low carbohydrate diet that increases the risk of low blood sugar—already a risk in T1D due to exogenous insulin. It is not uncommon for children on the ketogenic diet to have blood glucose < 70 mg/dL, which is often the treatment threshold for hypoglycemia in T1D. Necessary treatment of low blood glucose in children with T1D and seizures attenuates the therapeutic, antiepileptic effect of the ketogenic diet.<sup>23</sup> Additionally, in the case of severe hypoglycemia, there would likely be a blunted response to glucagon in an individual in therapeutic ketosis and increased risk of hypoglycemic seizure.

### Diabetic Ketoacidosis

It can be challenging to differentiate therapeutic ketosis from diabetic ketoacidosis; it is difficult to interpret ketone levels in these individuals. There is no consensus regarding an acceptable level of ketosis for pediatric patients with T1D on the ketogenic diet.<sup>9</sup> Theoretically, there are important differences in lab values between the ketogenic diet and diabetic ketoacidosis. In therapeutic ketosis, blood glucose should be normal or low/normal, ketone body concentration should be 7–8 mmol/L, and pH should be normal, whereas in diabetic ketoacidosis, blood glucose is variable, ketone concentration will be elevated (> 25 mmol/L), and pH will be low (< 7.3).<sup>24</sup> However, developing diabetic ketoacidosis starts with a similar, mild/moderate ketosis, and it is at this point that intervention is critical and can prevent severe diabetic ketoacidosis, which has life-threatening complications. Distinction between ketone levels from therapeutic ketosis in the ketogenic diet and developing diabetic ketoacidosis may be difficult to detect outside of the medical setting. It is also possible that following the ketogenic diet could increase the possibility or tempo of developing severe diabetic ketoacidosis by having more ketones at baseline.

### Poor Palatability

Several of the case studies described identified issues of palatability, which are common in dietary interventions. In 2 studies, the ketogenic diet was stopped due to poor palatability or child refusal, despite the beneficial effects from the diet therapy.<sup>20,23</sup> It is understandable that children may not adhere to such a limited diet, especially as they get older and are offered more choices and develop food preferences. The ketogenic diet may be a more feasible option in children who are—for unrelated reasons—gastrostomy-tube dependent, as formulas can be selected based on their



nutritional content and avoid the issue of poor palatability. Additionally, there are numerous websites and cookbooks that offer a variety of recipes for meals, snacks, and desserts that meet ketogenic diet limitations. However, significant time and cost is required for ketogenic meal preparation, and this may not be compatible with families' lifestyles.

### Poor Growth

Significant dietary changes have potential effects on growth and development in pediatric patients. T1D guidelines recommend a well-balanced diet with 50% to 55% of energy derived from carbohydrates—much higher than recommended in the ketogenic diet.<sup>25</sup> A case series of 6 children with T1D who adopted a low carbohydrate diet of varying degrees had consequences, including poor growth, an unfavorable lipid profile, generalized fatigue, and mental health comorbidities.<sup>26</sup> However, other studies have reported significant linear catch-up growth<sup>21</sup> and advancement in developmental or cognitive function<sup>20-22</sup> after initiation of the ketogenic diet. The risk of growth effects from the ketogenic diet should be thoughtfully considered on an individual basis.

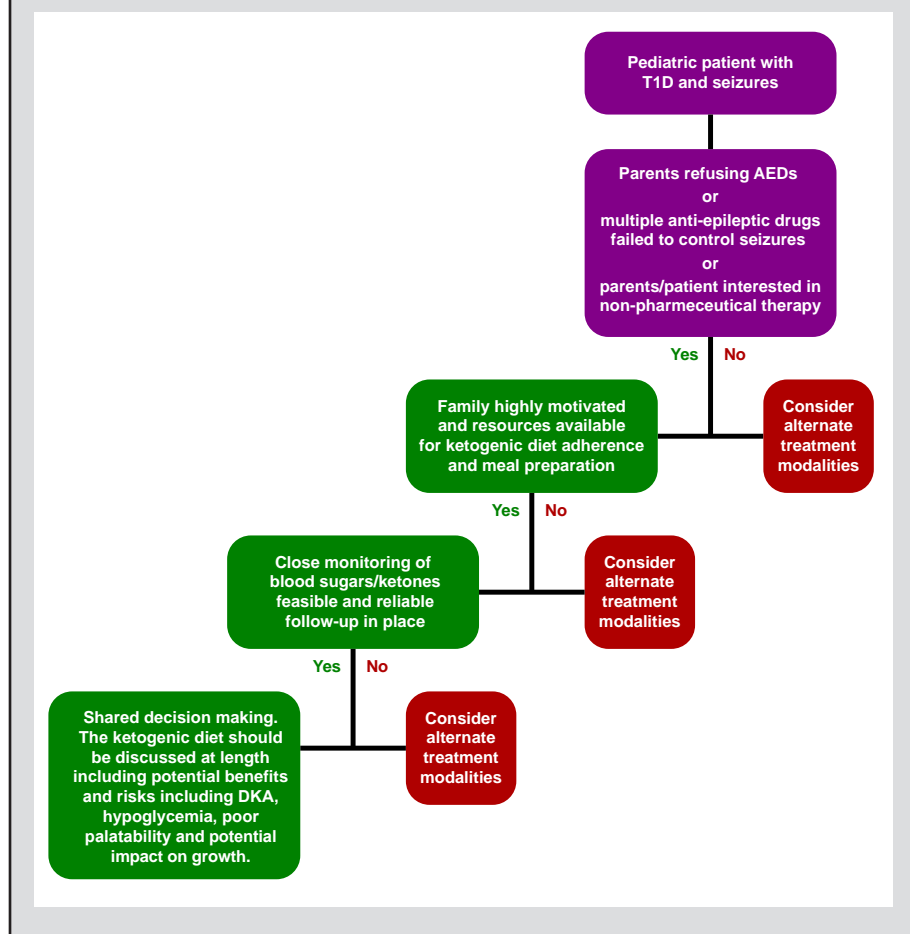
### Ketogenic Diet in Patients with Epilepsy and T1D

There are 4 case reports to date that attempt to examine the safety and efficacy of the ketogenic diet in patients with concurrent epilepsy and T1D (Table).<sup>20-23</sup> Although these case studies present examples of the ketogenic diet treating seizure disorders with improved HbA1c levels in some pediatric patients with T1D, there are no case-control cohort studies or systematic reviews on this topic. Furthermore, with the potential significant risks of the ketogenic diet in pediatric patients with T1D, it may be unethical to study this potential therapy in a large, blinded, randomized controlled trial.

### CONCLUSIONS

The mechanism of the connection between T1D and seizure disorders is unclear, but genetic predisposition, anti-GAD antibodies, metabolic derangements (ie, hypoglycemia and hyperglycemia), and cerebrovascular damages may contribute. There is anecdotal evidence in the form of case reports that supports the feasibility and efficacy of the ketogenic diet as therapy in children with both epilepsy and T1D, but no randomized controlled trials exist to

**Figure 2.** Framework for Clinical Considerations for Initiating the Ketogenic Diet in a Pediatric Patient With Type 1 Diabetes and Seizures



rigorously evaluate the broader application of these findings. In summary, the risks and benefits of the ketogenic diet as medical nutrition therapy for patients with both T1D and epilepsy should be considered on an individualized basis (Figure 2). Clinicians should inform families considering this treatment modality of the clinical risks and intensive monitoring required.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

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# Surveillance for the Rare Condition of Sick Cell Disease in Wisconsin

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## ABSTRACT

**Background:** Despite universal newborn screening, there is no comprehensive surveillance system to understand the sickle cell disease population in Wisconsin.

**Methods:** We initiated the development of a sickle cell disease surveillance system by linking newborn screening data and electronic health records from 2 large tertiary health care institutions in Wisconsin: Children's Wisconsin and Froedtert Hospital.

**Results:** There were 1478 individuals within the 3 data sources. One hundred thirty-two (82%) of 159 identified by newborn screening from 2013 through 2019 received care at Children's Wisconsin. The majority of individuals with sickle cell disease at Children's Wisconsin and Froedtert Hospital resided in Milwaukee County.

**Discussion:** The new surveillance program will increase our understanding of the sickle cell disease population in Wisconsin and help improve quality of care and health outcomes.

## BACKGROUND

Sickle cell disease (SCD) is a genetic condition caused by a pathogenic gene variant in the beta-globin chain of hemoglobin. In the United States, SCD predominantly occurs among Black individuals. Despite universal newborn screening,<sup>1</sup> there is no national-level surveillance system to understand the care and health outcomes for the SCD population. Children and adults with SCD experience significant morbidity and have impaired quality of life.<sup>2</sup> These individuals face health care disparities at numerous

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levels, including access to specialty care and recommended treatment.<sup>3</sup> High quality care, assessed based on quality-of-care metrics (Table 1), is needed to improve SCD outcomes. However, due to lack of surveillance data, there is limited knowledge to inform actions needed at a systems level to effectively improve outcomes for the SCD population.

## Existing Knowledge Regarding SCD in Wisconsin

Published newborn screening data show 19 to 32 infants are diagnosed with SCD each year in Wisconsin, with an overall

birth incidence of 0.319 per 1000 births.<sup>1</sup> Previous studies from Wisconsin have assessed health care utilization for individuals with SCD. Research using Wisconsin Medicaid data show emergency department (ED) reliance (number of ED visits divided by the number of ED and outpatient visits) varies by age for those with SCD.<sup>4,5</sup> Data show less than 20% of children with SCD had excessive ED reliance (defined as >0.33), whereas 40% to 50% of those in the age-group transitioning from a pediatric to adult facility (those who turned 19 years during the study) had excessive ED reliance.

Another study that used Medicaid data (years 2004–2007) looked at infection prevention strategies in individuals with SCD, including receipt of penicillin prophylaxis and pneumococcal and influenza immunizations.<sup>5</sup> The study showed a small proportion (18%) of eligible children received the standard of care for penicillin prophylaxis, and there was low adherence to recommended annual influenza vaccination (21%).<sup>6</sup> Encouragingly, 77% of eligible children in the study received pneumococcal (PCV7) vaccination. Also, with targeted quality improvement efforts at Children's Wisconsin, we were able to

**Table 1.** Examples of Recommendations in Guidelines Issued by American Society of Hematology and National Heart, Lung, and Blood Institute

Recommendation	Eligible Sickle Cell Disease Population
Annual transcranial doppler ultrasound	2–16 years of age with sickle cell anemia (HbSS/HbS beta <sup>0</sup> thalassemia)
Brain magnetic resonance imaging (at least 1 time)	Early-school-age children with sickle cell anemia
Antibiotic prophylaxis	<5 years of age with sickle cell anemia
23-valent polysaccharide pneumococcal vaccine	>2 years of age with sickle cell disease

achieve and sustain >70% annual transcranial doppler screening rates for children with sickle cell anemia.<sup>7</sup> Notably, these studies are all limited to data from either 1 insurance type (Medicaid) or single facility (Children’s Wisconsin). As a result, a lack of understanding of the overall epidemiology and health outcomes for the entire SCD population in Wisconsin still exists.

### Surveillance for SCD in Wisconsin

The Centers for Disease Control and Prevention’s (CDC) Sickle Cell Data Collection (SCDC) program is a population-based, longitudinal surveillance system. The goal of SCDC is to study long-term trends in diagnosis, treatment, and health care access for people with SCD living in the United States. In 2021, eleven states including Wisconsin, were competitively selected to participate in the SCDC program.<sup>8</sup>

The SCDC program in Wisconsin aims to include all individuals living with SCD in the state. We will link and aggregate data from various existing institutional and state-level data sources to establish a SCD surveillance system for Wisconsin. We have established a multidisciplinary team that includes newborn screening program members, health care providers, policymakers, bioinformaticians, researchers, and individuals with SCD to guide the program.

In this brief report, we describe preliminary findings from the linkage of data from the newborn screening program and electronic health records (EHR) from 2 large tertiary-care facilities with SCD clinics, Children’s Wisconsin (CW) for children and Froedtert Hospital (FH) for adults. We also discuss how Wisconsin’s participation in SCDC could improve care and outcomes for those with SCD in the state.

### METHODS

We used a combination of deterministic and probabilistic linkages to deduplicate and link records based on patient name, sex, and date of birth. The string of names were compared and matched using Levenshtein’s edit distance.<sup>9</sup> Sex and date of birth were compared as exact matches. A varying range of weights for the specific identifiers were used to identify overlapping patients, along with chart review as needed.

A 3-tiered SCD case definition was applied where (1) individuals identified with SCD through the Wisconsin newborn

screening program were considered confirmed cases, (2) individuals who did not meet the confirmed case definition but had 3 or more SCD-associated encounters at CW and/or FH were considered probable cases, and (3) individuals who did not meet the confirmed case definition but had 1 or 2 SCD-associated visits at CW and/or FH were considered possible cases. SCD-associated encounters

are those with a SCD International Classification of Disease [ICD] code present at admission, discharge, or final diagnosis. (See Appendix for SCD ICD codes.)

In this report, we describe the overlap between data from the newborn screening program and the EHR at CW and FH for years 2013–2019. We also describe demographic characteristics (age, sex, race, ethnicity, known vital status) for individuals who met either the confirmed or probable case definition and received care at CW and/or FH. Age was calculated as of December 31, 2019, or on the date of death if the individual was deceased. Vital status was determined from the EHR. We used the Federal Office of Rural Health Policy eligible file to determine the rural/nonrural category. Any ZIP code where more than 50% of its population resides in a nonmetro county and/or a rural census tract was classified as rural.

### RESULTS

A total of 1478 individuals met 1 of the tiers of the SCD case definition (Figure). There were 159 infants diagnosed by the Wisconsin newborn screening program during 2013–2019 who were considered confirmed cases; 83% (N=132) of these had at least 1 SCD-associated encounter at CW during 2013–2019. There were 793 and 797 individuals at CW and FH, respectively, who had at least 1 SCD-associated visit. Upon linking and deduplicating EHR data sources with newborn screening data, there were 1451 unique individuals across the 2 sites (1450 had an SCD-associated visit at CW/FH plus 1 who did not have a SCD-associated visit at CW but received care at the facility). Of these, 68% (N=993) met the confirmed or probable case definition, and 31% (N=458) met the possible case definition. Overall, there were 1020 confirmed or probable (993 + 27 from newborn screening but not in EHR) cases in the program. The overlap between data sources for cases by age group is shown in Table 2.

Fifty-three percent of confirmed or probable cases at CW and/or FH were female (N=525), and the median age was 22 (range: 0.10–87.8) years. Ninety-five percent (N=942) were Black, and 98% (N=971) were neither Hispanic nor Latino. Fifty-five (6%) patients died during 2013–2019. Of those in Wisconsin and with available ZIP code data, 83% resided in Milwaukee County, and 99% were classified as living in a nonrural area.



## DISCUSSION

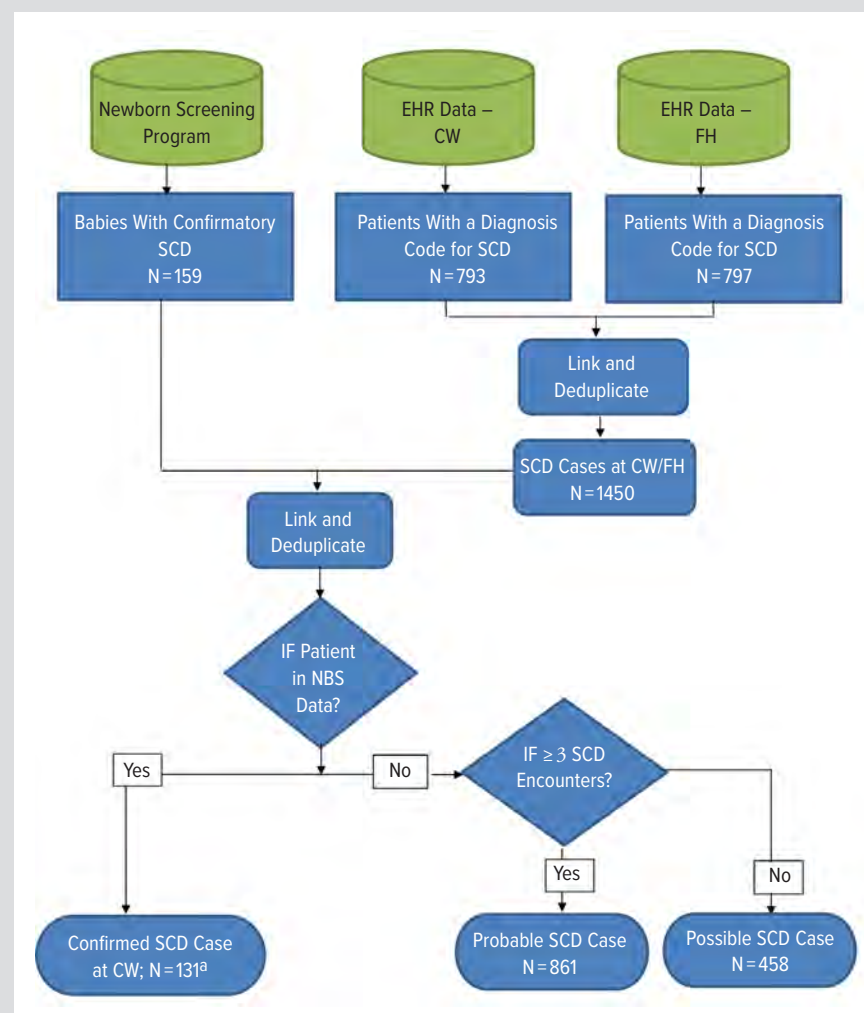
Our preliminary linkage of 3 data sources shows the majority of children diagnosed with SCD through Wisconsin newborn screening (82%) had at least 1 visit at CW. Combined data from CW and FH show a large proportion of patients receiving care at these institutions reside in 1 county (Milwaukee County). There is ongoing work to include individuals with SCD who receive care within Wisconsin outside of these health care systems by incorporating other statewide data sources, such as administrative claims data from Medicaid and the Wisconsin Health Information Organization (all payers claims). This comprehensive assessment intends to identify to the best of our ability the majority of individuals living with SCD in Wisconsin. Further work on this surveillance program will facilitate systematic data collection and provide a platform to engage various stakeholders to understand the needs of the SCD population. Specific examples below discuss how the program can be leveraged to improve the lives of those with SCD living in Wisconsin.

**Understanding demographics of the SCD population in Wisconsin:** The knowledge of demographics (age, sex, race/ethnicity, geographic distribution) of individuals with SCD is essential to understanding this population's needs. This program will help determine if certain subgroups of the SCD population reside in areas with few or no hospitals, EDs, or subspecialty care so efforts can ensure equitable access to care for all individuals with SCD.

**Quality of care delivered to individuals with SCD:** Our program will help determine if individuals with SCD in Wisconsin are receiving recommended care to manage their disease. Sharing data on quality-of-care metrics (Table 1) with clinicians and third-party payers will help identify and fill the gaps in care.

**Health care service utilization and health-related outcomes for individuals with SCD:** Individuals with SCD experience severe acute pain events that often

**Figure.** Flow Chart to Describe the Identified Sickle Cell Disease Cases in This Report Using Newborn Screening and Electronic Health Record Data for Years 2013–2019



Abbreviations: EHR, electronic health record; NBS, newborn screening; SCD, sickle cell disease; CW, Children's Wisconsin; FH, Froedtert Hospital.

<sup>a</sup>There was 1 more child diagnosed by NBS as having SCD in 2019 who received care at CW but did not have a SCD-associated visit during the study period. Therefore, total confirmed SCD cases at CW = 132.

**Table 2.** Overlap of Probable or Confirmed Cases Between EHR and NBS sources in the Wisconsin Sickle Cell Data Collection Program

Age Group (in Years)	N	In NBS Only	In CW Only	In FH Only	In NBS and CW	In CW and FH
<10 years	255	27	92	0	132	4
10-19 years	232	0	179	1	0	52
20-29 years	188	0	8	25	0	155
30-39 years	153	0	0	44	0	109
40-49 years	90	0	0	54	0	36
50-59 years	64	0	0	42	0	22
60+ years	36	0	0	29	0	7
Total	1020 <sup>a</sup>	27	279	195	132	387 <sup>a</sup>

Abbreviations: EHR, electronic health record; NBS, newborn screening; CW, Children's Wisconsin; FH, Froedtert Hospital.

<sup>a</sup>2 subjects from EHR had age missing.

require ED visits and hospitalizations. They are also at risk of chronic end organ damage. This surveillance program can help identify the frequency of acute care utilization for pain using prior validated algorithms<sup>10</sup> and determine the prevalence of complications so an informed care approach can be adopted.

**Communication platform for individuals with SCD:** We will develop communication plans to share the findings of our program with the SCD community in Wisconsin. This will help establish a platform to share research findings and SCD resources with those who might otherwise be unaware of the complexities of the disease.

## CONCLUSIONS

Our results show the potential for learning more about the SCD population by combining data sources. Future work incorporating additional SCDC data sources is required to fully assess the prevalence of SCD throughout the state and inform policy and practice. This program will also serve as a model to understand other rare chronic conditions.

**Acknowledgements:** The authors wish to thank the members of the Bioinformatics team of the Clinical and Translational Science Institute of Southeast Wisconsin, who, under the leadership of Bradley Taylor, maintain the i2b2 electronic health record data warehouse for Children's Wisconsin and Froedtert Hospital. They would also like to acknowledge Mandie Loehe and Sandra Dawe and thank them for their contribution of newborn screening data collection. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

**Funding/Support:** This project is supported by funding from the Centers for Disease Control and Prevention, CDC-RFA-DD20-2003 (Grant #1 NU58DD000013-01-00).

**Financial Disclosures:** None declared.

**Appendix:** Available at [wmjonline.org](http://wmjonline.org)

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# Use of Peer- and Self-Evaluation to Improve Conversations with Interfacility Referring Clinicians

Anika Nelson, MD; Svetlana Melamed, MD; Sarah Corey Bauer, MD; Erin Preloger, MD; Kelsey Porada, MA; Jennifer Hadjiev, MD

## ABSTRACT

**Background:** Pediatric hospital medicine physicians receive little formal training in communicating with interfacility referring clinicians. We sought to improve pediatric hospital medicine physician confidence and communication scores by 10% during patient triage calls from interfacility referring providers via a continuing professional development initiative.

**Methods:** We conducted a single-center 10-month quality improvement project. Confidence was assessed via survey before and after the initiative. A novel self- and peer-evaluation tool was used to assess accepting pediatric hospital medicine physician communication on recorded calls. Call assessment scores were measured at baseline, cycle 1, and cycle 2. Interventions included group discussion and development of a scripting flowsheet.

**Results:** Twenty pediatric hospital medicine physicians participated and completed a total of 203 call assessments. From baseline to post-initiative, general confidence communicating with referring clinicians increased by 13% (mean ranks 11.8, 16.8, respectively), and specific confidence communicating when there is a difference of opinion increased significantly by 37% (mean ranks 9.8, 19.2,  $P < 0.001$ ). Interfacility transfer conversation evaluation scores increased by 11%.

**Discussion:** Our initiative improved accepting physician's confidence and communication evaluation scores using self- and peer-evaluation, group reflection, and a scripting flowsheet. Self- and peer-evaluation of recorded calls can be an effective intervention for building physician confidence in communicating with referring clinicians.

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## BACKGROUND

Interfacility transfers of pediatric patients from community sites to a tertiary children's hospital are common and have increased over time.<sup>1,2</sup> Hospitalists accept a large proportion of transferred patients.<sup>3,4</sup> Pediatric hospital medicine (PHM) physicians are expected to be competent in managing conversations with referring clinicians, but there is no training in the literature or widely accepted standardized handoff for interfacility transfers.<sup>5-7</sup> These conversations have been described as "frustrating and time consuming" and clinicians sometimes feel the need to "convince" the receiving physician to accept their patient.<sup>8</sup> The pressure referring clinicians feel to "sell" their patients to the accepting clinicians is consistent with the finding that upon arrival, patients appear to be in a different condition than expected 14.3% of the time.<sup>3</sup> Referring clinicians may perceive the accepting clinicians to be "rude, difficult, and unpleasant," while accepting physicians are "hesitant" to ask questions for fear of being perceived as "disrespectful."<sup>9</sup> Differences of opinion between the referring clinicians and accepting clinicians can be challenging to navigate. At our institution, PHM physicians have expressed discomfort with accepting interfacility transfers and a desire for more formal training in this area.

Our aims were to improve PHM physician confidence and evaluation scores during interfacility transfer conversations with referring clinicians by 10% from baseline scores by Plan-Do-Study-Act (PDSA) cycle 2.

## METHODS

### Context

Our PHM group comprised 32 physicians at a single freestanding children's hospital. During 2017-2018, there was an average of 11.5 admissions per day to the PHM service, and 29% of admissions came from referring clinicians outside our hospital.

### Methodology

We conducted a single-center quality improvement (QI) project with 2 PDSA cycles over 10 months. All PHM physicians were eligible to participate on a voluntary basis. Maintenance of Certification Part 4 credit was awarded after project completion.

### Interfacility Transfer Conversations

Referring clinicians requesting an interfacility transfer to our service speak to the on-call PHM physician on a recorded line. These calls were defined as "interfacility transfer conversations" and used for self- and peer-evaluation during this project. This included calls from outside emergency departments, urgent cares, and primary care clinicians. It excluded calls from our emergency department or other units within our hospital. Prior to the first cycle, participants were asked to rate their confidence in managing interfacility transfer conversations. Participants logged the calls they took during their clinical shifts by documenting date, time, and patient's medical record number. The call recordings were saved to an encrypted folder accessible to the participants.

### Measures

**Physician Confidence**—Surveys were collected at baseline and after PDSA-2 to measure PHM physician confidence in managing interfacility transfer conversations. The questions assessed general confidence in communicating with referring clinicians on the physician referral line and specific confidence communicating when the clinicians have a difference of opinion on patient care. Clinicians rated their confidence on a 5-point Likert scale from 1 (not at all confident) to 5 (extremely confident).

**Interfacility Transfer Conversations Evaluation Scores**—A literature review failed to identify a validated tool for assessing interfacility clinician communication. Therefore, we developed a novel evaluation tool to score interfacility transfer conversations (Appendix). It contained a 14-item Likert-type assessment tool adopted from a local institutional "Referring Physician Culture Enhancement Toolkit." Scores for each item ranged from 0 (not done well) to 3 (done very well). A comment section was included.

To obtain a baseline score, participants self-selected 3 recorded interfacility transfer conversations for self- and peer-evaluation. Participants listened to the recorded conversations and scored the accepting physician using the evaluation tool. The average of self- and peer-assessment scores were used as the baseline score. For each PDSA cycle, participants again self-selected 3 recorded interfacility transfer conversations for peer- and self-evaluation with the

same evaluation tool. Participant dyads were randomly assigned and differed for each cycle. Dyads met in person to compare evaluation scores and provide feedback.

**Interventions**—Participants met as a large group at the end of each cycle to review the average assessment scores and anonymized qualitative comments from the peer- and self-evaluations. The group used these data to identify areas for targeted improvement and develop interventions. The first interventions involved a group discussion on how to navigate challenging conversations and differences of opinion. The second intervention was the development and use of a novel scripting flowsheet (Figure 1).

**Ethical Considerations**—The Children's Hospital of Wisconsin Human Subjects Protection Program reviewed this study and determined it nonhuman subjects research.

### Data Analysis

Anonymous self-reported confidence scores were compared between baseline and after PDSA cycle 2 using Mann-Whitney U tests.

Interrater reliability was calculated at baseline using intraclass correlation coefficients. Self- and peer-rating scores from the evaluation tool were combined and averaged for each individual call, which was intended to reduce bias in the call assessments based on evidence on limitations of physician self-assessment.<sup>10,11</sup> To account for nonapplicable items and for ease of interpretability for QI project participants, scale ratings were converted to percentage of all points possible for overall call scores. Average scores across all participants were calculated at baseline, cycle 1, and cycle 2. Descriptive statistics and Cronbach's alpha for the 14 assessment items were calculated and representative open-ended comments were summarized.

## RESULTS

Twenty of 32 PHM physicians participated in the study and performed a total of 203 call assessments.

### Physician Confidence

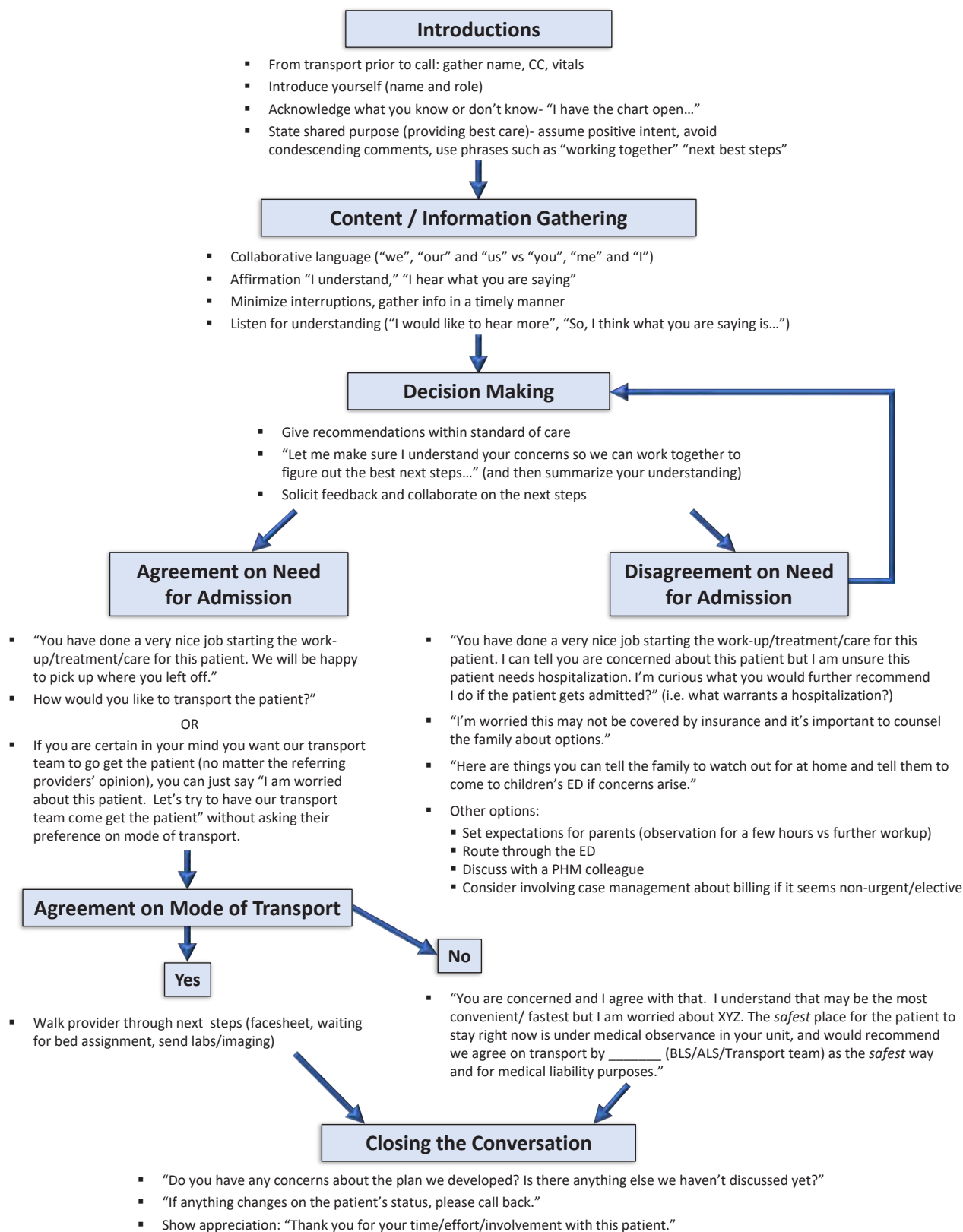
On the item "In general, how confident do you feel in communicating with referring providers on the Physician Referral line?", scores from baseline to after PDSA-2 increased by 13%, meeting our QI aim, although the change in mean ranks (11.8, 16.8) did not reach statistical significance ( $U = 57.00$ ,  $z = -1.76$ ,  $P = 0.08$ ). Regarding the item "When you and the referring provider have a difference of opinion on patient care, how confident do you feel in communicating with the other provider?", confidence scores increased by 37%, surpassing our QI aim; this increase in mean ranks (9.8, 19.2) was statistically significant ( $U = 27.5$ ,  $z = -3.29$ ,  $P < 0.001$ ).

### Interfacility Transfer Conversations Evaluation Scores

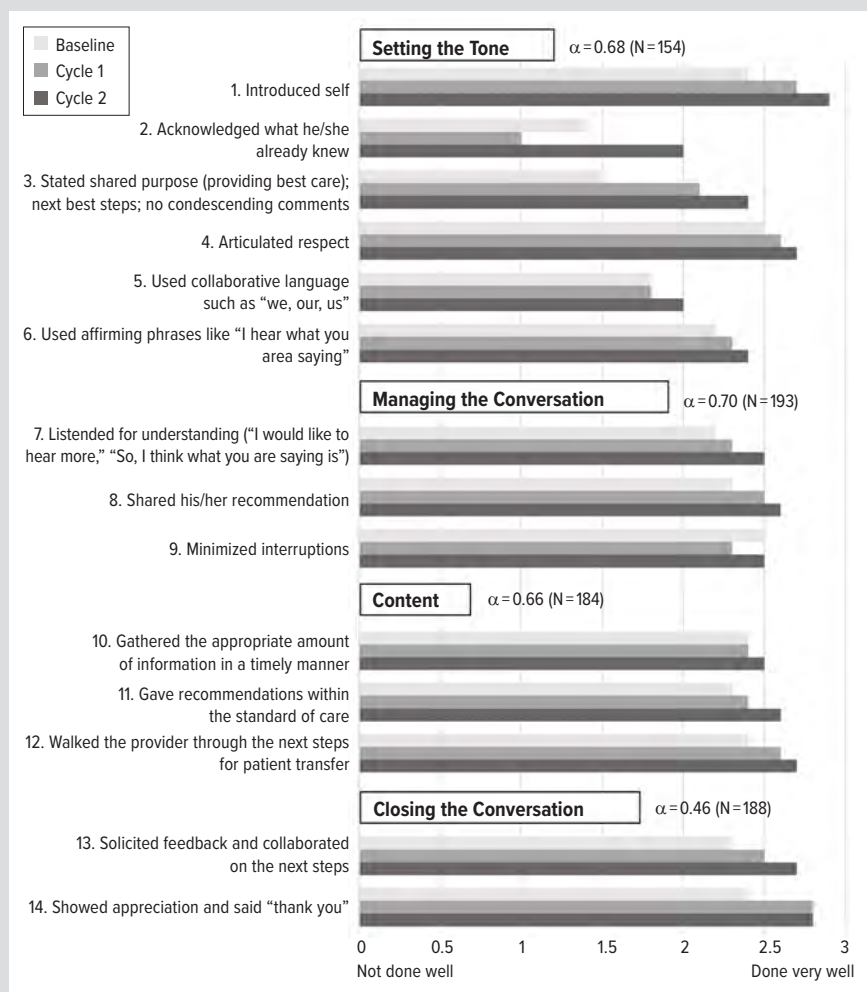
The baseline intraclass correlation coefficient for self- and peer-



**Figure 1.** Transport Call Scripting Flowsheet



**Figure 2.** Group Average Scores on 14-Item Call Assessment Tool Across Cycles



Cronback's alpha ( $\alpha$ ) used to measure internal consistency.  
Ns refer to the number of call assessments with evaluable data.

evaluations was 0.23 ( $P=0.21$ ,  $N=40$  calls); baseline call assessment data showed an average self-evaluation overall score of 60% and peer-evaluation score of 85%, with a combined average score of 73%. Results of PDSA cycle 1 increased to 78% and PDSA cycle 2 to 84%, surpassing the target aim by 1%. Figure 2 presents group average descriptive statistics for each item on an ordinal scale, as well as internal consistency within domains.

### Open-Ended Evaluations

The Table presents representative comments from participant self- and peer-evaluations of calls.

### DISCUSSION

In this single-center study using a QI framework, we improved PHM physician confidence in managing conversations with referring clinicians and increased our accepting physician evaluation tool scores. We addressed a gap in PHM physician training by creating a tool for self- and peer-evaluation of accepting physicians' communication with referring clinicians at the time of interfacility transfer, along with the interventions of a scripting flowsheet and large-group reflection.

Based on qualitative comments (Table), we believe participants made specific changes to the way they manage conversations with referring clinicians and adopted our scripting flowsheet for collaborative language. While not a stated intervention, we suspect the process of listening to one's own calls and those of peers improved confidence in managing conversations with referring clinicians. Participants often reflected on the tone of their voice—that they sounded distracted or unnecessarily interrupted the referring clinician. This self-awareness was likely a motivator for change.

The study was limited by the absence of a previously evaluated tool for assessing clinicians' communication. Despite a broad literature review, we were unable to identify such a tool and, therefore, created our own using our institution's culture

**Table.** Participant Qualitative Comments

What was done well?	What could the speaker improve upon?
Gathered information well, had clear communication and did repeat back to verify information. (Final)	I really need to watch my tone with referring providers! Accept that not all questions need to have answers. Understand that referring providers are worried and just accept the patient. (Final)
Navigated through differences of opinion to provide best care. Provided systems education to referring provider. (Final)	I sounded distracted. (PDSA1)
Tried to get patient safely here without making him feel like I was stepping on his toes, gave recommendations in a respectful way. Affirmed his impression of patient. Warm tone. (Final)	Many interruptions, I remember feeling like he wasn't giving me a lot of info. I remember worrying that I was coming off as condescending but I was worried about the kiddo. (PDSA1)
Articulated that you understood where the doc was coming from. Respectful. (PDSA1)	"Why did you get a XYZ?" came across a little disapproving. Could have said more statements to help validate what the ED doc was saying. Maybe rephrase some questions... sometimes you sounded a little annoyed. (Final)
Extremely collaborative: "Do you mind giving me a second to review?" "Would you be comfortable?" (PDSA1)	Asking one question at a time rather than multiple questions. (Baseline)

Abbreviations: PDSA1, Plan-Do-Study-Act cycle 1; ED, emergency department.

enhancement toolkit guidelines. In practice, the tool showed inadequate interrater reliability between self- and partner-assessments, which is likely due to both limitations of the tool and user biases. Twelve PHM faculty members (38%) did not participate in this voluntary project; therefore, our sample may not be representative. Due to the nature of the project, participants were not blind to the interventions or the goal of improving conversation evaluation scores, and this may have biased our results. Additionally, the calls used for evaluation were self-selected by participants and limited to 3 per cycle. This was done for feasibility as physicians were personally responsible for keeping a log of their calls and, due to the high volume of calls received on an individual shift, logging all calls would have been prohibitively burdensome. Participants were encouraged to log calls that were challenging in some way and, anecdotally, it seems that many did. However, we cannot rule this out as a source of bias.

Finally, we did not survey referring clinicians and do not know if our interventions affected their experience or the quality of the information exchanged during handoff. While participating physicians perceived conversations to be more collegial and collaborative, further studies are needed to assess whether referring clinicians felt similarly or if these interventions affected patient outcomes.

## CONCLUSIONS

Self- and peer- evaluation of recorded calls, use of a scripting flow-sheet, and large-group discussions can be effective interventions for building PHM physician confidence and skills in communicating with referring clinicians during interfacility transfer calls.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

**Acknowledgments:** The authors thank Patricia Lye, MD; Jacqueline Kuzminski, MD; Jacqueline Gauger; Judy Borchardt; and the Children's Wisconsin Transport Team for their assistance with this project.

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# Collaborative Rooming: An Innovative Pilot Project to Overcome Primary Care Challenges

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## ABSTRACT

**Background:** Primary care physicians are overburdened with growing complexities and increasing expectations for primary care visits. To meet expectations, primary care physicians must multitask during visits and spend extra hours in the office for charting, billing, and documentation. This impacts the physician's quality of life and may affect the quality of patient care. Many of the administrative tasks performed by physicians could, alternatively, be performed by nonphysician staff, leading to the adoption of team-based collaborative models.

**Methods:** Mayo Clinic Health System piloted a team-based collaborative model in a small physician practice in Osseo, Wisconsin, where staff could be trained quickly and efficiently. The model used medical assistants/licensed practical nurses (MA/LPN) to partner with primary care physicians during a patient visit. The LPN/MA, under physician supervision, ordered and monitored pending orders/labs, coordinated patient care, provided after-visit educational needs, and communicated other urgent messages to team members.

**Results:** After 6 months, a comparison of pre- and posttrial data showed improved staff and patient satisfaction, decreased physician administrative work, and no cost-effectiveness improvement. Screening of medical conditions in the elderly improved, but no change was noted with chronic disease metrics.

**Discussion/Conclusions:** Data showed improved staff and patient satisfaction, decreased physician clerical burden, increased appointment slots, mixed clinical outcomes, and did not demonstrate cost-effectiveness. The authors recommend that similar models be conducted in large settings to see if these results are reproducible.

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## BACKGROUND

Physicians spend a considerable amount of time providing care outside of office visits for patients with chronic illnesses.<sup>1</sup> For every hour physicians provide direct clinical face time to patients, nearly 2 additional hours are spent in the electronic medical record (EMR) on desk work within the clinic day. Outside office hours, physicians spend another 1 to 2 hours of personal time each night completing/finishing computer and other clerical work.<sup>2-4</sup>

An EMR enhances the ability of physicians to complete information about patients, monitor patient outcomes, and participate in new payment models that shift the focus from volume to value-based quality care.<sup>5,6</sup> But interacting with an EMR system during office visits can be distracting and impair communication with patients, which may affect patient care. Primary care physicians spend more time working in the EMR than face-to-face time with patients in clinic visits.<sup>7</sup> They are rated as having less effective communication when they spend more time looking

at the computer and when there are more periods of silence in the consultation. More research is needed to determine effective ways primary care physicians can verbally engage patients while simultaneously managing data in the EMR and to demonstrate if such “multi-tasking” is even possible.<sup>8-11</sup>

To overcome these challenges, innovative team-based collaborative models are emerging in various settings. Primary care physicians are shifting from independent to shared responsibility



by transferring some EMR tasks to other team members, such as LPN/MAs.<sup>12-14</sup> In team-based primary care models, MAs also have reported a higher workload with greater job satisfaction under team-based primary care.<sup>15</sup>

In this pilot project, primary care physicians worked collaboratively with MA/LPNs during the visit, which helped the physicians spend more time with the patient while the MA/LPN assisted with EMR tasks and coordination of care, making work joyful for the physician and MA/LPN while improving patient satisfaction.

## METHODS

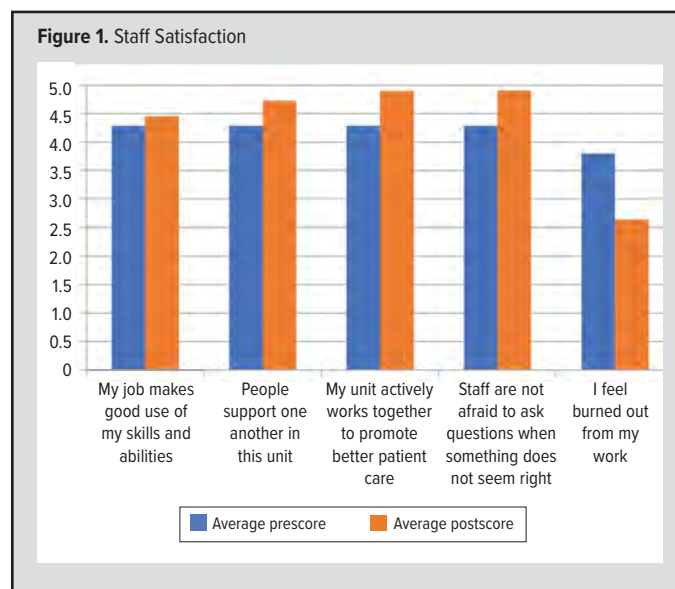
From July 2019 through March 2020, Mayo Clinic Health System launched an innovative pilot project based on a team-based collaborative model in a rural primary care practice in Osseo, Wisconsin. The project was initiated to explore the cost-effectiveness of a model designed to decrease the burden on primary care physicians while improving access, physician satisfaction, and clinical outcomes. A total of 3 physicians and 5 LPN/MAs participated in the project. Before the pilot, each physician had been assigned 1 LPN/MA, but during the pilot, each physician was assigned an extra 0.5 LPN/MA to raise the ratio to 1.5 LPN/MA:1 physician. Physicians and LPN/MAs were trained, educated, and given expectations about the new workflow before the project implementation. Routine daily huddle and weekly meetings were designed for effective communication among team members.

During the pilot, LPN/MAs reviewed health maintenance items (immunizations, preventive cancer screenings, overdue chronic disease follow up); verified and updated medications, pending medications for renewal, and pending visit orders (labs, follow-up appointment, consults, etc); entered screening test scores (asthma, depression, anxiety, etc), and added relevant instructions to the After Visit Summary document.

Additionally, LPN/MAs sent care coordination messages to allied health staff, including pharmacists, therapists, social workers, psychologists, and others who support the care of complex patients while the physician remained focused on the patient. The physician double-checked pending orders at end of the office visit to confirm their accuracy and make any adjustments. The time LPN/MAs spent with patients after the visit reinforced the physician's plan of care and confirmed any upcoming lab, radiology, or referring physician appointments. This component of the office visit allowed the physician to complete dictation, billing, and post-visit planning for the patient immediately following the office visit, while ensuring the patient's after visit care needs had been met by the LPN/MA team member. These LPN/MA tasks are distinctively different from a scribe doing EMR documentation during the clinical visit.

## RESULTS

This pilot project began on July 22, 2019, and was completed on March 25, 2020. The 3 physicians completed 3,752 visits during



this time. In mid-March 2020, significant changes in the clinic were implemented due to the effect of the first wave of COVID-19. The global pandemic halted the organization's ability to expand this project to other sites and led to its early termination.

Data comparisons from the pre-pilot and pilot phases revealed that staff and patient satisfaction scores improved (Figure 1). The "likelihood to recommend the provider" is the organization's top box patient experience measure, and the data showed an improvement score during the pilot phase. It should be noted these data have a 2- to 3-month lag due to the collection and collation processes. (Figure 2).

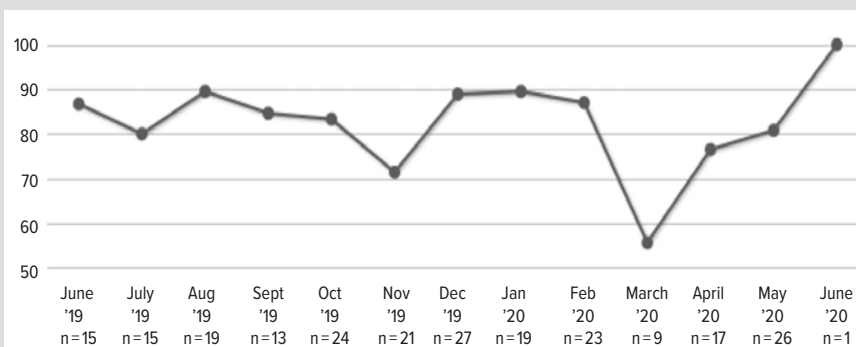
During the pilot phase, time spent in the EMR by the 3 physicians outside scheduled office time (8 AM to 5 PM) was reduced when compared to Mayo Clinic Health System (MCHS)-Bloomer, which has a similar clinician base, panel size per clinician, and rural population as MCHS-Osseo (same geographical region) (Figure 3). Additional metrics of time spent in order entry per appointment were reduced during the pilot phase. This metric also was benchmarked against the MCHS-Bloomer practice (Figure 4).

During the pilot, quality metrics showed mixed results. Colon and breast cancer prevention metrics improved slightly, no changes were noted in overall chronic disease scores, and a decrease was observed in depression screening (See Appendix). For this pilot to remain financially neutral and offset the cost of an additional 0.5 full time equivalent LPN/MA per physician, each physician would need to add 2 office visits per day, but this target was not met during the 6-month pilot.

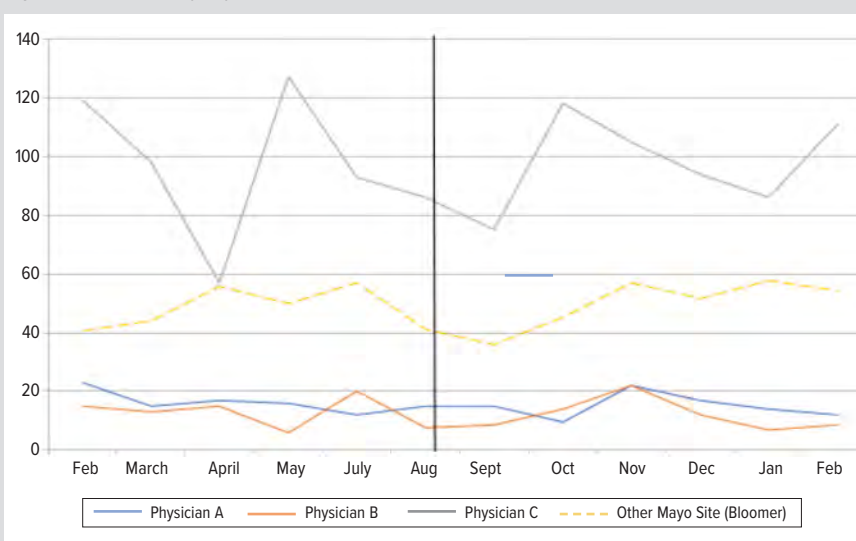
## DISCUSSION

Time spent on EMR and administrative tasks has been identified as a major contributor to primary care physician burnout. Studies have demonstrated that these responsibilities can be del-

**Figure 2.** Likelihood of Recommending Data

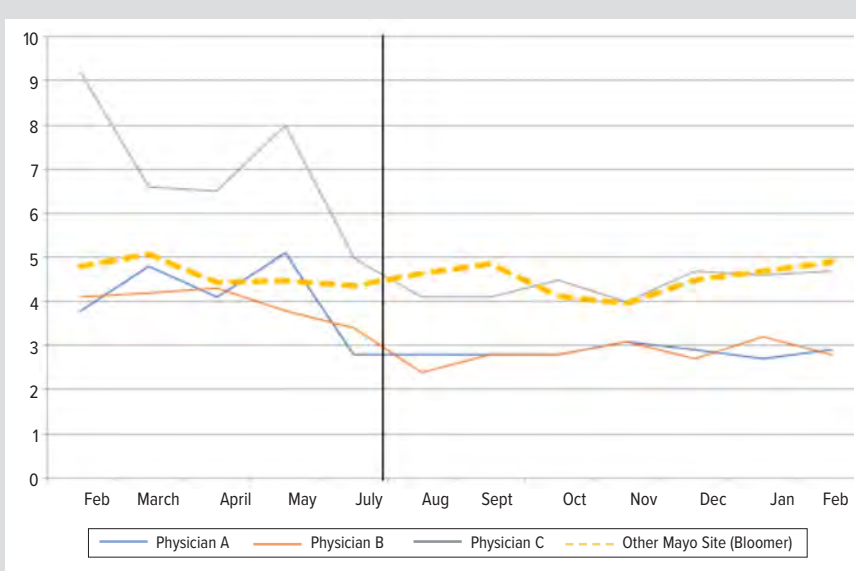


**Figure 3.** Time Spent By Physician on Electronic Medical Record Outside Scheduled Time



Note: June data are not included due to limited clinician availability.

**Figure 4.** Time Spent by Clinicians Inputting Orders per Appointment



Note: June data are not included due to limited clinician availability.

egated to other staff members in a collaborative fashion that not only increase job satisfaction among clinicians but also improve the patient experience.

The pilot project's metrics showed improved staff and patient satisfaction and decreased physician clerical burden. The study by Sheridan et al of the experience of MAs in a team-based primary care model similarly reported increased job satisfaction but also an increased workload.<sup>14</sup> Our pilot project showed improved screening for breast and colon cancer but no change in chronic disease metrics, likely because of the project's premature closing, which reduced the time available for clinical improvements to occur.

During the project, physicians who spent less time in the EMR during office visits improved their face-to-face interaction with patients—results similar to those shown by team-based models from Intermountain Healthcare and Misra-Hebert et al.<sup>15,16</sup> However, although Intermountain Healthcare's project demonstrated a 20% increase in patient visits,<sup>15</sup> our pilot did not demonstrate an increase in the number of patient visits per day.

The cost of additional MA training and lack of reimbursement for nonbillable services by MAs is a major limiting factor of these models.<sup>13</sup> Future studies should attempt to demonstrate how the higher personnel cost of the collaborative model can be offset by reduced staff turnover and higher revenues from increased visits.

## CONCLUSIONS

Overall, our pilot project demonstrated mixed results in terms of success. More collective efforts are needed by medical communities to innovate, test, and measure the team-based models of care like the collaborative rooming model described. Team-based care supports high-quality care for patients and improves staff and patient satisfaction. Further research is required to better understand and develop collaborative models to improve patient, staff, and clinician satisfaction while

delivering high-quality, patient-centered care, and more research is needed to improve the cost-effectiveness of these innovative team-based models.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

**Appendix:** Available at [wmjonline.org](http://wmjonline.org).

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# Getting SET for Student Success: Foundations for a Student Education Team

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## ABSTRACT

**Background:** Family medicine clinical education poses logistic issues that we sought to address with the Student Education Team model.

**Methods:** The model combined team-based, patient-centered care with student experiences in a sustainable precepting model. Four learners successfully underwent precepting simultaneously. Schedulers booked patients in the team schedule, and the patients knew they would see a student and a faculty team member.

**Results:** The Student Education Team model increased the learner to preceptor ratio compared to traditional precepting models. Use of the team increased the number of learners completing rotations. The team schedule nearly eliminated patients refusing student involvement and enhanced throughput because patients saw the most readily available staff.

**Discussion:** The team offered clinicians and learners a model for incorporating learning into clinicians' schedules.

## BACKGROUND

Current clinical education models pose many logistic issues, including preceptor-learner pairing, patient scheduling and acceptance of learners, and preceptor recruitment and retention. The current apprenticeship-preceptor model presents difficulties in finding clinicians willing to assume the role of precepting; in

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limiting the clinician-preceptors' access to patients; and in contending with limited physical space, time constraints, limited administrative support, and lack of compensation for teaching.<sup>1,2</sup> With an increasing need for clinical rotations for medical, nurse practitioner (NP), and physician assistant (PA) students, the demand for these educational opportunities is increasing faster than the apprenticeship model alone can sustain.<sup>3</sup> To address these challenges in a more efficient, sustainable, and cost-effective manner, a Student Education Team (SET) model was created within a community-based family medicine practice. In this report, we share key tenets of the SET model and preliminary data demonstrating that it is a sustainable approach to team-based family medicine education, and we recommend that other community-based practices consider this model.

## METHODS

The SET model includes a team of physicians, NPs, and PAs who teach up to 4 medical, NP, and PA student learners at a time (Figure). Within the model, an innovative schedule template was created. Patients are scheduled in waves of 2 patients per appointment slot to the SET team rather than to specific clinicians. The model was implemented at a physician-led major group practice by adapting multiple tools and resources<sup>4,5</sup> to address practical challenges in educating medical learners in team-based, patient-centered care.

To provide opportunities for students to learn and practice team-based care, foundational principles of the SET include hands-on clinical experience, interdisciplinary learning, and consistent teaching methods. In this model, students receive profes-



sional socialization in their chosen field through preceptors matching the student's future role while collaborating with family medicine clinicians in complementary roles. The SET clinic is located within a larger family medicine clinical department. Students, preceptors, and support staff are located together in the work area to enhance teamwork and facilitate learning opportunities. Students on the team provide front-line patient care, participate in quality initiatives, and attend meetings. All clinicians on the SET share teaching responsibilities for students, enhancing the ability to recruit preceptors.

Administrative support is leveraged to manage schedules and create shared electronic health record (EHR) templates for students and preceptors, such as the use of wave scheduling.<sup>5</sup> This scheduling template allows students to see patients before staffing with a preceptor, allows time for mentoring, and maintains clinical productivity for clinicians.

To ensure a patient-centered transition to the SET model, the practice sent letters to all patients in the SET clinicians' panels describing the practice change. On an ongoing basis, the scheduling teams used scripts to set expectations and explained that patients would see both a student and a supervising faculty member.

Two available clinicians were designated as student preceptors for the day, and other clinicians from the team maintained their own clinic schedules. The SET preceptors split their time equally between student supervision and their own practices. Students spent equivalent time with each preceptor, regardless of the students' training disciplines.

## RESULTS

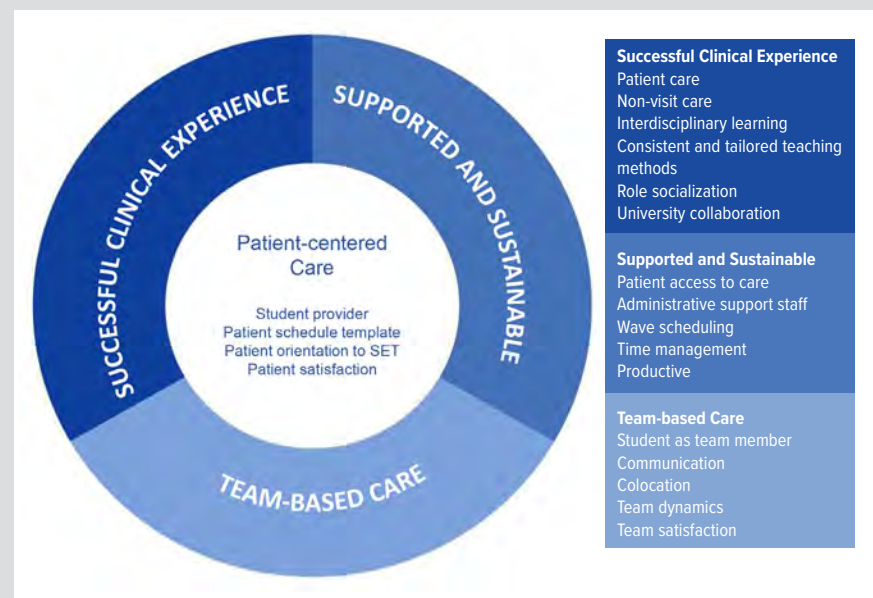
### Team Structure

The SET model began with 4 clinicians (1 family physician, 1 NP, and 2 PAs; a combined 2.9 full-time equivalents [FTE]); 4 rooming staff (3.2 FTEs); and 1 registered nurse in a triage role. Departmental leaders selected team members who had experience in both clinical practice and precepting or new employees who were interested in teaching. The 4 clinicians were chosen because they were the only clinicians in the department who were precepting at least 1 NP, PA, or medical student per year.

### Teaching Capacity

Medical and PA learners working in the SET spent 4 to 6 consecutive weeks in a rotation. NP students typically spent the equivalent of 2 to 3 days per week each semester in direct clinical education

**Figure.** The Student Education Team (SET) Model



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**Table.** Student Capacity in the Student Education Team (SET) Model

Students' Academic Discipline	No. of Days Per Week	Avg No. of Weeks	SET Annual Capacity
Medical	5	4-6	8-12
Nurse Practitioner	2-3	16	14
Physician Assistant	5	4-6	8-12

in the SET while they continued their didactic curriculum and worked as registered nurses. Each day, the SET could accommodate up to 4 learners, and it hosted 33 learners per year since its inception in 2018 (Table). Before the SET was implemented, the 4 clinicians precepted 4 to 6 students per year (1-2 learners per clinician per year).

### SET Workflow

Students on the SET followed a shared daily schedule for patient care, including huddles to review the patient schedule and goals for the day, didactic and interactive teaching time, and time for supervised nonvisit care (reviewing and communicating diagnostic test results, managing medication refill requests, and replying to patient questions). During each visit, the student saw the patient in the examination room, reviewed relevant findings and the care plan with an available preceptor, and closed the visit in the examination room with the patient and preceptor.

Although all clinicians on the team mentored all students, each student was assigned a primary preceptor whose training discipline matched the student's. The primary preceptor guided the learner's overall clinical experience and met regularly with the student to discuss goals, address challenges, and provide men-

toring. Primary preceptors completed student evaluations that reflected feedback from the entire team. Feedback was obtained through informal discussions between preceptors on the team.

Learners placed in the SET were placed on the basis of current affiliation agreements with the NP, PA, and medical programs. Because learners were from multiple educational programs and were in different stages in their didactic and clinical education, preceptors huddled with the learners to review the patient schedule and make recommendations for whom the students should see according to their experience. Preceptors also used direct observation of the students to provide them with additional feedback.

The SET clinical space included 8 examination rooms, 1 nurse-team station with dedicated workstations for students, and 2 private offices for the use of any team member. Administrative staff scheduled student rotations with the SET, managed preceptor schedules, and managed EHR templates. Preceptors provided direct supervision and were responsible for each clinic visit, in accordance with Medicare, US Drug Enforcement Administration, and state licensure regulations.

### General Outcomes

Metrics for success and sustainability of the SET model in a community-based practice included improved access to care, patient satisfaction with student involvement in patient care, and maintenance of adequate clinical productivity metrics. Obtaining metrics for the team has been a challenge owing to the small sample size and variability related to external factors, including temporary suspension of precepting due to the COVID-19 pandemic. The SET was an asset to the department because the shared student schedule template increased same-day access to care, while maintaining levels of clinical productivity for the preceptors. Five appointment slots daily are designated “same-day appointments” to enhance access.

Because patients are aware of student involvement at the time of scheduling their appointment, there has been essentially no refusal of participation at the time of the appointment, which is a barrier to traditional apprenticeship models. In 2021, patient fill rates for the SET schedule averaged 95%, the new/unique patient rate for the schedule was 10%, and the no-show rate was less than 10% for the SET.

The SET also has increased the number of learners at the family medicine site from 3 to 5 per year to more than 30 learners per year. The number of physician preceptors at the site also increased from 1 in 2018 to 5 in 2022. With the exception of involvement in positions that further the individual’s career, no team members (clinicians or support staff) have stopped precepting or working with the team since the model was adopted. Additionally, the success of the SET resulted in variations of the model being implemented in the obstetrics and gynecology and pediatrics departments.

## DISCUSSION

The SET model was created to address barriers to educating and mentoring medical learners. The model accomplished this goal through development of an innovative scheduling template and the use of hands-on team-based learning while it involved various mentors with different credentials. Although the SET has shown initial positive effects in patient access and continued clinician productivity, future research is needed to assess patient satisfaction, student outcomes, and preceptor outcomes.

An advantage of the SET model for patient care is that the team-based approach to scheduling management allows patients to shift between schedules to improve patient flow and student access to learning experiences while maintaining continuity with the team. The SET clinicians who are not scheduled to precept may assist when needed and bring interesting learning opportunities to the team from their own clinic schedule.

Additional research is underway to assess how the SET affects common barriers to precepting and to identify factors that contribute to the ongoing success of the team. We recommend that other community-based practices consider this model.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

**Ethical Approval:** Not applicable.

**Previous Presentations:** STFM Conference on Medical Student Education, Portland, Oregon; January 30-February 2, 2020.

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# Helping Residents Excel in Team-Based Care: An Interactive Case-Based Interprofessional Education Curriculum

Cecilia Scholcoff, MD, MPH; Katherine Sherman, MS; Jessica Kuester, MD; Amy Farkas, MD, MSc

## ABSTRACT

**Background:** Communication and collaboration with an interprofessional team is vital for patient care, yet teaching these skills to resident physicians faces multiple challenges.

**Methods:** We developed an interactive, case-based curriculum on interprofessional communication and collaboration and implemented it at a large Veterans Affairs hospital. A pre/post survey study design was used to evaluate the curriculum, with 31 residents completing both surveys (100% response rate).

**Results:** After the curriculum, there was improvement in the residents' knowledge, comfort, and satisfaction in communicating and collaborating with the interprofessional team. Satisfaction scores with clinic also improved in all measures.

**Discussion/Conclusions:** Overall, a curriculum aimed at teaching interprofessional communication and collaboration improved residents' comfort and satisfaction in this realm and may help them achieve competence in these challenging-to-teach skills.

to resident physicians in the outpatient setting presents multiple challenges due to time limitations of residents and faculty, space limitations, buy-in from stakeholders, and educational expertise in this area.<sup>4</sup>

The Department of Veterans Affairs (VA) implemented its version of the PCMH—called Patient Aligned Care Team (PACT)—in 2010, and studies have found improvement in patient care measures in VA primary care.<sup>5</sup> We developed and implemented a curriculum to teach interprofessional communication and collaboration to internal medicine residents with primary care clinic at a large, academic, urban VA hospital.

## BACKGROUND

Interprofessional collaboration improves patient outcomes and has led to a shift in primary care to the patient-centered medical home (PCMH), which is based on an interdisciplinary model of care.<sup>1</sup> The National Academy of Medicine identifies working within an interdisciplinary team as a core competency for providing high-quality care, and the Accreditation Council for Graduate Medical Education includes communication and collaboration with the interprofessional team within its internal medicine systems-based practice milestones.<sup>2,3</sup> Teaching interprofessional collaboration skills

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## METHODS

### Intervention and Setting

A curriculum, based on work by Nikiforova et al,<sup>6</sup> was developed with input from the interprofessional care team at the VA hospital. The objectives, cases, questions, and answers were developed then distributed to the interprofessional team for feedback. Feedback was subsequently incorporated into the final version of the curriculum (Appendix). Internal medicine residents (post-graduate years [PGY] 1-3) with continuity clinic at the VA hospital received the curriculum during the 2019-2020 academic year. The curriculum had 7 sessions that were delivered monthly during a required pre-clinic conference session, each lasting 30 minutes. After an introduction session that highlighted the goals, structure, and evidence of PACT, each session focused on a specific interprofessional discipline: licensed practical nurses (LPN), registered nurses (RN), pharmacists, primary care mental health integration (PC-MHI) psychologists and pharmacists, social workers, and registered dietitians. The interprofessional team member, a faculty facilitator, and

**Table 1.** Mean Rank Comfort and Satisfaction Scores With Patient Aligned Care Team (PACT) Members

Team Member	Pre-data Mean Rank	Post-data Mean Rank	P value
Medical Support Assistant			
Comfort	25.45	37.55	0.0050
Satisfaction	26.33	34.40	0.0480
Licensed Practical Nurse			
Comfort	26.95	36.05	0.0270
Satisfaction	27.02	35.94	0.0257
Registered Nurse			
Comfort	27.68	35.32	0.0646
Satisfaction	28.45	34.55	0.1125
Social Worker <sup>a</sup>			
Comfort	26.70	34.30	0.0766
Satisfaction	23.22	31.19	0.0432
Pharmacist			
Comfort	25.47	36.35	0.0112
Satisfaction	24.41	33.93	0.0218
Registered Dietician			
Comfort	26.25	34.75	0.0498
Satisfaction	21.15	29.52	0.0311
PC-MHI Therapist <sup>a</sup>			
Comfort	25.45	36.37	0.0122
Satisfaction	21.48	31.23	0.0140
PC-MHI Pharmacist <sup>a</sup>			
Comfort	22.98	36.34	0.0020
Satisfaction	18.08	28.71	0.0065

Abbreviation: PC-MHI, Primary Care-Mental Health Integration.

Note: Measurements were in Likert scale from 1—very uncomfortable/unsatisfied to 5—very comfortable/satisfied.

<sup>a</sup> Curriculum session affected by COVID-19 pandemic and delivered via email.

the residents were present for these sessions. The sessions involved case-based discussion of how the interprofessional team member is vital for patient care and how to communicate with the team member. Our curriculum was affected by clinic cancellations due to the COVID-19 pandemic; therefore, we emailed to residents the faculty guide and suggested answers for the sessions on social workers and the PC-MHI team. We did not verify that residents reviewed the material emailed for those sessions.

## Outcomes

Residents completed preintervention and postintervention surveys. Our surveys assessed resident knowledge of the PACT members (using yes/no format), as well as comfort and satisfaction levels as it pertains to engaging these members (using Likert scale from 1—very uncomfortable/unsatisfied to 5—very comfortable/satisfied) and measures of resident satisfaction with continuity clinic. We also collected demographic data including resident age, PGY level, and assigned clinic day. Surveys were paper-based and coded to allow for paired data.

## Analysis

Paired pre/post survey data were analyzed to evaluate the impact of our curriculum using binomial proportions and Wilcoxon

signed rank test for median comparison with Bonferroni correction using SAS 9.4 14.3. Binomial proportions were used to determine whether the rate of residents who knew how to contact particular PACT team members improved over baseline. The Milwaukee Veterans Affairs Institutional Review Board approved the study.

## RESULTS

We had a 100% response rate, with all 31 residents completing both the presurvey and postsurvey. We surveyed 9 PGY1s, 11 PGY2s, and 11 PGY3s.

After the curriculum, there was a positive change in the residents' knowledge of how to contact all PACT members. The pre-intervention data found that most residents knew how to contact LPNs and RNs, 80% and 87%, respectively. This improved to 90% and 97% in the postintervention survey but was not statistically significant. Prior to the curriculum, fewer residents knew how to contact the social worker (65%), pharmacist (55%), registered dietician (29%), PC-MHI therapist (42%) and PC-MHI pharmacist (13%). These categories had the highest percent change between the preintervention to postintervention survey and improved to 81% (social worker), 87% (pharmacist), 58% (registered dietician), 74% (PC-MHI therapist), and 63% (PC-MHI pharmacist), which is an increase of 16%, 32%, 29%, 32%, and 50%, respectively. These improvements were statistically significant, with a  $P$  value  $< 0.05$ . To account for variability from our small sample size, we also calculated a more conservative measure using the upper 95% confidence interval of the baseline proportion, which found the gains for the pharmacist, PC-MHI therapist, and PC-MHI pharmacist were statistically significant ( $P$  value 0.0333, 0.0458, and  $< 0.0001$ , respectively).

Resident comfort and satisfaction as it pertains to collaborating with the PACT members improved after implementation of the curriculum (Table 1). Several improvements in resident comfort and satisfaction were statistically significant ( $P < 0.0062$ ). We also measured satisfaction with several aspects of resident continuity clinic (Table 2), which improved with curriculum implementation.

## DISCUSSION

We found that implementation of an interactive, case-based curriculum focused on interprofessional collaboration and communication improved residents' knowledge, satisfaction, and comfort as it pertains to interacting with the interprofessional team. Our data showed that the biggest gains in terms of preintervention to postintervention change were in the interactions with interprofessional members who were less commonly contacted in routine clinical practice. For example, only a small proportion of residents—13%—knew how to contact the pharmacist on the PC-MHI team prior to our curriculum. This improved to 63% after the curriculum. In contrast, many of the residents already knew how to contact the RN—a more commonly contacted PACT member—and felt com-



fortable and satisfied in doing so prior to the intervention. This highlights the need for interprofessional education to ensure that trainees are aware of and comfortable utilizing all the resources available to patients rather than just those most utilized.

Other interventions have been studied to fill this gap in resident education, from simulation sessions to systematic changes to how resident clinic is conducted.<sup>7-10</sup> Many of these interventions are effective in addressing this gap; however, several of these require specialized training or structural changes that may not be feasible for most programs. We studied the use of a case-based curriculum that could be easily incorporated into already structured didactic sessions in resident continuity clinic as a more accessible solution to teaching interprofessional collaboration and communication during training. Furthermore, we found significant gains in residents' knowledge, comfort, and satisfaction interacting with the interprofessional team members for which the curriculum was emailed rather than delivered in-person due to the COVID-19 pandemic. Hence, these kinds of tools might help bridge the gap in situations where in-person team meetings or education are not feasible.

Our study has limitations. First, it was a single-center study that included a small number of trainees; hence, generalizability could be limited. However, our work builds on previous curricular interventions, suggesting that it may be broadly applicable to improve education in interprofessional collaboration.<sup>6</sup> Next, it is possible that improvements in outcomes were related to usual progression of clinical training; but gains in interprofessional knowledge, comfort, and satisfaction were seen in senior residents, PGY2s, and PGY3s who had been in the same clinic since their PGY1 year. Additionally, given that some sessions were emailed without requiring confirmation of review of the material, it is unclear what part of the curriculum led to the gains observed in residents' knowledge, comfort, and satisfaction. Lastly, we had planned to assess if improvement in residents' knowledge, satisfaction, and comfort led to improved patient care; however, we were unable to do so because of changes in care delivery during the COVID-19 pandemic. We did not evaluate if our curriculum led to mastery in systems-based practice milestones and think that further study into these outcomes is warranted.

### CONCLUSIONS

We believe that incorporating interprofessional education into the curriculum helps address some of the challenges inherent in teaching interprofessional communication and collaboration during residency. It ensures that residents are exposed to the interprofessional team, regardless of scheduling, time and space limitations, and faculty expertise in this topic.

**Acknowledgements:** The authors would like to acknowledge all members of the Patient Aligned Care Teams at the Clement J. Zablocki VA Medical Center who gave them feedback on their curriculum and supported their endeavors to teach these skills.

**Table 2.** Mean Personal Satisfaction with Continuity Clinic

Variable	Pre-data Mean Rank	Post-data Mean Rank	P value
How well primary care provider and registered nurse work together	28.42	34.58	0.112
How well primary care provider and other health professionals work together	27.02	35.98	0.026
How well primary care provider and administrative staff work together	24.37	38.63	0.0007
Nursing support for patients between visits	28.00	35.00	0.0722
Appreciation	27.40	35.60	0.0496
Job stress	26.23	36.77	0.0121
Continuity with patients	29.16	33.84	0.2444
Responsibility/ownership for patients	27.98	35.02	0.0856

Note: Measurements were in Likert scale from 1 – very unsatisfied to 5 – very satisfied.

**Funding/Support:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Financial Disclosures:** None declared.

**Appendix:** Available at [wmjonline.org](http://wmjonline.org)

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# Simulation-Based Medical Education: Development of an Assessment Tool for Novice Use

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## ABSTRACT

**Background:** Simulation-based medical education, an educational model in which students engage in simulated patient scenarios, improves performance. However, assessment tools including the Oxford Non-Technical Skills (NOTECHS) scale require expert assessors. We modified this tool for novice use.

**Methods:** Medical students participated in 5 nontechnical simulations. The NOTECHS scale was modified to allow for novice evaluation. Three novices and 2 experts assessed performance, with intraclass correlation used to assess validity.

**Results:** Twenty-two learners participated in the simulations. Novice reviewers had moderate to excellent correlation among evaluations ( $0.66 < \text{intraclass correlation coefficients [ICC]} < 0.95$ ). Novice and expert reviewers had moderate to good correlation among evaluations ( $0.51 < \text{ICC} < 0.88$ ).

**Discussion:** The modified NOTECHS scales can be utilized by novices to evaluate simulation performance. Novice assessment correlates with expert review. These tools may encourage the use of simulation-based medical education.

## BACKGROUND

The use of simulation in medical education has increased significantly over the past decade.<sup>1</sup> Simulation-based medical education (SBME) improves students' clinical skills and patient outcomes compared to traditional education methods.<sup>2-5</sup> Student

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skill improvement is attributable, in part, to performance assessment and feedback from low-stakes, high-fidelity simulations. One commonly used validated assessment tool of SBME is the Oxford Non-Technical Skills (NOTECHS) scale, which was designed to assess nontechnical skills, such as cognitive reasoning and communication, of an individual within a group setting (eg, assessment of a surgeon in the operating room).<sup>6</sup>

Despite its utility in assessing individual nontechnical skills, the NOTECHS scale is limited by the need for assessors with prior experience in the specific nontechnical skill areas being tested.<sup>6</sup> Thus, NOTECHS scale assessments typically require faculty participation. This presents challenges for implementation, as it requires coordination with busy academic and clinical schedules and, thus, potentially limits use of SBME. For this reason, using nonclinical personnel as assessors (ie, crowdsourcing clinical novices) could improve the efficiency and frequency of SBME. Crowdsourcing novices for assessment of student technical performance in simulation can be time-efficient and achieve high interrater reliability between novices and clinicians.<sup>7-10</sup>

In order to address this limitation of existing simulation assessment tools, our team of surgeons and clinical novices modified the NOTECHS scale as part of an exploratory study to assess the ability to eliminate the need for experienced assessors and allow for successful performance evaluation by novices.

**METHODS**  
This project was determined to be exempt from review by the institutional review board. Fourth-year medical students at the

Figure 1. a-NOTECHS Assessment Tool

Faculty Name: \_\_\_\_\_  
Student Code: \_\_\_\_\_

**UW Madison Surgery IPC Intern Prep Course SIMCenter Evaluation Tool – 2017**

Please circle the case being performed: Oliguria A Fib Chest Pain Change in Mental Status

Topic	5 = High Performing	4 = Above Average	3 = Satisfactory	2 = Below Average	1 = Poor Performing
<b>Overall Approach</b> Interaction with patient and nursing staff to successfully evaluate the patient and obtain pertinent clinical information in a timely and organized fashion	Organized approach results in efficient obtainment of clinical data, medical decision making, clinical treatment and notification of senior resident	Generally organized, however misses an important aspect of care	Becomes sidetracked in evaluation of the patient, resulting in loss of care efficiency.	Provides appropriate medical care but disorganized approach hinders the timing or delivery of that care	Scattered or disorganized approach interferes with timely care and management of the patient
<b>Data Collection</b> Orders diagnostic tests appropriate to and focused on the clinical setting	Obtained all critical data points	Obtained most of the critical data	Obtained some critical data	Required prompting to obtain critical data	Failure to obtain critical data
<b>Differential Diagnosis</b> Creates a differential diagnosis appropriate to the clinical setting	Comprehensive Included Critical Diagnosis	Appropriately Broad	3-4 Diagnoses	One or Two Diagnoses	No Differential Diagnosis
<b>Medical Decision Making</b> Appropriate to the clinical setting	Initiated all appropriate therapies Appropriate disposition of patient	Initiated some appropriate therapies	Delayed decision making resulted in delay of care	Some ideas but no clear decisions made	Delay in treatment of urgent condition Stumped
<b>Communication and Interaction w/ RN</b>	Requested appropriate work up at initial call Professional behavior. Good Communication.	Provided some Communication	Incomplete communication Didn't request additional testing/info	Delayed or repetitive communication	Excessively delayed communication Required prompting Disregarded RN or Rude
<b>Communication with Senior Resident</b>	Called Senior in timely, appropriate fashion Concise report, with all needed information	Called within appropriate time period. Missing minimal information	Call delayed or missing some info	Required prompting to call senior	Excessively delayed Communication Required excessive prompting

Comments:-

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University of Wisconsin (UW) who matched into surgical residency programs completed an Internship Preparation Course (IPC). Additional components of the course are reported elsewhere.<sup>11,12</sup> The curriculum incorporated SBME by conducting SimMan 3G simulations at the UW Health Clinical Simulation Program. Simulation scenario scripts were written by course directors about 5 common on-call clinical presentations: chest pain, atrial fibrillation, oliguria, altered mental status, and trauma. Each scenario was designed to test clinical decision-making rather than technical skills. To simulate the clinical environment, registered nurses and senior resident confederates were simulated by faculty and resident surgeons.<sup>13</sup> The scenarios were designed to last approximately 7 to 8 minutes. The simulations were audio/video recorded for review. The Oxford NOTECHS scale was adapted to allow for assessment of a single student's performance (a-NOTECHS; Figure 1). This initial adaptation was separate from modifying the tool for novice use. Faculty and resident surgeons assessed learner performance using the

a-NOTECHS form to provide feedback to students. These assessments were not included in our analysis.

We modified the a-NOTECHS to allow for assessments to be completed without the need for prior training or a clinical background with the input of a first-year medical student and 2 faculty surgeons. The overarching a-NOTECHS domains remained unchanged and included overall approach, data collection, differential diagnoses, medical decision-making, communication and interaction with the nurse, and communication with the senior resident. All simulation assessment tools and scenario scripts are included as appendices. Our modified-NOTECHS (m-NOTECHS) for the chest pain scenario is included as an example (Figure 2). The process of creating scenario-specific m-NOTECHS scales is described by domain.

#### Data Collection, Differential Diagnoses, Medical Decision-Making

In the original a-NOTECHS, the 3 domains of data collection, differential diagnoses, and medical decision-making require evalu-

**Figure 2.** m-NOTECHS Assessment Tool, Chest Pain

<b>Data Collection</b> <i>Orders diagnostic tests appropriate to and focused on the clinical setting</i>	<b>Differential Diagnosis</b> <i>Creates a differential diagnosis appropriate to the clinical setting</i>	<b>Medical Decision-Making</b> <i>Appropriate to the clinical setting</i>	<b>Communication and Interaction With Registered Nurse (RN)</b>	<b>Communications With Senior Resident (SR)</b>	<b>Overall Approach</b> <i>Interaction with pt and nursing staff to successfully evaluate the pt and obtain pertinent clinical info in a timely and organized fashion</i>
<b>Critical Data Points:</b> <input type="checkbox"/> Vitals ( $\geq 3$ ) ___Heart rate ___Blood pressure ___Respiratory rate ___Temperature ___O <sub>2</sub> saturation <input type="checkbox"/> Current medications <input type="checkbox"/> Confirm pt is on telemetry <input type="checkbox"/> Confirm pt has an IV  <b>Labs:</b> <input type="checkbox"/> Troponin* <input type="checkbox"/> BMP/electrolytes ( $\geq 2$ ) ___Potassium, K ___Magnesium, Mg ___Phosphorus, P <input type="checkbox"/> CBC <input type="checkbox"/> ABG  <b>Imaging:</b> <input type="checkbox"/> ECG* <input type="checkbox"/> Chest x-ray	<b>Critical Diagnoses:</b> <input type="checkbox"/> Angina <input type="checkbox"/> Demand ischemia <input type="checkbox"/> NSTEMI <input type="checkbox"/> STEMI <input type="checkbox"/> Anxiety <input type="checkbox"/> PE <input type="checkbox"/> Pleuritic pain/PNA	<input type="checkbox"/> Apply Oxygen  <b>Administer medication:</b> <input type="checkbox"/> Nitroglycerin <input type="checkbox"/> Aspirin <input type="checkbox"/> Reglan <input type="checkbox"/> 2nd nitroglycerin <input type="checkbox"/> Beta-blocker <input type="checkbox"/> Morphine  <input type="checkbox"/> Administer IV fluids <input type="checkbox"/> Transfer to ICU or call code	<input type="checkbox"/> Contact occurs w/in first 2 mins and 30 sec of sim*  <input type="checkbox"/> Request nurse's sign out/notes on pt <input type="checkbox"/> Request pt PMH <input type="checkbox"/> Obtain current/ home medications <input type="checkbox"/> Order/discuss workup of pt** <input type="checkbox"/> Communicates concerns/differential diagnosis <input type="checkbox"/> Communicates medication order(s)  <input type="checkbox"/> Professional communication (Please and thank you)	<input type="checkbox"/> Contact occurs w/ each evaluation interaction* <input type="checkbox"/> Pt name <input type="checkbox"/> Age <input type="checkbox"/> Gender <input type="checkbox"/> Hospital/post-op day <input type="checkbox"/> Reason in the hospital or operation <input type="checkbox"/> Reason for call <input type="checkbox"/> Vitals ( $\geq 2$ ) ___Heart rate ___Blood pressure ___Respiratory rate ___Temperature ___O <sub>2</sub> saturation <input type="checkbox"/> Lab and/or imaging results ( $\geq 2$ ) ___Electrolytes ___Troponin ___ECG ___Chest x-ray <input type="checkbox"/> Treatment thus far + any results (or thoughts/questions)	Scattered or disorganized approach that interferes w/ timely care and management of pt = 1  Provides appropriate medical care but disorganized approach hinders timing/delivery of that care; required SR guidance in data and treatment = 2  Becomes sidetracked in evaluation of pt, loss of efficiency; required SR guidance in data or treatment = 3  Organized but missed important aspect of care; 1 box; required minimal guidance = 4  Efficiently completed scenario; all boxes = 5
No tests ordered = 1 1-3 checkbox; missed * = 2 4-5 checkboxes, incl. * = 3 6-7 checkboxes = 4 8-10 checkboxes = 5	No diagnoses stated = 1 1-2 stated dx = 2 3-4 stated dx = 3 5+ stated dx, stumbled, scattered = 4 5+ stated dx, concise = 5	Stumped = 1 Verbalized idea(s) but nothing done = 2 1-3 checkbox = 3 4-6 checkboxes = 4 7-9 checkboxes = 5	Did not contact or had to be told by facilitator to contact RN; was rude, ignored or disregarded RN = 1 Delayed, missed *; repetitive = 2 3-4 checkboxes, incl. * but missed ** = 3 5-6 checkboxes, incl. * & ** = 4 7-8 checkboxes = 5	Did not contact; was rude or disregarded SR = 1 Delayed, missed *; had to be told by facilitator to contact SR = 2 1-4 checkboxes, incl. * = 3 5-7 checkboxes, incl. * = 4 8-10 checkboxes, incl. * = 5	

Abbreviations: pt, patient; O<sub>2</sub>, oxygen; BMP, basic metabolic panel; CBC, complete blood cell count; ABG, arterial blood gas; ECG, electrocardiogram; NSTEMI, non-ST-segment elevation myocardial infarction; STEMI, ST-segment elevation myocardial infarction; PE, pulmonary embolism; PNA, pneumonia; dx, diagnoses; IV, intravenous; ICU, intensive care unit; PMH, past medical history; post-op, postoperative.

ators to globally judge whether a criterion is met without providing specific benchmarks (eg. “obtained all critical data points”). This language is not suitable for novice reviewers as they do not have the clinical experience to make these expert-level judgements (Figure 1). The process of quantifying these 3 domains was similar. Scenario-specific tests, diagnoses, and treatments were interpreted from the learning objectives of scenario scripts and made into checkboxes. The course directors added other appropriate

possibilities and labeled specific data and treatments that must be completed in order to achieve a “satisfactory” m-NOTECHS score (Figure 2). In order to quantitate the “some” and “most” terms used in the a-NOTECHS scoring throughout these 3 domains, each score was quantified by requiring a set number of checkboxes. Within medical decision-making, a delay in treatment was defined as the elapse of 75% of the allotted simulation time before a treatment was initiated.



## Communication and Interaction With the Registered Nurse

“Timely” (Figure 1) was defined as communication occurring prior to elapse of 25% of the allotted simulation time; communication occurring after that was considered delayed. Obtaining other relevant patient information from the nurse, such as past medical history, the nurse’s notes, and current medications, were added as checkboxes. Checkboxes also were added for professionalism, communicating medications or other orders, and discussing concerns with the nurse to further quantify the communication (Figure 2).

## Communication With the Senior Resident

In each scenario, a specific action or change in patient status was marked as an essential time for communication with the senior resident (Figure 1). Thus, contact at or before each point defined timely communication with the resident, and communication after that point was considered delayed. Since the scenarios were urgent situations, communication occurring after 75% of the allotted simulation time was defined as excessively delayed, which allowed for consistency in scoring across simulations. The information that needed to be communicated included orientation of the senior resident to the patient, reason for hospitalization, why the student called, any tests or treatments that had been done, and the results. Checkboxes were formed to address each of those points and quantitate communication for scoring (Figure 2).

## Overall Approach

After reviewing several of the recorded simulations, it was observed that facilitators occasionally guided or helped students with data collection and treatments. To account for this variability in the scoring, the amount of help provided was added to the scoring descriptions in overall approach. Help provided in both data and treatment was added to the score of 2, help in either domain was added to the score of 3, and minimal help was added to the score of 4 (Figure 2).

## Analysis

Audio-visual simulation recordings were evaluated by novice and expert reviewers. The novice reviewers were 2 medical student

**Table 1.** Descriptive Statistics for Scores Provided by Novice and Expert Reviewers for Each Simulation by Domain

	Novice (n=3)			Expert (n=2)		
	Median	Lower Quartile	Upper Quartile	Median	Lower Quartile	Upper Quartile
<b>Domain – Data Collection</b>						
Simulation 1: Atrial Fibrillation	4	3	4	4	4	4
Simulation 1: Altered Mental Status	4	3	4	4	4	5
Simulation 2: Chest Pain	3.5	2	4	3	3	4
Simulation 2: Oliguria	2	2	2	3	2	3
Simulation 3: Trauma	2	2	3	3	2	3
<b>Domain – Differential Diagnoses</b>						
Simulation 1: Atrial Fibrillation	2	2	3	2	2	3
Simulation 1: Altered Mental Status	2	1	2	1.5	1	2
Simulation 2: Chest Pain	2	2	2	2	2	2
Simulation 2: Oliguria	2	2	2	2	2	2.5
Simulation 3: Trauma	2	2	3	2	2	2
<b>Domain – Medical Decision-Making</b>						
Simulation 1: Atrial Fibrillation	3	3	4	3	3	4
Simulation 1: Altered Mental Status	2	1	3	2	2	3
Simulation 2: Chest Pain	4	4	4	4	4	4
Simulation 2: Oliguria	3	3	4	3	2	4
Simulation 3: Trauma	3	2	4	3	2	4
<b>Domain – Communication with the Registered Nurse</b>						
Simulation 1: Atrial Fibrillation	3	2	4	3.5	1	5
Simulation 1: Altered Mental Status	3	2	5	3.5	2	4
Simulation 2: Chest Pain	3	3	4	4	3	4
Simulation 2: Oliguria	3	2	3	4	1	4
Simulation 3: Trauma	1.5	1	3	2	1	4
<b>Domain – Communication With the Senior Resident</b>						
Simulation 1: Atrial Fibrillation	3	1	4	3	1	4
Simulation 1: Altered Mental Status	1	1	1	1	1	2
Simulation 2: Chest Pain	4	2.5	4	4	4	5
Simulation 2: Oliguria	3	2	4	4	1.5	4
Simulation 3: Trauma	4	4	5	4	4	5
<b>Domain – Overall Approach</b>						
Simulation 1: Atrial Fibrillation	3	3	4	2	2	3
Simulation 1: Altered Mental Status	3	2	3	2	1	2
Simulation 2: Chest Pain	3	3	4	3	3	4
Simulation 2: Oliguria	3	3	3	3	3	4
Simulation 3: Trauma	3	3	3	3	3	4

authors who had just completed their first year of medical school and had limited clinical exposure (SU, JL) and a surgical education researcher (AR). While 1 student (SU) helped to create the modified checklists, all 3 were content novices. One surgery resident who completed 2 clinical years of training (LK) and 1 fifth-year surgery resident (AS) served as expert reviewers in the context of these common on-call scenarios. Neither were involved in checklist creation. The novices and experts used the scenario-specific assessments (m-NOTECHS) for each simulation. Descriptive statistics were calculated. One novice and 1 expert were randomly selected to assess inter-item reliability to assess internal consistency of scores. Intraclass correlations were conducted to evaluate reliability among novices and experts. The novice and expert reviewers’ scores were used for research purposes only and not provided to students.

**Table 2.** Mean Inter-Item Correlation for 1 Randomly Selected Novice (Top Number) and 1 Randomly Selected Expert (Bottom Number)

		Data Collection	Differential Diagnosis	Medical Decision-Making	Communication with RN	Communication with SR	Overall Approach
<b>Simulation 1: Atrial Fibrillation</b>	Data collection	1.0	0.37	-0.14	-0.13	-0.38	-0.01
		1.0	0.57	-0.15	-0.40	-0.24	0.42
	Differential diagnosis	0.37	1.0	-0.19	-0.46	-0.19	0.10
		0.57	1.0	0.05	0.05	-0.63	0.47
	Medical decision-making	-0.14	-0.19	1.0	0.59	0.30	0.41
		-0.15	0.05	1.0	0.74	-0.13	0.06
	Comm with RN	-0.13	-0.46	0.59	1.0	0.06	0.62
		-0.40	0.05	0.74	1.0	-0.05	0.27
	Comm with senior resident	-0.38	-0.19	0.30	0.06	1.0	-0.27
		-0.24	-0.63	-0.13	-0.05	1.0	-0.26
	Overall approach	-0.01	0.10	0.41	0.62	-0.27	1.0
		0.42	0.47	0.06	0.27	-0.26	1.0
<b>Simulation 1: Altered Mental Status</b>	Data collection	1.0	-0.13	0.28	0.35	-0.29	-0.10
		1.0	-0.13	0.59	0.38	0.18	0.41
	Differential diagnosis	-0.13	1.0	0.40	-0.55	-0.04	0.03
		-0.13	1.0	-0.19	-0.18	0.66	0.13
	Medical decision-making	0.28	0.40	1.0	0.05	0.32	0.15
		0.59	-0.19	1.0	0.70	0.18	0.69
	Comm with RN	0.35	-0.55	0.05	1.0	-0.04	-0.21
		0.38	-0.18	0.70	1.0	-0.12	0.77
	Comm with senior resident	-0.29	-0.04	0.32	-0.04	1.0	-0.20
		0.18	0.66	0.18	-0.12	1.0	0.07
	Overall approach	-0.10	0.03	0.15	-0.21	-0.20	1.0
		0.41	0.13	0.69	0.77	0.07	1.0
<b>Simulation 2: Chest Pain</b>	Data collection	1.0	0.24	-0.35	-0.20	0.13	0.13
		1.0	-0.27		-0.53	-0.14	0.01
	Differential diagnosis	0.24	1.0	-0.20	0.20	0.23	0.60
		-0.27	1.0		0.29	0.06	0.22
	Medical decision-making	-0.35	-0.20	1.0	0.00	-0.15	0.42
			1.0				
	Comm with RN	-0.20	0.20	0.00	1.0	0.34	0.24
		-0.53	0.29		1.0	-0.15	0.13
	Comm with senior resident	0.13	0.23	-0.15	0.34	1.0	0.56
		-0.14	0.06		-0.15	1.0	0.67
	Overall approach	0.13	0.60	0.42	0.24	0.56	1.0
		0.01	0.22		0.13	0.67	1.0
<b>Simulation 2: Oliguria</b>	Data collection	1.0	0.53	-0.27	-0.04	0.08	0.10
		1.0	0.54	0.18	0.22	0.23	0.00
	Differential diagnosis	0.53	1.0	-0.28	0.22	0.00	0.21
		0.54	1.0	0.10	0.41	-0.18	0.00
	Medical decision-making	-0.27	-0.28	1.0	0.46	-0.27	-0.24
		0.18	0.10	1.0	0.25	0.44	0.53
	Comm with RN	-0.04	0.22	0.46	1.0	0.23	0.17
		0.22	0.41	0.25	1.0	0.29	0.53
	Com with Senior Resident	0.08	0.00	-0.27	0.23	1.0	0.72
		0.23	-0.18	0.44	0.29	1.0	0.70
	Overall Approach	0.10	0.21	-0.24	0.17	0.72	1.0
		0.00	0.00	0.53	0.53	0.70	1.0
<b>Simulation 3: Trauma</b>	Data collection	1.0	0.19	0.29	0.12	0.49	0.74
		1.0	0.08	-0.24	0.28	0.38	0.50
	Differential diagnosis	0.19	1.0	0.47	-0.01	0.43	0.28
		0.08	1.0	0.45	-0.27	-0.04	-0.07
	Medical decision-making	0.29	0.47	1.0	0.14	0.39	0.51
		-0.24	0.45	1.0	-0.15	0.17	-0.23
	Comm with RN	0.12	-0.01	0.14	1.0	-0.12	0.15
		0.28	-0.27	-0.15	1.0	0.19	0.03
	Comm with senior resident	0.49	0.43	0.39	-0.12	1.0	0.52
		0.38	-0.04	0.17	0.19	1.0	0.27
	Overall approach	0.74	0.28	0.51	0.15	0.52	1.0
		0.50	-0.07	-0.23	0.03	0.27	1.0

There was no variability in medical decision-making scores by the expert for the chest pain scenario.

## RESULTS

In total, 22 learners participated in the IPC simulations. Participants were split into 2 groups. For simulation 1, one group participated in the atrial fibrillation scenario (n=11) and the other participated in the altered mental status scenario (n=11). For simulation 2, one group participated in the oliguria scenario (n=10) and the other participated in the chest pain scenario (n=12). For simulation 3, all learners participated in the trauma scenario (n=17). Five learners in the IPC did not participate in the simulations due to scheduling conflicts or were unable to be scored due to facilitator deviation from the script.

Descriptive statistics are shown in Table 1. Learners scored the lowest in the differential diagnosis domain and highest in the data collection domain. Learners scored the lowest in the altered mental status scenario and the highest in the chest pain scenario. Inter-item correlation for Novice #3 and Expert #2 are shown in Table 2.<sup>14</sup>

Intraclass correlation coefficients (ICC) between the 3 novices, 2 experts, and 3 novices and 2 experts were calculated for each scenario and each rubric domain and are shown in Table 3. The novice reviewers had good to excellent correlation in their summation of all domains of 4 simulations and moderate to good correlation in their summation of all domains of 1 simulation (chest pain). The novice and expert reviewers had moderate to good correlation in their summation of all domains of 4 simulations and good correlation in their summation of all domains of 1 simulation (altered mental status).<sup>15</sup> Domain-specific correlations vary. The lowest correlations were seen in the overall approach domain.

## DISCUSSION

This exploratory study shows that our m-NOTECHS can be used by clinical novices to evaluate student performance with little variation in scores between expert and novice raters. Thus, the m-NOTECHS could provide consistent novice scoring of simulated performance, with novice scores correlating with those of an expert reviewer. Although outside of the scope of this study, clinical novices likely gain knowledge from evaluating simulation

performance. Simulation participants and novice reviewers alike may benefit from this method of assessment—an area ripe for future study.<sup>16</sup>

In addition to a lack of available expert reviewers, other barriers to SBME implementation exist, including the need for confederate actors, simulation center staff, and reliable equipment. Future work should further reduce the number of other resources required to run educational simulations. Furthermore, our described meth-

**Table 3.** Intraclass Correlation Coefficient (ICC) Calculations with 95% CI Between the Three Novices, Two Experts, and Among the Three Novices and Two Expert Clinicians for Each Simulation and Each Rubric Section

	3 Novices	2 Experts	3 Novices + 2 Experts
<b>Summation of all Domains</b>			
Simulation 1: Atrial Fibrillation	0.89 < ICC < 0.95	0.56 < ICC < 0.83	0.67 < ICC < 0.83
Simulation 1: Altered Mental Status	0.85 < ICC < 0.93	0.85 < ICC < 0.94	0.77 < ICC < 0.88
Simulation 2: Chest Pain	0.66 < ICC < 0.83	0.71 < ICC < 0.89	0.51 < ICC < 0.72
Simulation 2: Oliguria	0.78 < ICC < 0.90	0.68 < ICC < 0.87	0.63 < ICC < 0.81
Simulation 3: Trauma	0.89 < ICC < 0.95	0.56 < ICC < 0.78	0.55 < ICC < 0.72
<b>Domain – Data Collection</b>			
Simulation 1: Atrial Fibrillation	0.02 < ICC < 0.81	-0.36 < ICC < 0.80	0.23 < ICC < 0.83
Simulation 1: Altered Mental Status	0.51 < ICC < 0.93	0.49 < ICC < 0.95	0.62 < ICC < 0.93
Simulation 2: Chest Pain	0.53 < ICC < 0.92	0.50 < ICC < 0.96	0.46 < ICC < 0.90
Simulation 2: Oliguria	0.81 < ICC < 0.98	-0.07 < ICC < 0.87	0.51 < ICC < 0.92
Simulation 3: Trauma	0.68 < ICC < 0.94	-0.57 < ICC < 0.38	0.36 < ICC < 0.80
<b>Domain – Differential Diagnoses</b>			
Simulation 1: Atrial Fibrillation	0.71 < ICC < 0.97	0.00 < ICC < 0.903	0.66 < ICC < 0.96
Simulation 1: Altered Mental Status	0.10 < ICC < 0.79	-0.15 < ICC < 0.82	0.14 < ICC < 0.73
Simulation 2: Chest Pain	0.25 < ICC < 0.84	-0.60 < ICC < 0.60	0.33 < ICC < 0.86
Simulation 2: Oliguria	0.68 < ICC < 0.96	0.75 < ICC < 0.98	0.74 < ICC < 0.96
Simulation 3: Trauma	0.57 < ICC < 0.91	0.10 < ICC < 0.82	0.33 < ICC < 0.78
<b>Domain – Medical Decision-Making</b>			
Simulation 1: Atrial Fibrillation	0.90 < ICC < 0.99	0.224 < ICC < 0.94	0.75 < ICC < 0.97
Simulation 1: Altered Mental Status	0.81 < ICC < 0.98	0.39 < ICC < 0.94	0.56 < ICC < 0.92
Simulation 2: Chest Pain	0.31 < ICC < 0.86	-	0.09 < ICC < 0.70
Simulation 2: Oliguria	0.80 < ICC < 0.98	-0.11 < ICC < 0.86	0.38 < ICC < 0.87
Simulation 3: Trauma	0.85 < ICC < 0.98	0.13 < ICC < 0.83	0.39 < ICC < 0.81
<b>Domain – Communication with the Registered Nurse</b>			
Simulation 1: Atrial Fibrillation	0.79 < ICC < 0.98	0.00 < ICC < 0.90	0.48 < ICC < 0.92
Simulation 1: Altered Mental Status	0.54 < ICC < 0.93	0.40 < ICC < 0.94	0.53 < ICC < 0.91
Simulation 2: Chest Pain	0.20 < ICC < 0.82	-0.46 < ICC < 0.72	0.13 < ICC < 0.74
Simulation 2: Oliguria	0.22 < ICC < 0.86	0.42 < ICC < 0.95	0.30 < ICC < 0.84
Simulation 3: Trauma	0.92 < ICC < 0.99	0.29 < ICC < 0.87	0.19 < ICC < 0.68
<b>Domain – Communication with the Senior Resident</b>			
Simulation 1: Atrial Fibrillation	0.77 < ICC < 0.98	0.71 < ICC < 0.98	0.67 < ICC < 0.96
Simulation 1: Altered Mental Status	0.84 < ICC < 0.98	0.37 < ICC < 0.94	0.57 < ICC < 0.92
Simulation 2: Chest Pain	0.25 < ICC < 0.84	0.46 < ICC < 0.96	-0.04 < ICC < 0.55
Simulation 2: Oliguria	0.92 < ICC < 0.99	0.82 < ICC < 0.99	0.85 < ICC < 0.98
Simulation 3: Trauma	0.43 < ICC < 0.87	0.35 < ICC < 0.89	0.17 < ICC < 0.67
<b>Domain – Overall Approach</b>			
Simulation 1: Atrial Fibrillation	0.17 < ICC < 0.87	-0.28 < ICC < 0.83	0.27 < ICC < 0.85
Simulation 1: Altered Mental Status	-0.15 < ICC < 0.61	0.44 < ICC < 0.95	0.12 < ICC < 0.71
Simulation 2: Chest Pain	-0.23 < ICC < 0.48	0.17 < ICC < 0.92	0.02 < ICC < 0.64
Simulation 2: Oliguria	0.04 < ICC < 0.79	0.04 < ICC < 0.89	0.21 < ICC < 0.79
Simulation 3: Trauma	0.52 < ICC < 0.90	0.03 < ICC < 0.79	0.13 < ICC < 0.64

Of note, the 2 experts gave all learners the same score for Simulation 2: Chest Pain; thus, no ICC could be reported.

odology can be used to adapt and improve novice-friendly scoring systems for a wider variety of nontechnical simulations used across multiple medical specialties.

This study is limited by the small number of students participating in simulations at a single institution and a limited number of reviewers for evaluation of the m-NOTECHS. Despite providing simulation scripts, utilizing multiple facilitators led to subtle variation in the simulation. Additionally, evaluators were not blinded to the names of the medical students they were evaluating, which may introduce bias in scoring. The inter-item correlations varied widely and suggest that further refinement of the scoring rubrics may improve internal consistency.

Regardless, these tools and simulations can be used and modified for SBME and serve as resources for medical educators. Using a modified scoring rubric with explicit, jargon-free criteria can allow for timely and accurate review of complex medical decision-making by novices. This may eliminate 1 barrier to implementation and encourage continued use of simulation in medical education, a resource-intensive learning tool.

**Funding/Support:** This work was supported by the National Cancer Institute of the National Institutes of Health (NIH), grant T32CA090217. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. The authors would like to thank the University of Wisconsin School of Medicine and Public Health Shapiro Summer Research Fellowship Program and the Department of Surgery for their financial support of this project.

**Financial Disclosures:** None declared.

**Appendices:** Available at [wmjonline.org](http://wmjonline.org).

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# Medical Students as Educators: Students' Experience, Interest, and Confidence in Teaching

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## ABSTRACT

**Background:** Medical students represent the next generation of physician educators, yet may not be prepared to meet future teaching responsibilities.

**Methods:** An electronic survey was sent to medical students at a US allopathic institution to assess their experience, interest, and confidence in teaching.

**Results:** Most students indicated interest in teaching medical students ( $n = 91$ , 62%) or residents ( $n = 88$ , 60%) postresidency. Less than half expressed confidence in teaching clinical interviewing/physical exam skills ( $n = 71$ , 49%), lecture/didactic ( $n = 62$ , 42%), and procedural techniques ( $n = 41$ , 28%).

**Discussion:** Many medical students identified having only nascent medical teaching skills and expressed interest in elective opportunities. Formal teaching programs are necessary to cultivate medical students as effective physician educators.

## BACKGROUND

Physicians are expected to engage in lifelong learning—to educate themselves and their patients, peers, and students. Their vital roles as clinical educators start as early as residency, which has shown to benefit both learners and educators.<sup>1</sup> Two-thirds of medical students in one survey felt that residents played a significant part in their learning.<sup>2</sup> Surveys of residents also found that they enjoyed teaching and thought it improved their clinical skills.<sup>1</sup>

While residents value their roles as educators, many do not feel equipped to teach.<sup>1,3</sup> The need to develop residents as better teach-

ers has resulted in formal teaching-skills instruction across more residency programs.<sup>4</sup> Despite these efforts, some studies suggest that residents too often assume teaching responsibilities with insufficient formal preparation—partly attributed to patient care duties that conflict with teaching-skills programs.<sup>1</sup>

Given demands on resident time, a solution has been to introduce formal instruction in teaching skills prior to intern year.<sup>1</sup> A survey of 99 US medical schools found that only 44% offered formal, comprehensive programs to train their students to teach effectively.<sup>4</sup> Additionally, offered courses varied widely in terms of format, duration, and scope.<sup>4</sup>

Increasing and strengthening existing efforts to offer teaching experiences to medical students may help prepare them to teach others and become better learners during and beyond medical school.<sup>1,4</sup>

Little is known about medical students' interest and confidence in learning teaching skills.<sup>1,5,6</sup> Many medical students express interest in and recognize the importance of developing teaching skills but may lack the confidence to take on teaching responsibilities without formal training.<sup>1,5</sup> Our survey-based study characterizes existing interests, motivations, and confidence in teaching skills among medical students at a US allopathic institution.

## METHODS

A 12-item survey was created using Qualtrics XM survey software (Qualtrics XM; Utah, USA) to ascertain student interests, motivations, and confidence in teaching. Survey questions were adapted from a similar study on Canadian medical students.<sup>5</sup> Our survey was sent via email to medical students at the University

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**Table 1.** Students' Prior Experiences, Interest in Teaching, Plans for Residency/Future Practice, Plans to Work in an Academic Setting, and Interest in Teaching Electives (N= 146)

	Year in Medical School				
	1st Year (N = 52)	2nd Year (N = 38)	3rd Year (N = 39)	4th Year (N = 27)	All years (N = 146)
Response, No. (%)					
Prior healthcare employment					
Yes	39 (75%)	18 (64.3%)	23 (59%)	15 (55.6%)	95 (65.1%)
No	12 (23.1%)	10 (35.7%)	15 (38.5%)	12 (44.4%)	49 (33.6%)
NA	1 (1.9%)	0 (0%)	1 (2.6%)	0 (0%)	2 (1.4%)
Prior teaching experience					
Yes	32 (61.5%)	15 (53.6%)	19 (48.7%)	17 (63%)	83 (56.8%)
No	20 (38.5%)	13 (46.4%)	20 (51.3%)	10 (37%)	63 (43.2%)
Interest in teaching medical students post-residency					
Yes	32 (61.5%)	15 (53.6%)	21 (53.8%)	23 (85.2%)	91 (62.3%)
No	2 (3.8%)	2 (7.1%)	1 (2.6%)	0 (0%)	5 (3.4%)
Maybe/Not Sure	16 (30.8%)	10 (35.7%)	15 (38.5%)	4 (14.8%)	45 (30.8%)
NA	2 (3.8%)	1 (3.6%)	2 (5.1%)	0 (0%)	5 (3.4%)
Interest in teaching residents post-residency					
Yes	31 (59.6%)	15 (53.6%)	20 (51.3%)	22 (81.5%)	88 (60.3%)
No	2 (3.8%)	1 (3.6%)	1 (2.6%)	0 (0%)	4 (2.7%)
Maybe/not sure	17 (32.7%)	11 (39.3%)	16 (41%)	5 (18.5%)	49 (33.6%)
NA	2 (3.8%)	1 (3.6%)	2 (5.1%)	0 (0%)	5 (3.4%)
Current plans for residency/future practice <sup>a</sup>					
Anesthesiology	0 (0%)	2 (7.1%)	2 (5.1%)	1 (3.7%)	5 (3.4%)
Cardiothoracic surgery	0 (0%)	1 (3.6%)	0 (0%)	0 (0%)	1 (0.7%)
Dermatology	0 (0%)	0 (0%)	2 (5.1%)	0 (0%)	2 (1.4%)
Emergency medicine	2 (3.8%)	1 (3.6%)	7 (17.9%)	6 (22.2%)	16 (11%)
Family medicine	2 (3.8%)	1 (3.6%)	4 (10.3%)	2 (7.4%)	9 (6.2%)
General surgery	0 (0%)	5 (17.9%)	2 (5.1%)	3 (11.1%)	10 (6.8%)
Internal medicine	8 (15.4%)	3 (10.7%)	6 (15.4%)	6 (22.2%)	23 (15.8%)
Neurology	0 (0%)	0 (0%)	1 (2.6%)	0 (0%)	1 (0.7%)
Neurosurgery	1 (1.9%)	0 (0%)	0 (0%)	0 (0%)	1 (0.7%)
Obstetrics and gynecology	2 (3.8%)	0 (0%)	0 (0%)	1 (3.7%)	3 (2.1%)
Ophthalmology	1 (1.9%)	0 (0%)	1 (2.6%)	0 (0%)	2 (1.4%)
Orthopedic surgery	1 (1.9%)	1 (3.6%)	2 (5.1%)	1 (3.7%)	5 (3.4%)
Otolaryngology (ENT)	0 (0%)	0 (0%)	1 (2.6%)	1 (3.7%)	2 (1.4%)
Pathology	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Pediatrics	2 (3.8%)	1 (3.6%)	4 (10.3%)	2 (7.4%)	9 (6.2%)
Physical medicine/rehabilitation	2 (3.8%)	0 (0%)	0 (0%)	0 (0%)	2 (1.4%)
Plastic surgery	1 (1.9%)	0 (0%)	0 (0%)	1 (3.7%)	2 (1.4%)
Psychiatry	3 (5.8%)	0 (0%)	2 (5.1%)	0 (0%)	5 (3.4%)
Radiology	1 (1.9%)	0 (0%)	0 (0%)	3 (11.1%)	4 (2.7%)
Radiation oncology	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Urology	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Vascular surgery	1 (1.9%)	0 (0%)	0 (0%)	0 (0%)	1 (0.7%)
Unsure/Undecided	24 (46.2%)	13 (46.4%)	5 (12.8%)	0 (0%)	42 (28.8%)
NA	1 (1.9%)	0 (0%)	0 (0%)	0 (0%)	1 (0.7%)
Plans to work in an academic setting					
Yes	22 (42.3%)	9 (32.1%)	12 (30.8%)	16 (59.3%)	59 (40.4%)
No	2 (3.8%)	3 (10.7%)	10 (25.6%)	1 (3.7%)	16 (11%)
Maybe/not sure	26 (50%)	15 (53.6%)	15 (38.5%)	10 (37%)	66 (45.2%)
NA	2 (3.8%)	1 (3.6%)	2 (5.1%)	0 (0%)	5 (3.4%)
Interest in teaching electives during medical school <sup>b</sup>					
Curriculum development	12 (23.1%)	8 (28.6%)	13 (33.3%)	16 (59.3%)	49 (33.6%)
Teaching in a clinic/hospital setting	38 (73.1%)	16 (57.1%)	30 (76.9%)	20 (74.1%)	104 (71.2%)
Small group clinical skills teaching	23 (44.2%)	15 (53.6%)	23 (59%)	15 (55.6%)	76 (52.1%)
Lecturing	28 (53.8%)	7 (25%)	9 (23.1%)	14 (51.9%)	58 (39.7%)
Other elective	0 (0%)	0 (0%)	0 (0%)	1 (3.7%)	1 (0.7%)

Abbreviations: NA, not available (represents missing responses); ENT, ear, nose, throat.

<sup>a</sup>Options for anticipated residency or future field of practice included 22 residency choices and 1 option for "Unsure/Undecided." Medical students were asked to choose only 1 response.

<sup>b</sup>Students were allowed to select multiple options to indicate interest in more than 1 elective course.

of Wisconsin School of Medicine and Public Health and was open for responses from February 14, 2020, through March 11, 2020. This study was exempt from review by the University of Wisconsin Institutional Review Board.

## Data Analysis

Data were analyzed using R software (R Foundation; Vienna, Austria). We created descriptive statistics to examine student year (question 1 [Q1]), future residency plans (Q2), prior teaching experience (Q3-Q4), prior health care employment (Q5-Q6), plans to work in an academic setting (Q7), interest in teaching medical students or residents post-residency (Q8-Q9), motivations for teaching (Q10), confidence in teaching (Q11), and interest in teaching electives (Q12). Only students who indicated interest in teaching medical students (Q8) or interest in teaching residents (Q9) post-residency were asked to indicate motivation to teach (Q10). All other questions were asked of all students.

Responses for motivation (Q10) and confidence (Q11) were assessed on a 5-point Likert scale. Hypothesized predictors for motivation included Q1 and Q2. Predictors for confidence included Q1-Q3, Q5, and Q8-Q9. We used Kruskal-Wallis ANOVA to test for differences in mean ranked response between predictor groups. We present Hochberg-adjusted *P* values (*P*<sub>adj</sub> value) to account for multiple tests. We considered a relationship statistically significant if the *P*<sub>adj</sub> value was less than 0.05. We used Spearman inter-item correlation to examine associations between the 6 motivation items and 3 confidence items.

## RESULTS

The survey was completed by 153 of 758 medical students (20%), comprising first (n = 52, 34%), second (n = 28, 18%), third (n = 39, 25%), and fourth-year students (n = 27, 18%); master of public health (MPH) students (n = 3, 2%), and medical scientist training program students (MSTP) (n = 4, 3%). MPH and MSTP

students were excluded given low response and unknown year in medical school. Analyses were performed on the remaining 146 first- through fourth-year students.

### Prior Experience and Future Plans

More than half of the respondents had prior health care employment ( $n=95$ , 65%) or teaching experience ( $n=83$ , 57%) (Table 1). Twenty-nine percent were “unsure/undecided” about residency plans ( $n=42$ , 29%). A plurality of respondents reported plans to work in an academic setting ( $n=59$ , 40%) and expressed interest in teaching medical students ( $n=91$ , 62%) or residents ( $n=88$ , 60%) post-residency. More than half desired to engage in small-group clinical teaching electives ( $n=76$ , 52%).

### Motivations for Teaching

Of 100 students who indicated interest in teaching medical students or residents post-residency, nearly all expressed an intrinsic interest in medical education as a motivation to teach ( $n=95$ , 95%), which was followed by a desire to “give back” ( $n=87$ , 87%) (Table 2). Junior students reported higher motivation to teach due to prestige than senior students ( $P_{\text{adj}}$  value = 0.043). Future residency plans did not appear to influence motivations for teaching. Inter-item correlations ranged from 0.05 to 0.58, with agreement between motivation ratings highest for extrinsic items of academic advancement, requirement to work in an academic center, and prestige.

### Confidence in Teaching

Less than half of the respondents expressed some confidence in teaching clinical interviewing/physical exam ( $n=71$ , 49%), lecture/didactic ( $n=62$ , 42%), and procedural techniques ( $n=41$ , 28%) (Table 3). Student year was associated with confidence in teaching clinical interviewing/physical exam skills ( $P_{\text{adj}}$  value=0.012), with greater confidence among fourth-year students. Those interested in pursuing specialty care were more confident in procedural technique ( $P_{\text{adj}}$  value=0.005) than those interested in primary care or were undecided. Inter-item correlations ranged from 0.18 to 0.46, with agreement between confidence ratings highest for clinical interviewing/physical exam skills and procedural technique.

## DISCUSSION

Our survey-based study offers a lens through which we can better understand what medical students desire out of a medical education program. Medical students expressed significant interest in teaching and a desire to participate in opportunities to learn how to teach in clinical settings, a finding consistent with other studies.<sup>1,2,5,6</sup> To meet this need, medical institutions must reframe how we introduce teaching to our students. This task is a complex skill that will be better served through longitudinal integration into a curriculum that may include, but is not limited to, facilitating small-group sessions, teaching clinical skills,

learning educational theory, and mentoring.<sup>7</sup> Medical schools across the US have increasingly recognized the need to broaden formal training in education, and some have responded by integrating didactic and hands-on teaching experiences into their curricula.<sup>4</sup> However, there is room for growth, including a need to increase the number of formal training programs<sup>4</sup> and evaluate program effectiveness on preparing students for teaching in residency.<sup>8</sup>

Our study uniquely assessed the influence of various factors—including student year, future residency plans, prior experience, and interest in teaching—on motivations to teach and confidence in teaching. Confidence in teaching was higher among senior versus junior students in clinical interviewing and physical exam skills, likely driven by experience. Career interest also influenced confidence in teaching across certain clinical domains. Students pursuing specialty care reported greater confidence in procedural skills than those pursuing primary care or were undecided. Many students said they felt unprepared to teach procedural techniques, consistent with the Canadian study.<sup>5</sup> This transition indicates an awareness of the inherent risk in trying to teach what one has only recently learned. While the approach of “See one, do one, teach one,” is still followed, it can conflict with the goal of providing excellent and safe patient care. These skills may be taught through formal coursework, such as in simulation centers, but may not necessarily substitute real clinical experience.<sup>9</sup> One study found that a junior doctor-delivered bedside supervision program provided during a clinical clerkship led to high satisfaction and increased confidence in procedural skills among medical students.<sup>9</sup>

Our study suggests that interactive methods that can be integrated into already established curricula, such as a bedside supervision program, may promote skills development and boost confidence among medical students regardless of career preference or prior experience. Providing students an opportunity to try and even fail, complemented by appropriate coaching and feedback, could allow them to suffer the growing pains of developing a new and vital skill and gain appropriate confidence before being asked to teach in a busy and sensitive clinical environment.

Limitations of this study include a low survey response rate—particularly from senior students. Low response in medical students has been attributed to survey fatigue and lack of time, especially in clinical clerkships.<sup>5</sup> Reasons for not returning the questionnaire were not collected, so it is unknown whether interest in medical education influenced nonresponse. This study was performed at a single allopathic medical school that uniquely integrates public health in the curriculum, limiting generalizability to other US medical students. However, our conclusion that medical students have strong interest in medical education is consistent with other work, suggesting that students acknowledge the importance of learning to teach in the modern physician.<sup>1,5,6</sup> Our study adds to current literature that medical stu-

**Table 2.** Factors That Motivate Medical Students Given Interest in Teaching Medical Students or Residents Post-Residency, by Year and Future Residency Plans (N=100)<sup>a</sup>

		Not Interested	Neutral	Interested	NA <sup>c</sup>	P <sub>adj</sub> value
Motivation to Teach Due to <sup>b</sup>		Response, No. (%)				
Academic advancement, by: Student year:	First year	3 (8.3%)	9 (25%)	24 (66.7%)	0 (0%)	0.570
	Second year	4 (23.5%)	4 (23.5%)	8 (47.1%)	1 (5.9%)	
	Third year	5 (22.7%)	6 (27.3%)	11 (50%)	0 (0%)	
	Fourth year	8 (32%)	6 (24%)	8 (32%)	3 (12%)	
Plans for residency/future <sup>d</sup>	Primary care	7 (23.3%)	5 (16.7%)	18 (60%)	0 (0%)	0.996
	Specialty care	7 (17.1%)	13 (31.7%)	18 (43.9%)	3 (7.3%)	
	Unsure/undecided	6 (20.7%)	7 (24.1%)	15 (51.7%)	1 (3.4%)	
Intrinsic interest, by: Student year:	First year	0 (0%)	0 (0%)	36 (100%)	0 (0%)	0.996
	Second year	0 (0%)	0 (0%)	16 (94.1%)	1 (5.9%)	
	Third year	0 (0%)	0 (0%)	22 (100%)	0 (0%)	
	Fourth year	0 (0%)	1 (4%)	21 (84%)	3 (12%)	
Plans for residency/future <sup>d</sup>	Primary care	0 (0%)	1 (3.3%)	29 (96.7%)	0 (0%)	0.996
	Specialty care	0 (0%)	0 (0%)	38 (92.7%)	3 (7.3%)	
	Unsure/undecided	0 (0%)	0 (0%)	28 (96.6%)	1 (3.4%)	
Prestige, by: Student year:	First year	7 (19.4%)	18 (50%)	11 (30.6%)	0 (0%)	0.043
	Second year	8 (47.1%)	7 (41.2%)	1 (5.9%)	1 (5.9%)	
	Third year	13 (59.1%)	6 (27.3%)	3 (13.6%)	0 (0%)	
	Fourth year	11 (44%)	10 (40%)	1 (4%)	3 (12%)	
Plans for residency/future <sup>d</sup>	Primary care	15 (50%)	12 (40%)	3 (10%)	0 (0%)	0.996
	Specialty care	15 (36.6%)	16 (39%)	7 (17.1%)	3 (7.3%)	
	Unsure/undecided	9 (31%)	13 (44.8%)	6 (20.7%)	1 (3.4%)	
Requirement to work at an academic center, by: Student year:	First year	7 (19.4%)	12 (33.3%)	17 (47.2%)	0 (0%)	0.238
	Second year	7 (41.2%)	5 (29.4%)	4 (23.5%)	1 (5.9%)	
	Third year	11 (50%)	6 (27.3%)	5 (22.7%)	0 (0%)	
	Fourth year	7 (28%)	9 (36%)	6 (24%)	3 (12%)	
Plans for residency/future <sup>d</sup>	Primary care	9 (30%)	10 (33.3%)	11 (36.7%)	0 (0%)	0.996
	Specialty care	12 (29.3%)	14 (34.1%)	12 (29.3%)	3 (7.3%)	
	Unsure/undecided	11 (37.9%)	8 (27.6%)	9 (31%)	1 (3.4%)	
Desire to “give back,” by: Student year:	First year	1 (2.8%)	2 (5.6%)	33 (91.7%)	0 (0%)	0.996
	Second year	0 (0%)	2 (11.8%)	14 (82.4%)	1 (5.9%)	
	Third year	1 (4.5%)	2 (9.1%)	19 (86.4%)	0 (0%)	
	Fourth year	0 (0%)	1 (4%)	21 (84%)	3 (12%)	
Plans for residency/future <sup>d</sup>	Primary Care	0 (0%)	2 (6.7%)	28 (93.3%)	0 (0%)	0.678
	Specialty Care	2 (4.9%)	2 (4.9%)	34 (82.9%)	3 (7.3%)	
	Unsure/Undecided	0 (0%)	3 (10.3%)	25 (86.2%)	1 (3.4%)	
Increase confidence in teaching, by: Student year:	First	0 (0%)	5 (13.9%)	31 (86.1%)	0 (0%)	0.996
	Second	2 (11.8%)	3 (17.6%)	11 (64.7%)	1 (5.9%)	
	Third	1 (4.5%)	4 (18.2%)	17 (77.3%)	0 (0%)	
	Fourth	1 (4%)	2 (8%)	19 (76%)	3 (12%)	
Plans for residency/future <sup>d</sup>	Primary Care	0 (0%)	6 (20%)	24 (80%)	0 (0%)	0.996
	Specialty Care	4 (9.8%)	3 (7.3%)	31 (75.6%)	3 (7.3%)	
	Unsure/Undecided	0 (0%)	5 (17.2%)	23 (79.3%)	1 (3.4%)	

<sup>a</sup>Only the 100 students who indicated interest in teaching medical students or residents post-residency were asked to indicate their motivations to teach across the 6 items.

<sup>b</sup>The influence of student year and plans for residency/future on motivations to teach were assessed using the Kruskal-Wallis ANOVA test. The 5-point Likert measure (“not at all interested,” “not very interested,” “neutral,” “somewhat interested,” and “very interested”) was used for this analysis. For ease of visualization, cross-tabulations of predictors are shown against merged response categories. “Not at all interested” and “not very interested” were combined into “not interested.” “Somewhat interested” and “very interested” were combined into “interested.”

<sup>c</sup>“NA” stands for “not available” and represents missing responses.

<sup>d</sup>Options for anticipated residency or future field of practice included 22 residency choices and 1 option for “unsure/undecided.” Internal medicine, family medicine, and pediatrics were categorized into “primary care.” All other specialties except for “unsure/undecided” were categorized into “specialty care.”



**Table 3.** Students' Perceived Confidence in Teaching Skills, by Student Year, Future Residency Plans, Prior Teaching Experience, Prior Health Care Employment, or Interest in Teaching (N=146)

		Not Confident	Neutral	Confident	NA <sup>a</sup>	P <sub>adj</sub> value
Perceived confidence in teaching skills in <sup>b</sup>		Response, No. (%)				
Lecture/didactic, by:						
Student year:	First	16 (30.8%)	10 (19.2%)	21 (40.4%)	5 (9.6%)	0.686
	Second	9 (32.1%)	5 (17.9%)	10 (35.7%)	4 (14.3%)	
	Third	7 (17.9%)	15 (38.5%)	14 (35.9%)	3 (7.7%)	
	Fourth	2 (7.4%)	3 (11.1%)	17 (63%)	5 (18.5%)	
Plans for residency/future: <sup>c</sup>	Primary care	11 (26.8%)	11 (26.8%)	15 (36.6%)	4 (9.8%)	0.996
	Specialty care	10 (16.1%)	14 (22.6%)	31 (50%)	7 (11.3%)	
	Unsure/undecided	13 (31%)	8 (19%)	15 (35.7%)	6 (14.3%)	
	NA	0 (0%)	0 (0%)	1 (100%)	0 (0%)	
Prior teaching experience	Yes	15 (18.1%)	18 (21.7%)	40 (48.2%)	10 (12%)	0.618
	No	19 (30.2%)	15 (23.8%)	22 (34.9%)	7 (11.1%)	
Prior health care employment	Yes	27 (28.4%)	21 (22.1%)	38 (40%)	9 (9.5%)	0.523
	No	7 (14.3%)	12 (24.5%)	24 (49%)	6 (12.2%)	
	NA	0 (0%)	0 (0%)	0 (0%)	2 (100%)	
Interest in teaching <sup>d</sup>	Yes	24 (24%)	21 (21%)	48 (48%)	7 (7%)	0.996
	No/maybe	10 (24.4%)	12 (29.3%)	14 (34.1%)	5 (12.2%)	
	NA	0 (0%)	0 (0%)	0 (0%)	5 (100%)	
Clinical interviewing/physical exam skills, by:						
Student year:	First	18 (34.6%)	12 (23.1%)	18 (34.6%)	4 (7.7%)	0.012
	Second	3 (10.7%)	7 (25%)	14 (50%)	4 (14.3%)	
	Third	4 (10.3%)	10 (25.6%)	22 (56.4%)	3 (7.7%)	
	Fourth	2 (7.4%)	3 (11.1%)	17 (63%)	5 (18.5%)	
Plans for residency/future <sup>c</sup>	Primary care	9 (22%)	13 (31.7%)	15 (36.6%)	4 (9.8%)	0.088
	Specialty care	8 (12.9%)	8 (12.9%)	39 (62.9%)	7 (11.3%)	
	Unsure/undecided	9 (21.4%)	11 (26.2%)	17 (40.5%)	5 (11.9%)	
	NA	1 (100%)	0 (0%)	0 (0%)	0 (0%)	
Prior teaching experience	Yes	16 (19.3%)	18 (21.7%)	40 (48.2%)	9 (10.8%)	0.996
	No	11 (17.5%)	14 (22.2%)	31 (49.2%)	7 (11.1%)	
Prior health care employment	Yes	17 (17.9%)	20 (21.1%)	49 (51.6%)	9 (9.5%)	0.996
	No	10 (20.4%)	12 (24.5%)	22 (44.9%)	5 (10.2%)	
	NA	0 (0%)	0 (0%)	0 (0%)	2 (100%)	
Interest in teaching <sup>d</sup>	Yes	19 (19%)	22 (22%)	53 (53%)	6 (6%)	0.996
	No/maybe	8 (19.5%)	10 (24.4%)	18 (43.9%)	5 (12.2%)	
	NA	0 (0%)	0 (0%)	0 (0%)	5 (100%)	
Procedural technique (eg, suturing, flu shot administration), by:						
Student year	First	23 (44.2%)	15 (28.8%)	10 (19.2%)	4 (7.7%)	0.996
	Second	10 (35.7%)	8 (28.6%)	6 (21.4%)	4 (14.3%)	
	Third	17 (43.6%)	7 (17.9%)	12 (30.8%)	3 (7.7%)	
	Fourth	7 (25.9%)	2 (7.4%)	13 (48.1%)	5 (18.5%)	
Plans for residency/future <sup>c</sup>	Primary care	24 (58.5%)	10 (24.4%)	3 (7.3%)	4 (9.8%)	0.005
	Specialty care	17 (27.4%)	12 (19.4%)	26 (41.9%)	7 (11.3%)	
	Unsure/undecided	15 (35.7%)	10 (23.8%)	12 (28.6%)	5 (11.9%)	
	NA	1 (100%)	0 (0%)	0 (0%)	0 (0%)	
Prior teaching experience	Yes	29 (34.9%)	20 (24.1%)	25 (30.1%)	9 (10.8%)	0.996
	No	28 (44.4%)	12 (19%)	16 (25.4%)	7 (11.1%)	
Prior health care employment	Yes	34 (35.8%)	24 (25.3%)	28 (29.5%)	9 (9.5%)	0.996
	No	23 (46.9%)	8 (16.3%)	13 (26.5%)	5 (10.2%)	
	NA	0 (0%)	0 (0%)	0 (0%)	2 (100%)	
Interest in teaching <sup>d</sup>	Yes	40 (40%)	22 (22%)	32 (32%)	6 (6%)	0.996
	No/maybe	17 (41.5%)	10 (24.4%)	9 (22%)	5 (12.2%)	
	NA	0 (0%)	0 (0%)	0 (0%)	5 (100%)	

<sup>a</sup>“NA” stands for “not available” and represents missing responses.

<sup>b</sup>The influence of student year, plans for residency/future, prior teaching experience, prior health care employment, and interest in teaching medical students or residents post-residency on confidence in teaching were assessed using the Kruskal-Wallis ANOVA test. The 5-point Likert measure (“not at all confident,” “not very confident,” “neutral,” “somewhat confident,” and “very confident”) was used for this analysis. For ease of visualization, cross-tabulations of predictors are shown against merged response categories. “Not at all confident” and “not very confident” were combined into “not confident.” “Somewhat confident” and “very confident” were combined into “confident.”

<sup>c</sup>Options for anticipated residency or future field of practice included 22 residency choices and 1 option for “unsure/undecided.” Internal medicine, family medicine, and pediatrics were categorized into “primary care.” All other specialties except for “unsure/undecided” were categorized into “specialty care.”

<sup>d</sup>Interest in teaching medical students post-residency and interest in teaching residents post-residency were combined into “interest in teaching” for this analysis, as there was significant overlap in responses to both questions.

dents may not feel confident or prepared to teach, likely driven by prior experience or career interests. This unmet need is an opportunity for medical schools to develop formal longitudinal medical education programming and cultivate students as the next generation of effective physician educators.

**Funding/Support:** This work was supported by the Clinical and Translational Science Award (CTSA) program, through the National Institutes of Health (NIH) National Center for Advancing Translational Sciences (NCATS), grant UL1TR002373. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

**Financial Disclosures:** None declared.

**Ethical Approval:** This study was exempt from review by the University of Wisconsin Institutional Review Board.

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# Enhancing Communication Among Adolescents and Health Care Providers: Evolution and Evaluation of Youth-Driven Initiative Addressing Barriers

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## ABSTRACT

**Background:** Significant interpersonal barriers impede the delivery of quality adolescent health care. While a complex issue, public health and health care entities continue to seek ways to work with the populations they serve to better address such challenges.

**Methods:** The PATCH Teen Educator Program, an initiative of the Providers and Teens Communicating for Health (PATCH) Program, promotes open, honest, and medically accurate conversations between health care professionals and adolescents via youth-led workshops for both clinicians and adolescents.

**Results:** Across 6 program sites, workshop participants noted positive changes towards enhancing patient-clinician communication. Youth facilitators also reported notable changes related to workforce and youth development after their 9-month commitment to the program.

**Discussion:** These results showcase promising effects of the youth-driven initiative on enhancing local adolescent patient-clinician communication, as well as effects on engaged youth.

## BACKGROUND

Effective patient-clinician communication is critical in delivering quality health care.<sup>1,2</sup> Yet research continues to show significant interpersonal barriers between adolescents and health care professionals, many of which emanate from trust, respect, and overall uncertainty in approaching such interactions.<sup>3,4</sup> While complex in nature, public health and health care entities continue to seek ways to work with the populations they serve to better address such challenges.

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The PATCH Teen Educator Program, an initiative of the Providers and Teens Communicating for Health (PATCH) Program, promotes open, honest, and medically accurate conversations between local health care professionals and adolescents by bringing youth voices to the forefront of adolescent health care conversations. Teen educators are hired and trained to facilitate 2 complementary workshops: the 90-minute PATCH for Providers workshop helps clinicians understand the concerns, fears, and preferences of youth in health care settings and provides suggestions on ways to more effectively communicate and build relationships with teens; the 60-minute PATCH for Teens work-

shop empowers young people to begin managing their own health care and equips them with the knowledge and skills needed to navigate and advocate for youth-friendly services. Teen educators also meet twice a month for ongoing training and enrichment. This report highlights the evolution of this Wisconsin-based initiative and showcases its collective effect in 6 US communities.

## BACKGROUND

In 2010, the Wisconsin Alliance for Women's Health launched a replication pilot project of a New York City peer education program to improve adolescent-provider sexual and reproductive health conversations in Dane County, Wisconsin.<sup>5</sup> With a \$10,000 start-up grant, youth were hired to facilitate 2 scripted workshops – one for health care professionals and one for peers.

After the inaugural pilot, a 2-year grant was awarded to conduct a rigorous evaluation of the intervention, in partnership with an academic affiliate. Workshop participants indicated significant improvements in knowledge, self-efficacy, and behavioral inten-

tions to provide and seek quality sexual health care.<sup>6</sup> Additionally, clinicians self-reported behavior change 3 months post-workshop.

In 2014, workshop content and delivery strategies underwent an overhaul. The revised workshops aimed to provide foundational information and tactics to enhance overall adolescent patient-clinician communication and relationships.<sup>1-10</sup> Program replication efforts also began in 2014 when a health insurance plan awarded funds to pilot the intervention in rural Wisconsin. An additional investment from an academic endowment fund broadened replication into an urban Wisconsin community a year later. These 2 projects examined the factors necessary for full-scale program replication (eg, time, cost, and adaptations needed based on different populations and settings). The first non-Wisconsin PATCH Site launched in 2017.

### **PATCH Sites**

PATCH sites are communities that have dedicated their own resources towards implementing the PATCH Teen Educator Program. New sites hear about the program through various mediums (eg, conferences and word-of-mouth) and request a PATCH Teen Educator Program Planning Guide. This document contains foundational information about the intervention's theory, model, and impact and helps initiate conversations related to fit and feasibility within the community. Interested parties sign a memorandum of agreement and participate in a multiday, in-person site training – allowing sites to formally meet PATCH program staff, gain a comprehensive understanding of the PATCH Teen Educator Program, and develop a foundation for ongoing collaboration with PATCH's community of practice.

### **Teen Educators**

PATCH sites recruit and hire youth (ages 14–18) through a competitive hiring process that includes completing an application and interview. To ensure integration of youth voices from populations most affected by health disparities, consideration is given to characteristics such as ability status, ethnicity, gender identity, health condition(s), pregnancy or parenting status, and ZIP code. Selected youth commit to a 9-month contract, participating in an initial 20- to 24-hour training followed by bimonthly enrichment meetings. Continual engagement promotes team bonding and provides a space to build or expand upon teen knowledge, confidence, and skills. Teen educators also are responsible for facilitating PATCH workshops and empowered to advocate for change within the health care system and their community.

### **Workshops**

Facilitated by teen educators, the PATCH for Providers and PATCH for Teens: Peer-to-Peer workshops seek to improve participant knowledge, confidence, and intended behavior. While a standardized script is used for fidelity, teen educators are encouraged and trained to add their own perspectives and experiences. Each workshop highlights 3 key principles:

1. Teens need and deserve a good relationship with their health care providers.
2. Teens have legal health care rights.
3. Teens have a personal responsibility to learn to manage their own health care.

Workshop activities include self-reflection, group discussions, skits, and other scenario-based learning modalities. PATCH sites promote and facilitate workshops based on community needs and overall programmatic goals. The majority of the workshops are either hosted by the PATCH site, by an organization in the community, or part of a larger event (eg, a professional conference).

## **METHODS**

Between August 2018 and December 2019, 6 US communities implemented the PATCH Teen Educator Program: 3 located in Wisconsin, plus 1 each in Indiana, New York, and Oklahoma. Together, sites hired 71 teen educators and facilitated 28 PATCH for Providers workshops and 26 PATCH for Teens workshops.

Programmatic evaluations were developed by PATCH staff and provided to sites in both paper- and web-based (ie, Google Form) versions. Teen educators were asked to complete a post-program survey to assess self-reported developmental experiences associated with PATCH, and workshop participants were asked to complete an immediate post-workshop evaluation to measure perceived change as a result of participating in the workshop. In most cases, sites administered paper evaluations – transferring responses verbatim to a corresponding web version for streamlined data collection and analysis among sites. With Google Drive sharing properties, PATCH staff exported and merged site-specific data to assess the collective impact of the initiative.

## **RESULTS**

### **Teen Educators**

Of the 71 teen educators trained, 52 completed the post-program survey. The majority self-identified as 16 years old or older (15 years or younger, 15.4%; 16 years, 28.8%; 17 years, 21.2%; 18 years or older, 34.6%); White or Caucasian (52%) followed by Black or African American (28.8%); and female (63.5%), male (28.8%) and transgender (7.7%). Overall, 92.3% indicated their involvement in PATCH had been a positive turning point in their life. Most significant changes were related to life skills, cultural competency, and sense of self (Table 1). Less notable changes were related to academic success and community involvement. The following exemplifies the impact reported by teen educators: “It’s so nice to be in an environment where I can be myself and not feel judged. It is also a productive environment where I’m learning a lot, so I like that too.”

### **Workshop Participants: Providers**

Over 500 participants (N = 526) turned in the post-workshop evaluation, yielding a 65.7% response rate. The majority of respon-



dents self-identified as White or Caucasian (80%), female (78.6%), and/or having less than 5 years in the field (41.2%). Some of the largest reported changes (139% to 217% increase, Table 2) included understanding teen preferences and concerns in health care settings; understanding how to best communicate with teens about their health; confidence in being able to provide care that addresses the needs, preferences, and concerns of teens; and confidence in being able to educate, engage, and empower teens to be active participants in their health care. Further, 88.2% indicated they will likely change the way they interact with and care for teens, while 91.7% indicated they would utilize the knowledge and resources they gained from the workshop. The following is an example of participants' key takeaways: "Through this workshop, I realized the importance of treating teenagers like any adult patient with rights to dignity and respect, to equitable health care services, confidentiality and privacy, and decision-making regarding their health." Workshop ratings averaged 4.5 out of 5.

### Workshop Participants: Teens

Three-hundred participants turned in the post-workshop evaluation, yielding a 66.7% response rate. The majority of respondents self-identified as 15–17 years old (14 years or younger, 18.2%; 15 years, 28.3%; 16 years, 19.7%, 17 years, 23.0%; 18 years or older, 10.8%); White or Caucasian (51%) followed by Asian or Asian American (18%); and female (62.6%), male (29.4%), and transgender (7.9%). The following exemplifies comments made by participants: "You were extremely helpful and answered a lot of questions I have always had." "It's nice having teens present to other teens because it feels more casual and relatable." See Table 3 for a summary of self-reported changes. Workshop ratings averaged 4.2 out of 5.

## DISCUSSION

The PATCH Teen Educator Program helps communities authentically engage youth in addressing barriers impeding adolescent patient-clinician communication. By attending a 1-time, 60- to

**Table 1.** Abridged Summary of Self-Reported Post-Program Impacts From PATCH Teen Educators, Reported in Percentages

Because of my involvement in PATCH, ...	Yes, Definitely	Quite a Bit	A Little Bit	Not at All	No Opinion
I am a trusted resource to my peers	67.3	21.2	7.7	3.8	0.0
I learned I had a lot in common with people from different backgrounds	67.3	19.2	9.6	1.9	1.9
I am more of a leader	61.5	25.0	9.6	1.9	1.9
I work better with others on a team	59.6	26.9	9.6	3.8	0.0
I am more comfortable speaking in public	59.6	23.1	15.4	0.0	1.9
I learned I can do things I didn't think I could do before	63.5	19.2	11.5	5.8	0.0
I think more about my future	69.2	17.3	9.6	1.9	1.9
I am more willing to advocate for myself	65.4	19.2	11.5	1.9	1.9
I try harder in school	30.8	32.7	11.5	13.5	11.5
I spend more time volunteering or helping others in my community	34.6	36.5	19.2	7.7	1.9
I feel confident in my ability to manage my own health care	57.7	28.8	13.5	0.0	0.0
I have (or will advocate for) a better relationship with my health care provider	67.3	23.1	9.6	0.0	0.0
I plan to always have time alone with my health care provider – even if someone comes with me to the appointment	71.2	21.2	5.8	1.9	0.0
I plan to have a well-visit/check up with my health care provider every year	80.8	15.4	1.9	0.0	1.9

**Table 2.** PATCH for Providers Workshop Participants' Self-Reported Outcomes

% of Participants Who Self-Assessed "High" or "Very High" Prior to and After the Workshop <sup>a</sup>			
	Prior	After	P value <sup>b</sup>
Knowledge			
My understanding of teen preferences and concerns in health care settings	29.9	94.9	<0.0001
My understanding of how to best communicate with teens about their health	29.8	94.5	<0.0001
Confidence			
My confidence in being able to provide care that addresses the needs, preferences, and concerns of teens	33.5	88.4	<0.0001
My confidence in being able to have open and honest conversations with teens about more personal or "sensitive" topics	44.4	89.5	<0.0001
My confidence in being able to discuss, establish, and protect a teen's right to confidentiality	42.1	89.9	<0.0001
My confidence in being able to educate, engage, and empower teens to be active participants in their health care	37.0	88.5	<0.0001
My confidence in being able to build more trusting relationships with my teen patients	45.5	91.7	<0.0001
Intended behavior			95% CI
The likelihood that I will utilize the knowledge and resources I gained from this workshop		91.7	89.3 – 94.0
The likelihood that I will change the way I interact with and care for teens because of this workshop		88.2	85.5 – 90.9

<sup>a</sup>Participants were administered a retrospective pre-post self-assessment at workshop completion.

<sup>b</sup>McNemar's tests were used to assess retrospective pre to post scores at an alpha level of 0.01.

90-minute workshop led by trained youth, both clinician and teen audiences reported significant changes in knowledge, confidence, and intended behavior changes. Youth leading those workshops indicated more noteworthy effects of the program in supporting positive growth and skills for adulthood. Yet, key limitations include the sole use of self-reported data and the lack of demographic diversity in clinician participants.

**Table 3.** PATCH for Teens: Peer-to-Peer Workshop Participant's Self-Reported Outcomes, Reported in Percentages

<b>Knowledge: Because of PATCH, I now know....</b>	<b>Yes</b>	<b>Kind Of</b>	<b>No</b>	<b>Already Knew</b>
Why it is important to be open and honest with health care providers	69.0	5.1	0.7	25.2
The type of relationship I have with my health care provider matters	69.6	8.1	0.3	22.0
Teens have legal health care rights	78.0	8.8	0.3	12.9
I have a personal responsibility to be involved in my health care	71.3	12.5	1.0	15.2
Learning to manage my health care is an important part of becoming an adult	71.0	8.9	0.3	19.8
<b>Confidence: Because of PATCH, I am confident in my ability to...</b>	<b>More</b>	<b>Same</b>	<b>Less</b>	<b>Not Sure</b>
Talk openly and honestly with health care providers	46.3	46.6	2.4	4.8
Advocate (speak up) for myself in health care settings	52.4	41.2	1.4	5.1
Be involved in my own health care	58.0	35.8	1.4	4.8
Get the health care I need and deserve	53.6	41.2	1.4	3.8
<b>Intended Behaviors: Because of PATCH, I plan to...</b>	<b>Yes</b>	<b>Not Sure</b>	<b>No</b>	
Talk to my parents, guardians, or trusted adults about health care	65.3	28.2	6.5	
Be more involved in my own health care	85.9	10.3	3.8	
Learn more about how I can manage my own health care	84.9	10.3	4.8	
See a health care provider regularly	77.0	18.2	4.8	
Talk openly and honestly with health care providers	81.8	13.4	4.8	
Build better relationships with my health care providers	84.2	11.3	4.5	
Advocate (speak up) for my health care rights	86.9	10.7	2.4	
<b>Overall Experience: The PATCH workshop was...</b>	<b>Yes</b>	<b>Kind Of</b>	<b>No</b>	
Interesting	70.4	26.0	3.6	
Useful	87.1	11.8	1.1	
Easy to understand	82.2	17.4	0.4	
Fun	53.8	38.5	7.6	
I liked learning from other teens	80.0	18.8	1.2	
I learned a lot from PATCH	54.9	42.4	2.7	

This initiative has evolved and been replicated in various parts of the nation. Sites have varied in geography (rural and urban), organizational structure (government and nonprofit), capacity, and overall reach. With support from PATCH staff, communities have adapted the program to their specific needs and priorities (eg, hiring and training systems-involved youth as teen educators or simply integrating programming into existing public health initiatives). Health care and public health entities continually express interest the PATCH Teen Educator Program, as it seemingly provides a creative and youth-driven approach to addressing other public health priorities (eg, health care transition and trauma-informed care). There is interest in additional evaluation of the community-wide and long-term effects of replicating, scaling-up, and adapting the intervention.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

**Data Availability:** The data that support the findings of this study are available from the corresponding author upon request.

**Presentations:** A complete list of related oral and poster presentations can be found at [www.patch-program.org](http://www.patch-program.org).

**Acknowledgements:** Our work would not be possible without the support from many individuals and organizations who have rallied around the vision of PATCH, a vision of empowerment and advocacy that is vital to the health and well-being of adolescents.

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Jomol P. Mathew, PhD



Robert N. Golden, MD

# Harnessing Data to Foster Research and Improve Population Health

Jomol P. Mathew, PhD; Robert N. Golden, MD

When COVID-19 was spreading throughout the world, health care providers and researchers needed rapid access to data that were emerging at lightning speed. Fortunately, we were able to leverage currently available data analytics and digital technologies in our battle against COVID-19. Electronic health records (EHR), which became more widespread following enactment of the American Recovery and Reinvestment Act of 2009,<sup>1</sup> allowed iterative studies of symptoms and patient responses to treatments, while mobile technologies assisted in tracking the spread of the virus. Video-based technologies provided remote communication between providers and patients, and social media and the internet helped disseminate information. These developments likely contributed to the vastly reduced death toll (6.58 million worldwide as of November 11, 2022)<sup>2</sup> compared to the 1918-1919 influenza pandemic (approximately 50 million worldwide).<sup>3</sup> The COVID-19 pandemic radically changed our perspectives on how to

conduct research and clinical care, and it set the stage for data-driven biomedical research and clinical practice.

## REAL-WORLD DATA IN BIOMEDICAL RESEARCH AND HEALTH CARE

The development of disease is influenced by a person's genetics, exposome (lifetime environmental exposures), and interactions between them. Advances in human genome sequencing;<sup>4</sup> high-throughput multi-omics;<sup>5</sup> and computational, geospatial, and digital technologies have created unprecedented opportunities for studying genetic factors and the exposome in relation to risk for disease. While effective prevention, treatment, and management of diseases depend on these factors, relevant data from multiple perspectives are not often obtained, let alone integrated. The vastness, heterogeneity, and sparse linkage among data generated over a patient's life course, in turn, limit the ability to integrate and analyze data in a comprehensive and timely way. It is imperative that we find ways to effectively utilize large biomedical data sets.

Following the lessons learned from the pandemic, and with the release of the US Food and Drug Administration's new guidelines for using real-world data,<sup>6</sup> universities and academic medical centers must develop the capacity to conduct multidisciplinary, data-driven research. The University of Wisconsin School of Medicine and Public Health (SMPH) has launched several initiatives to advance research and the translation of findings to clinical care. Here, we highlight a few examples.

## The Wisconsin Real-World Data Collaborative

UW-Madison is developing a unique collaborative to enable ethical sourcing, standardization, quality control, annotation, integration, and analysis of biomedical data in a privacy-compliant environment. The Wisconsin Real-World Data Collaborative (RWDC) addresses several major challenges with real-world data:

**1. Incompleteness of data:** A single EHR often does not include complete health care information generated over a patient's life course, as patients move among places, medical facilities, and pharmacies. In addition, both genetic and exposure factors may be missing or difficult to access in EHRs. Data linkage across several complementary data sources is a common method to compensate for this incompleteness of EHR data. Given the utmost importance of patient privacy, research ethics, and compliance, we are implementing EHR data linkage with state and national data resources using privacy-preserving linkage tools.<sup>7</sup> Our approaches promise to safely access data from multiple sources.

**2. Small sample size:** When an academic medical center does not have enough patients to answer a research question—as in the case of a rare disease—collaborative integration of data from multiple sites becomes necessary. Such integration is often challenging due to local differences in data definitions. The Wisconsin RWDC is designed to map and harmonize data to common data models and vocabularies.

**3. Lack of diversity in research and inadvertent bias:** Many academic medical centers have

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**Figure 1.** Principles Embodied in the Wisconsin Real-World Data Collaborative



limited diversity in their patient populations. This can result in bias in sample selection and a lack of generalizability of findings across communities, states, and the country. The SMPH's Survey of the Health of Wisconsin (SHOW)—funded by the Wisconsin Partnership Program (WPP)—effectively addresses these issues through its statewide, randomly selected cohort for biomedical research. Between 2008 and 2019, the program enrolled more than 6000 state residents (including children) with well-characterized health and health outcomes data. SHOW's biorepository includes approximately 210,000 samples of urine, stool, blood, and derivative samples collected from participants who consented to use of their data in future research projects. SHOW uses advanced survey methods to ensure inclusion of participants that represent the diverse populations of Wisconsin.<sup>8</sup> In 2018–2019, intentional oversampling was applied to include disadvantaged and hard-to-reach populations that otherwise would not be represented in biomedical research; one-third of the sample includes residents of rural areas.

With a follow-up survey response rate of more than 60%, the cohort presents a remarkable opportunity to engage a diverse community of participants in prevention and treatment studies. SHOW is being incorporated into the Wisconsin RWDC to accelerate availability of

harmonized data and annotated specimens for research.

With heterogeneous, real-world data and a Wisconsin-centric cohort, the Wisconsin RWDC (Figure) will evolve into a unique data repository for innovative research.

### Innovation with Platform X and Data Science Dry Lab Suites

Data-driven biomedical research relies heavily on access to computing environments in which data can be securely retrieved from multiple sources, integrated, and rapidly analyzed. Lack of scalability and cost-effectiveness of storage and computing often impair researchers' abilities to analyze large data sets, particularly using analytical approaches such as machine learning and artificial intelligence. At the SMPH, our transformative Platform X computing environment features advanced data security, reliability, and scalability. Secure transfer of raw data, including protected health information, into Platform X and transfer of deidentified results out of the platform are facilitated through tools that enable authentication, authorization, and audit trails. To achieve reproducibility in data analytics, we also are developing the Data Science Dry Lab (DSDL) Suites, which bundle servers, reference datasets, analytical software, data pipelining tools, and algorithms commonly

used to support each domain of biomedical research. The first of these innovative suites is supporting clinical data analysis and neuroimaging research for a large, multisite study.<sup>9</sup>

### FUTURE VISION

Emerging opportunities for expanding the capacity of research that utilizes large data sets need new systems and technologies for harnessing data in order to deliver their full potential benefits. Platform X, the Wisconsin RWDC, and the DSDL Suites are examples of new tools that can allow researchers to define phenotypes, obtain and analyze holistic longitudinal data, and download deidentified results. At the same time, we must engage all of the diverse populations within our state and communicate results to the participants. We are fully committed to the development of an inclusive, real-world data infrastructure that will accelerate advances in research, education, and clinical care, and in doing so improve the health of the residents of Wisconsin and beyond.

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Joseph E. Kerschner, MD

## Elevating Science at the Medical College of Wisconsin

Joseph E. Kerschner, MD

Several years ago, a blog on the relationship between art and science posted by EBSCO Information Services (a company that provides information resources and tools to libraries, including art and science databases) noted that, “Traditionally, art and science have been treated as two separate disciplines, but when they are studied together, it’s clear to see the impact one has on the other. Visual art has been used to document the natural world for thousands of years, from cave drawings of animals that help today’s researchers figure out yesterday’s fauna, to paintings of centuries-old experiments that show us how they were conducted.”<sup>1</sup>

Among the most famous examples of the interconnection between art and science is the work of Renaissance master, Leonardo da Vinci. Although da Vinci is best known for his dramatic and expressive artwork, he also conducted dozens of carefully thought-out experiments and created futuristic inventions that were groundbreaking for the time. The Boston Museum of Science, which has exhibited da Vinci’s scientific drawings over the years, has created a website that includes an outstanding overview of da Vinci as the artist, the inventor, and the scientist “who has served as a role model applying the scientific method to every aspect of life, including art and music.”<sup>2</sup>

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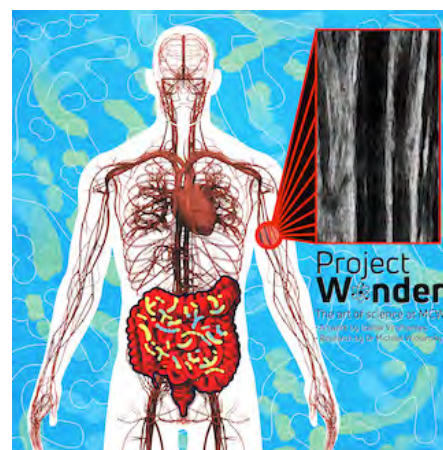
Another example is the drawings of Andreas Vesalius (1514–1564), whose groundbreaking drawings, *De humani corporis fabrica* (On the Structure of the Human Body), rapidly and fundamentally changed the understanding of human health and disease.<sup>3</sup> Several of these drawings have adorned the halls of the Medical College of Wisconsin’s anatomy laboratories for decades.

Art can serve as a bridge to science and is crucial in helping us understand our scientific legacy and how science is well-served by applying an artistic lens. Together, art and science help us interpret, study, and explore the world around us.

To that end, within the walls of the Medical College of Wisconsin (MCW) are individuals dedicated to generating the knowledge that changes lives across our community, state, and around the world. Basic and translational scientists at MCW drive discovery and relentlessly pursue innovative and cutting-edge treatments to positively impact health. The work is challenging, rewarding, and groundbreaking.

To elevate the important work of these health and science leaders, MCW has launched several initiatives designed to create awareness of its research enterprise and elevate the unique contributions of its scientists to advance health globally. One such terrific endeavor is Project Wonder: The Art of Science at the Medical College of Wisconsin.<sup>4</sup>

Project Wonder, launched in March 2022, partners MCW’s basic and translational scientists with in-house and community-based graphic designers, artists, illustrators, and writ-



Images from Project Wonder: The Art of Science at the Medical College of Wisconsin

ers to elevate and amplify their research interests and discoveries through bold, imaginative, one-of-a-kind artistic representations of innovative, life-changing research and its impact.

Promoted across Instagram, Facebook, Twitter, and LinkedIn, Project Wonder uses

social media to raise awareness of science by making it accessible and engaging for the public. Project Wonder reaches more than 1.5 million people across the globe. To date, the Project Wonder website showcases 11 evocative art pieces with accompanying stories, with more being added on a regular basis.

One piece, titled *Effect of Probiotic Supplementation on Endothelial Function*, seeks to answer the question, “Can bacteria in the gut predict the severity of a potential heart attack?” The piece is illustrated by an animated drawing of the body’s circulatory system and gut, accompanied by a beating heart flashing on and off.<sup>5</sup>

According to Michael Widlansky, MD, MPH, Northwestern Mutual Professor of Cardiology and professor of medicine and pharmacology and toxicology at MCW, gut bacteria may even be able to help improve diagnosis and treatment of heart disease. John Baker, PhD, MCW professor of surgery (pediatrics) and pharmacology and toxicology, and Nita Salzman, MD, PhD, MCW professor of pediatrics and microbiology and immunology, director of the Medical Scientist Training Program, and director of the Center for Microbiome Research, demonstrated a link between bacteria living in the gut and heart disease by treating rodents predisposed to heart disease with antibiotics.

The treatment reduced the size of heart attacks and the level of the hormone leptin in the bloodstream, which appears to play a messenger role connecting gut bacteria behavior to heart health. Drs Baker and Salzman found that treating the same rodents with a probiotic containing *Lactobacillus plantarum* 299v—a bacteria known to reduce leptin levels—generated a very similar result. In humans, studies have shown that gut bacteria play a role in controlling systemic inflammation in which the body’s immune system is more active than it should be – increasing the risk of heart disease and other conditions.

Based on these and other findings, Dr Widlansky is running a clinical trial testing the antiinflammatory properties of a *Lactobacillus plantarum* 299v probiotic in heart disease patients. His team will measure the effect of the treatment on reducing markers of inflammation in blood samples and increasing blood vessel dilation as a signal of improved vessel health. Dr Widlansky published findings from a pilot study of this probiotic treatment protocol in 2018 that found reduced inflammatory biomark-

ers in blood plasma and improved blood vessel function in 20 individuals. The clinical trial will expand upon these results significantly with a goal of recruiting more than 200 participants.

A second piece, titled *Watching the Brain Think*, seeks to answer the question, “Is it possible to watch a brain think?” The piece features a creatively illustrated photograph from 1992 that shows the most powerful magnet in Wisconsin (at that time) being lowered by a crane into the formerly named National Biomedical Electron Spin Resonance Center at MCW, accompanied by a soundtrack reminiscent of a spinning magnet.<sup>6</sup>

In the 1990s, MCW became internationally recognized for its pioneering work on functional magnetic resonance imaging (fMRI), an advanced version of the MRI. While research on fMRI was underway at Harvard University and other institutions at the time, MCW scientists published their first academic paper on fMRI in 1992, which detailed one of the world’s first three successful fMRI experiments. MCW’s team made significant contributions through the development of a real-time, noninvasive assessment of brain function and the observation of blood flow in the brain. Because blood flow in the brain is linked to the activation of nerve cells that pass along and store thoughts and information, blood flowing to a specific area of the brain indicates that area being used for a specific task, such as controlling motion, storing or recalling memories or processing language.

MCW’s research on fMRI was pioneered in the early 1990s by the late James S. Hyde, PhD, professor of biophysics and founding director of MCW’s Biophysics Research Institute (now the Department of Biophysics), and two graduate students, Eric C. Wong, MD, PhD, and Peter Bandettini, PhD. They used a magnetic resonance imager to not only look at the anatomy of the brain, but to watch thinking take place. In 1999, MCW scientists would use fMRI to make major discoveries, including a method for diagnosing Alzheimer’s disease. That same year, MCW researchers were the first to record the brain working in real time as a person mentally shifts attention from one subject to another or when a person is not paying attention at all.

MCW scientists have published more than 510 scientific articles on fMRI since the institution’s pioneering first manuscript in 1992. Researchers throughout the world have cited these papers more than 28,000 times in other published studies. MCW’s fMRI researchers

have garnered more than \$82 million in federal funding from the National Institutes of Health since the early 1990s.

Additional Project Wonder pieces cover such diverse topics as *Redlining, Race, Bias, and Breast Cancer*;<sup>7</sup> *Mitochondria Networks*;<sup>8</sup> *Cerebellum Semaphore*;<sup>9</sup> and *Cardiovascular Regenerative Engineering*.<sup>10</sup>

Da Vinci once said, “To develop a complete mind, study the science of art; study the art of science. Learn how to see. Realize that everything connects to everything else.”

Thanks to MCW’s basic and translational scientists and in-house and community-based graphic designers, artists, illustrators, and writers, their informative and evocative work underscores how the knowledge we are creating at MCW spans the entire health care continuum and is helping to change lives and communities.

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