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volume 120 · no. 3 · october 2021

Exploring Factors That Affect Rural Health

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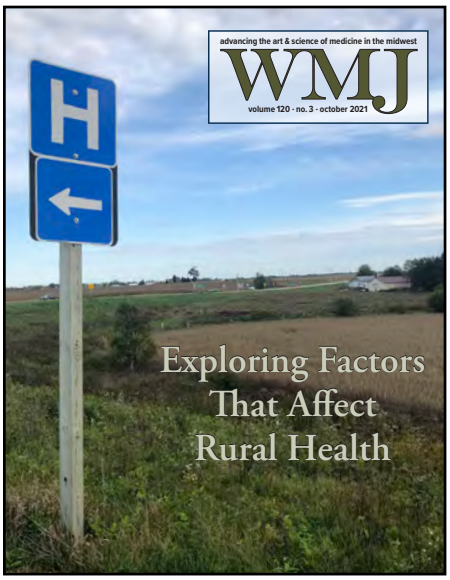

COVER THEME

Rural Health

Approximately 20% of Americans live in rural areas, yet rural Americans are less likely to have health care, have decreased access to health care, and may often need to travel long distances to find a doctor or hospital. In this issue of WMJ, *authors explore some of the myriad factors that affect rural health outcomes.*

Cover design and photography 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 120 • October 2021 • Issue 3

WMJ

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EDITORIAL

ORIGINAL RESEARCH

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 publsiher 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 publsiher and its affiliates unless specified. *WMJ* is indexed in Index Medicus, Hospital Literature Index, and Cambridge Scientific Abstracts.

Submit manuscripts at www.wmjonline.org.

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 537055; e-mail: wmj@med.wisc.edu

POSTMASTER
Send address changes to: University of Wisconsin School of Medicine and Public Health, Health Sciences Learning Center, 750 Highland Ave, Madison, WI 53705

ISSN 1098-1861 • Established 1903

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FROM THE DEANS

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Empathy for the Unvaccinated

Dear Editor:

When Dr Ehlenbach shared the news of his father's diagnosis of advanced lung cancer with colleagues, he was frequently asked by these physicians if his father had been a smoker. This question reveals an implicit desire to separate the complicit from the innocent, to fully inform their reaction to the news. Regardless, it is sad that his father was sick and that he died, full stop. Blaming patients for their health problems is a practice that predates scientific medicine, but it seems to have become worse over time. We invoke patients' failure to control diabetes as an explanation for limb loss, lack of discipline as the etiology of obesity, and "medication noncompliance" as the cause of runaway hypertension. Improving health through behavioral modification does not require vilification of patients. But our professions' bad habits threaten to destroy expressions of empathy required for a therapeutic relationship.

Nowhere is this more seditious or prevalent than for our patients with serious illness from COVID-19. The vast majority of patients with COVID currently filling intensive care units in Wisconsin have not received a COVID vaccine, and most of them would not be severely ill had they done so. Tens of thousands of Americans will die because they did not get vaccinated. For an already exhausted workforce, the notion that we could feel less exhausted, safer, and less burned out if people would simply take a free, safe, and highly effective vaccination is as straightforward as it is maddening that so many have not done so. The light at the end of the tunnel has dimmed. It is hard to watch people die from preventable illness. But this is what we do and have always done. It is challenging to care for people whose illness may harm you, yet this is also part of the job – consider tuberculosis, hepatitis C, and HIV. In return for our care, we receive relatively high pay and high status. We are not qualified to be judge and jury. In making these judgements we are likely to make mistakes.

We are desperately in need of a better narrative. Shifting narratives to support empathy can improve care as it has in substance use disorder. When we moved from considering addiction as a moral failing to conceptualizing it as a disease, it fundamentally altered our approach. Shaming our patients for failure to vaccinate, or routinely expressing anger to colleagues that these patients are sick because they are dumb, simply inflames the toxic divisions that got them to this place. To start, we need a different target for our well-justified anger. So we should focus our anger on those who misled them. Elected leaders and media personalities who spread misinformation and social media platforms like Facebook that amplify it have led our patients to make choices that are harming them and those around them. Next, we need to reframe our feelings about critically ill adult patients with COVID. It is tragic and it is exhausting, and we should acknowledge this. A better narrative is that we are sad that our patients succumbed to lies spread by people they trusted. We are flummoxed that they trusted them more than they trusted us. We will do better to be trustworthy, but for now we will fight their illness with them.

People will always be sick, humans will always make bad choices, and we will always be here to take care of them. It's time to have more empathy for the unvaccinated.

Margaret L. Schwarze, MD, MPP; William J. Ehlenbach, MD, MSc

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Funding/Support: None declared.

Financial Disclosures: None declared.

Racial and Ethnic Differences in Zoster Vaccine Uptake: A Cross-Sectional Study in a Veterans Health Administration Primary Care Clinic

Dear Editor:

Zoster vaccine uptake has been disappointing (34.5% of the target population) and marred by racial and ethnic disparities.[1,2] However, studies of uptake generally have limitations. Most are survey-based (and subject to self-report bias) and based largely on the discontinued live vaccine (not the currently available recombinant vaccine).[1,3] Furthermore, much of recent literature describes the situation 3 years ago when the recombinant vaccine was in shortage.[1]

These limitations raise a question: Do these racial and ethnic disparities persist? Insight into that question may be gleaned from a quality improvement project that we initiated to improve zoster vaccine uptake. Our baseline findings overcome those limitations. Our findings are current, record-based, and reflect the recombinant vaccine. Our findings are from a Veterans Health Administration clinic (where insurance and access are not barriers) and may shed light on the question of persistence of disparities, even when those barriers are absent.[4]

We queried the records of the Omaha primary care clinic of the Veterans Health Administration Nebraska-Western Iowa Health Care System for receipt of recombinant zoster vaccine since October 1, 2017. We included patients at least 50 years old on October 1, 2017 (close to the recombinant vaccine approval date) seen in the clinic October 1, 2020-July 5, 2021.

Our population of 10,323 was predominantly male (93.8%); 81.2% were non-Hispanic White, 10.7% were non-Hispanic Black, and 1.5% were Hispanic White. The prevalence of complete vaccination (2 doses) was 39.8% (females 34.7%, males 40.1%). Complete vaccination was 43.3% in non-Hispanic White patients, 33.8% in Hispanic White patients, and 24.9% in non-Hispanic Black patients. Receipt of at least 1 COVID-19 vaccine dose was 80.1%, 78.2%, and 82.2%, respectively.

A 39.8% prevalence of complete vaccination was higher than generally reported for zoster vaccine uptake.[1,2] Conceivably, this could reflect our study population: individuals seen in a clinic with vaccine reminders, standing vaccine orders, onsite vaccine, and no charge for vaccine. [4,5] Racial and ethnic disparities are consistent with most, but not all, of the literature.[1,2]

The contrast between zoster vaccine disparities and their absence with COVID-19 vaccine (for which awareness was extraordinarily high) supports the hypothesis that zoster vaccine disparities arise from disparities in awareness.[2]

Our baseline data confirm the appropriateness of our choice of zoster vaccine uptake as a quality improvement project, showing an opportunity for improving uptake and an opportunity to address factors other than insurance and access that account for racial and ethnic disparities.

Marvin J. Bittner, MD; Gia Thinh D. Truong, BS; Zachary A. Creech, BS

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Exploring Factors That Affect Rural Health

Sarina Schrager, MD, MS, *WMJ* Editor-in-Chief

Approximately 20% of Americans live in rural areas—a number that is even higher in Wisconsin, with almost a third of Wisconsin citizens living in rural areas. The definition of rural is not always clear. In fact, the US Census Bureau defines a rural county as one that is not near a metropolitan area, and a metropolitan area is defined as having cities with a population of 50,000 or greater.[1] So rural areas are counties that do not have a metropolitan area within their geographic boundaries, nor are they adjacent to metropolitan areas. As defined, rural counties encompass small communities or towns and agricultural land masses.[1]

Rural-urban health disparities are well documented.[2] Rural Americans are less likely to have health care, have decreased access to health care, and may often need to travel long distances to find a doctor or hospital. Rural areas face shortages in both primary care and specialty care clinicians. Overall, death rates are higher in rural areas, with significantly higher opioid overdoses as well.[2]

The COVID-19 pandemic has amplified many of these disparities. Rural intensive care units (ICU) are small and have not been able to keep up with the onslaught of COVID patients.[3] Early data showed that patients with COVID were three times more likely to die from COVID-related factors if they were admitted to hospitals with fewer than 50 ICU beds as compared to hospitals with more than 100 ICU beds.[4] Many rural hospitals have less than 10 ICU beds, which would mean that people admitted to rural ICUs with COVID would have worse outcomes. In addition, a survey of a nationally representative group of 5000 people found that rural residents were less likely to have performed behaviors to lessen the risk of contracting COVID (ie, wearing masks or social distancing).[5] The transition to remote school and work environments also has been challenging for many rural residents, as access to reliable broadband internet can be unreliable.

Rural Americans are less likely to have health care, have decreased access to health care, and may often need to travel long distances to find a doctor or hospital.

The *WMJ* has a longstanding interest in rural health due to the high numbers of Wisconsin residents who live in rural areas.[6] Three such papers are highlighted in this issue. Two studies characterize trauma care in rural Wisconsin and the third looks at national mortality trends in rural vs urban areas as well as mental health outcomes. Park et al[7] used a Google Map interface to determine distance to trauma centers for children living all over Wisconsin. They found that only 31% of children in the state lived within 30 minutes of a level I trauma center, but over 80% lived within 30 minutes of a level III trauma center. Distance to trauma center has been correlated with successful outcomes, so the fact that so many children in Wisconsin live far away from a level I trauma center could be concerning. The authors suggest that rural hospitals prepare to take care of pediatric trauma cases in all situations. Marshfield Clinic researchers[8] looked at 18 years of data (2000-2018) from their level II trauma center and found that trends in deaths mirrored those in national-level data. They saw an older population and increased trauma from falls.

A third paper in this issue by Anderson et al used county-level data from every county in the US and found, counter to previous literature, that as the county became more rural, cardiac mortality decreased.[9] Other literature has shown that people living in rural areas had increased risk of cardiac mortality,[2] but this study did not. The study also looked at number of "unhealthy mental health days" and found that as people's county became more rural, they had fewer unhealthy mental health days.

One trend that has emerged from the last two years of a pandemic is the increase in attention to rural health and the promotion of telehealth options of care, which may be ideal for people who live long distances away from health care. The US Department of Health and Human Services designated $1 billion to improve the COVID-19 response in rural areas. The money is designated to increase vaccine use and to support small hospitals by increasing infrastructure.[10] We may not be finished with this pandemic, but hopefully, some progress in improving rural health will remain.

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Financial Disclosures: None declared.

Funding/Support: None declared.

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WMJ

The Wisconsin Infection Prevention Center: *The Value of a Statewide Infection Prevention Center*

Nasia Safdar, MD, PhD; L. Silvia Munoz-Price, MD, PhD; Robert N. Golden, MD; Joseph E. Kerschner, MD; Ann Nattinger, MD, MPH; Ryan Westergaard, MD, PhD, MPH

Health care-associated infections (HAI), the majority of which are caused by antimicrobial-resistant organisms, pose a major threLetter at to patient safety.[1] Every year 700,000 HAIs occur in acute care settings alone in the United States, causing 75,000 deaths and billions in health care costs.[2] Despite recent advances, there remain significant gaps in knowledge regarding HAI prevention across the spectrum of health care. For successful HAI prevention, it is essential that novel interventions are identified and tested, driven by a deep understanding of pathogenesis and transmission.[1] Already, emerging pathogens, particularly multidrug-resistant organisms such as carbapenem-resistant *Acinetobacter baumannii* (CRAB), threaten to put us back in the pre-antibiotic era, where we may have few, if any, medical therapies to treat life-threatening infections. Thus, research into the epidemiology of HAIs, improved understanding of antimicrobial resistance (AR), and the development of effective novel interventions are high priorities of funding agencies,[3] health care facilities, and patients.[4]

The scope of the problem requires high-quality, high-impact, multidisciplinary, and multicenter research.[5] Currently, groups often work independently on similar questions, which can pose challenges in efficiency and leveraging of resources. Geographic variation in outbreaks of organisms, such as *Clostridioides difficile* (*C difficile*) and CRAB, highlight a need for collaborations within regions to respond directly to local public health needs by coordinating and leading multiple lines of inquiry.[6-8] We propose that a statewide consortium to coordinate prevention and translational research activities in Wisconsin will represent an important innovation for HAI prevention research. This Center, in close collaboration with public health, will allow research to move beyond the current paradigms and will catalyze the discovery, development, implementation, and dissemination of new strategies to improve patient safety and public health. We envision this Center expanding its collaboration to neighboring states in later phases.

The Wisconsin Infection Prevention Center – A Proposal to Support High-Impact Infection Prevention Research

The goal of the proposed Wisconsin Infection Prevention Center is to prevent HAIs and AR through high-quality and high-impact research. This Center will provide the platform and infrastructure to connect experts from a variety of disciplines alongside a coalition of academic institutions, public health agencies, and health care systems. By leveraging and optimizing these resources, the Wisconsin Infection Prevention Center will transform HAI and AR prevention by supporting prevention and translational research in health care settings across the spectrum of care. In addition, such a center will build capacity for research in HAI and AR by training and mentoring learners in the health professions in the skills needed to undertake research within health systems and communities.

The benefits of a successful statewide center are numerous.

- Foster collaboration among scientific leaders with multidisciplinary expertise in broad substantive and methodologic areas (eg, epidemiology, microbiology/microbiome research, pharmacy, infectious diseases, mathematical modeling, and bioinformatics).
- Provide infrastructure to extend the reach of public health agencies – connecting and engaging health care systems, research groups, and academic institutions in a research agenda targeted to public health needs.
- Cultivate the next generation of HAI and AR researchers through didactic and experiential learning. Mentor junior investigators in HAI- and AR-relevant methods and connect them with resources to supplement their development to ultimately expand the workforce for HAI and AR prevention.
- Undertake patient- and other stakeholder-centered research to meet and respond to the needs of HAI and AR in Wisconsin.[4]

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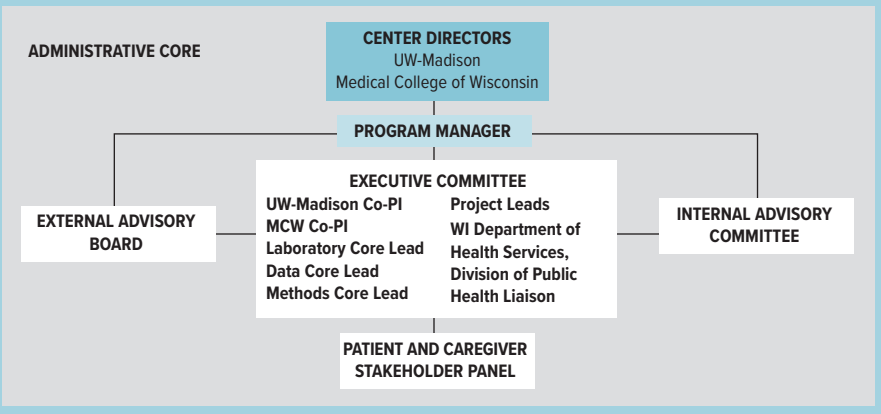
Figure. Proposed Structure of Wisconsin Infection Prevention Center Administrative Core



An Innovative Research Agenda Supported by a Collaborative Infrastructure

Wisconsin provides an excellent "real world" setting in which to conduct HAI prevention research that will support broad translation throughout the state and other regions. Led by investigators at the University of Wisconsin (UW)-Madison and the Medical College of Wisconsin (MCW), the Wisconsin Infection Prevention Center will build a coalition with the Wisconsin Department of Health Services/Division of Public Health, the Wisconsin State Laboratory of Hygiene, and health systems (eg, UW Health, Froedtert Health, Marshfield Clinic Health System). This coalition provides care to over 2 million residents of Wisconsin and beyond. By connecting the expertise of the investigators and clinicians in public health, translational research, epidemiology, and clinical trials across these institutions, the Wisconsin Infection Prevention Center will serve as a valuable resource to the state – allowing investigators to nimbly adapt to emerging pathogens and target research directly to HAI/AR issues of highest priority (eg, the ongoing CRAB outbreak in Wisconsin post-acute care settings).[7] Table 1 outlines a proposed research agenda demonstrating both the innovative nature of the questions, as well as the direct application of these topics to public health in Wisconsin.

The Wisconsin Infection Prevention Center's multidisciplinary activities will be supported by an infrastructure of an administrative and several scientific cores.

An Administrative Core will be charged with leadership, communication, and coordination of key partners to meet scientific goals. The Administrative Core's main roles will be (1) leading/overseeing Center activities (eg, ensuring optimal resource utilization and coordination of research efforts); (2) providing regulatory support for all affiliated research activities; (3) soliciting, reviewing, and selecting projects to meet the Center's scientific goals; (4) identifying opportunities for training and mentoring junior investigators; and (5) evaluating the overall Center and adjusting strategies accordingly in close collaboration with state's public health authorities. Multiple interacting entities will support these roles (Figure). The Wisconsin Infection Prevention Center will be co-led by principal investigators from both UW-Madison and MCW to ensure participation and parity from both of these leading research institutions. An Executive Committee (EC) will oversee all administrative, programmatic, and financial aspects of the Center – developing research agendas, providing decision-making around project execution, engaging collaborators, and ensuring coordination between and among scientific cores and investigators to meet goals. Notably, the EC will include liaison(s) to the Wisconsin Department of Health Services/Division of Public Health – allowing for the Center to directly coordinate responses to HAI and AR issues alongside these public health agencies. An Internal Advisory Committee and External Advisory Board will collaborate with the EC to guide overall activities, ensure access to resources, and provide strategic leadership. In addition, a Patient and Caregiver Stakeholder Panel will contribute their perspective to the EC to apply a patient-focused lens to all Center activities.

Three Scientific Cores (Laboratory, Methods, and Data) will provide centralized resources and support for projects:

1) The Laboratory Core will be responsible for executing lab components of all Center projects.
2) The Data Core will collaborate with investigators throughout the lifespan of research studies to provide statistics and data management support (eg, in experimental design, development of key study endpoints, sample size estimation, statistical analysis plan, monitoring of study conduct, statistical analysis of study data, reporting study results, and publication of findings).
3) The Methods Core will provide a platform for investigators to access specialized research expertise (eg, epidemiology, clinical trials, human factors engineering, health services research, health economics, informatics, and observational study design) and engage additional experts to successfully complete high-quality studies.

The availability of expertise within these cores provides an ideal learning laboratory for junior investigators – mentees will gain hands-on experience in a wide variety of HAI and AR prevention methods and topics (Table 1). Faculty mentors will assist mentees not only in developing individual career development plans, but also in connecting mentees with Center members and resources that will support career goals and development. Given the rising urgency of HAI and AR prevention research, the training provided by the Wisconsin Infection Prevention Center will be an opportunity to cultivate promising researchers and provide the necessary experience to sustain this high-impact research in the future.

Launching and Sustaining a Center to Move Beyond the Current Paradigms of HAI and AR Research

Given the ambitious goals of the Wisconsin Infection Prevention Center, initial funding is necessary to (1) allow investigators protected time to develop Center infrastructure and (2) fund high-impact clinical and translational research projects (Table 1). To support our activities, the Center will actively seek funding from the Centers for Disease Control and Prevention, the Agency for Healthcare Research and Quality, the National Institutes of Health, and foundations such as Advancing a Healthier Wisconsin and the Wisconsin Partnership Program. Upon

launch of the Wisconsin Infection Prevention Center, regular evaluation of the Center's goals and metrics will be critical to ensuring progress towards a high-impact translational research agenda (Table 2). All entities within the Administrative Core will play important roles in monitoring scientific and administrative progress and developing strategies for future research directions to ensure that the Center's research is targeted towards innovative and high-impact questions in response to the public health crises posed by HAI and AR.

Wisconsin has long been a leader in clinical innovation and public health. The proposed Wisconsin Infection Prevention Center will further cement the state as a regional and national powerhouse in infection prevention research. With the infrastructure and platform to support a broad research and translation agenda, the Wisconsin Infection Prevention Center will focus on novel interventions – prioritizing approaches where there is potential for broad population impact. Given its proposed coalition of institutions, health care networks, and public health agencies, the Center will be able to directly align with public health priorities – thus its work will be immediately applicable to the needs of the state and beyond.

In summary, we strongly believe that the Wisconsin Infection Prevention Center will leverage the talent in our state institutions, fostering multidisciplinary collaborations and research with close coordination with the state's public health authorities, ultimately benefiting all Wisconsinites.

Table 1. Proposed Initial Research Agenda for Wisconsin Infection Prevention Center

Lead Institutions	Research Aim
MCW, WSLH	Examine the epidemiology, environmental contamination, skin microbiome, and prevention interventions in Milwaukee-area post-acute care patients colonized with CRAB.
UW, MCW	Evaluate biomarkers as predictors of *Clostridioides difficile* infection, characterize testing methodology on antimicrobial prescribing, and establish geographic patterns of *C difficile* strains in Wisconsin.
UW, MCW, WDHS/WDPH	Characterize the post-acute health care networks in two Wisconsin counties to identify regional opportunities to interrupt the interinstitutional spread of AR bacteria.
UW	Identify modifiable risk factors for community-onset, health care-associated AR pathogens by leveraging the statewide Survey of the Health of Wisconsin and linking to the electronic health records of multiple health care systems.[9]
UW, MCW	Use machine learning to develop a tool for predicting the likelihood of infection due to resistant organisms.
MCW, WSLH, WDHS/WDPH	Evaluate prospective real-time whole genome sequencing on the epidemiology of CRAB at the state level in Wisconsin to determine if this strategy is more effective and cost-effective for surveillance and outbreak investigations.
UW, MCW	Determine how dietary fiber supplementation, compared to no supplementation, affects *C difficile* infection rates, the gut microbiome, and host immune response in individuals with a recent history of *C difficile*.

Abbreviations: CRAB, Carbapenem-Resistant *Acinetobacter baumannii*; MCW, Medical College of Wisconsin; UW, University of Wisconsin-Madison; WDHS, Wisconsin Department of Health Services; WDPH – Wisconsin Department of Health Services, Division of Public Health; WSLH – Wisconsin State Laboratory of Hygiene.

Table 2. Goals and Indicators to Evaluate Wisconsin Infection Prevention Center Impact and Capacity Building

Goal	Indicator/Measure
Increased capacity to conduct HAI/AR prevention research	• 100% of mentees successfully complete mentoring program • Center projects meet all aims • 100% of faculty engage in at least 1 Center activity each year
Increased HAI/AR prevention scientific output	• Minimum of 3 peer-reviewed articles/abstracts/presentations at scientific meetings and conferences for each Center project
Improved collaboration with other HAI/AR prevention researchers	• Active partnerships with state, regional, and national groups conducting HAI/AR prevention research • Active engagement with health care facilities networks for HAI/AR research • Each co-principal investigator serves on a working group for national HAI prevention consortia

Abbreviations: AR, antimicrobial resistance; HAI, health care-associated infection.

Acknowledgements: Julie Keating, PhD, assisted in editing and formatting this manuscript.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Driving Time to Trauma Centers for Children Living in Wisconsin

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ABSTRACT

Introduction: Trauma is the number 1 cause of death among children. Shorter distance to definitive trauma care has been correlated with better clinical outcomes. There are only a small number of pediatric trauma centers (PTC) designated by the American College of Surgeons, and the resources available to treat injured children at non-PTCs are limited. To guide resource allocation and advocacy efforts for pediatric trauma care in Wisconsin, we determined the precise distance to trauma centers for all children living in the state.

Methods: The 2010 US Census data was used to determine ZIP-centroid geolocation. The Wisconsin Department of Health Services trauma classification database was used to identify trauma facilities in Wisconsin. SAS routines invoking the Google Maps application programming interface were used to calculate the driving distance to each of the trauma facilities. We quantified the percentage of children living within 30- and 60-minute driving distances of level I-IV trauma centers.

Results: Just 31.3% of Wisconsin children live within a 30-minute drive of a level I PTC; 32.7% live within 30 minutes of a level II center; 81.3% within 30 minutes of a level III center; and 74.6% within 30 minutes of a level IV center.

Conclusions: Two-thirds of children in Wisconsin live beyond a 30-minute driving distance of a level I PTC, but most children live within 30 minutes of level III and IV trauma centers. As the closest hospitals for most children, smaller trauma centers should be adequately resourced to provide pediatric trauma care.

BACKGROUND

Trauma is the leading cause of death in children in the United States.[1] Distance to definitive trauma care is known to affect outcomes for both adults[2-4] and children.[5] In predominantly rural states, dedicated pediatric trauma centers (PTC) verified by the American College of Surgeons (ACS) are rare, and the time to travel to PTCs is longer.[6] Therefore, local trauma centers—though not specifically certified to care for injured children and with varying levels of mandated equipment, supplies, and training for pediatric patients—may be required to provide emergency care for severely injured children, at least for purposes of stabilization for subsequent transport to a pediatric trauma center. To guide public health policy and resource allocation, it is crucial to know how far the pediatric population is—both in distance and time—from pediatric and adult trauma centers of all levels.

Wisconsin has 2 large trauma centers located in its 2 largest cities, both of which provide ACS-verified level I care to children and adults, and 1 ACS-verified level II PTC. There are an additional 7 ACS-verified level II adult trauma centers that treat pediatric patients but are not ACS-verified for pediatric trauma, as well as 44 state-designated level III hospitals, 53 level IV hospitals, and 15 hospitals that have elected not to seek trauma center designation. Currently, the Wisconsin Department of Health Services does not have specific criteria for level III and IV hospitals regarding the care of pediatric trauma patients; pediatric-specific training and equipment at these centers are not mandated to achieve certification. The current Wisconsin trauma standards for levels III and

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IV centers are based on standards in the 1999 edition of the ACS Resources for Optimal Care of the Injured Patient.[7] Although studies have investigated the effect of distance to trauma centers on clinical outcomes for injured patients, there is limited data on relative locations of trauma centers and the populations they serve, and few methods exist for combining population and hospital data.[6,8] The availability of the Google Maps application programming interface (API) has made the driving distance and time analysis more dynamic and accessible.[9-11]

The goal of this study was to characterize the precise distance to travel to different levels of trauma care for children in Wisconsin by combining granular census data that identifies pediatric population density in each ZIP code with point-to-point calculators of driving time from ZIP code centroids to specific hospital addresses.

METHODS

Data Source

This study used publicly available data sources. "Turn-by-turn" driving distances and times were developed using a combination of geographical information systems and data-management tools. The US Census Bureau, Census 2010 Summary File 1 served as a source list for Wisconsin ZIP-centroid geolocation (latitude and longitude) for each Wisconsin ZIP code; a total of 774 ZIP codes and the pediatric population of each were identified and used in the analyses.

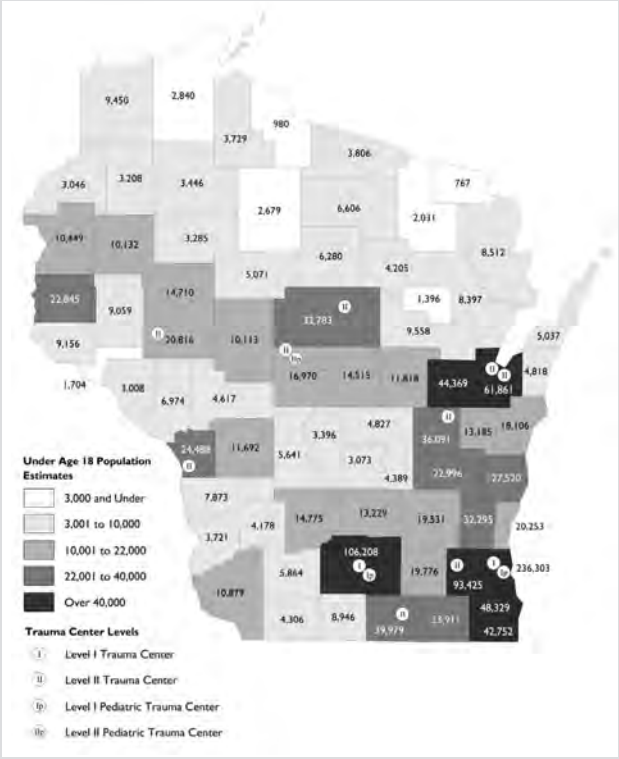
The Wisconsin Department of Health Services Hospital Trauma Classification Database was used to identify hospitals in Wisconsin and key characteristics associated with these facilities, including geolocation (latitude and longitude) of each facility and trauma verification status. The location of each hospital was then linked to Wisconsin ZIP codes and input into a Statistical Analysis System (SAS) macro that contacted the Google Maps API to obtain the driving distance and time from each trauma center to the centroid of each of the 774 Wisconsin ZIP codes.

The American Family Children's Hospital trauma database for 2015-2019 was queried to determine the percentage of pediatric trauma patients that were transferred to level I pediatric trauma centers from the state's levels II-IV trauma centers. This analysis was approved by the University of Wisconsin School of Medicine and Public Health Institutional Review Board.

Data Analysis

SAS v9.4 software was used for managing the datasets and batch-submitting requests to the Google Maps API. A series of routines was developed using SAS to link the Census and American Hospital Association ZIP-level data. Each of the 124 facilities was linked to each of the 774 ZIP codes in Wisconsin, resulting in a total of 95,834 distinct ZIP-facility pairs for which to determine driving distance and time. The SAS routines were then used to invoke the Google Maps API, looping through each of the ZIP-facility pairs in a distinct call to the API. The results were pooled, reformatted, and processed using the SAS routines, and the distances to each of the facilities were ranked for each ZIP code in ascending order. The resulting dataset formed the basis for all subsequent analyses. The driving distances to trauma centers of each level were assessed independently. In other words, if a child lived within 30 minutes of a level I PTC and within 60 minutes of a level II PTC, they were counted once for living within 30 minutes of a level I PTC and again for living within 60 minutes of a level II PTC. The American Family Children's Hospital trauma data was analyzed using R 3.6.1. A comparison of the injury severity score (ISS) was performed using the Wilcoxon rank-sum test.

Figure 1. Wisconsin Population Under Age 18, Estimates by County (2010), and Location of Level I and II Adult and Pediatric Trauma Centers



Darker shading corresponds to a higher density of children.

RESULTS

Two ACS-verified level I pediatric trauma centers, 1 ACS-verified level II pediatric trauma center, 9 ACS-verified level II adult trauma centers, 44 level III trauma centers, 53 level IV trauma centers, and 15 nontrauma hospitals were included in the analysis. Two of the level I adult trauma centers are in the same location as the 2 level I PTCs. There are 39 rural counties (54%) in Wisconsin,[12] and 58 critical access hospitals (35%).[13]

The population of children in Wisconsin and the location of the level I and II trauma centers are shown in Figure 1, and results of our analysis are summarized in Figure 2. Reflecting the predominantly rural population of the state, only 31.3% of Wisconsin children live within a 30-minute driving distance of one of the

Figure 2. Percent of Population Younger Than 18 Years Residing Within Specified Driving Time of Nearest Trauma Center, Wisconsin, 2017

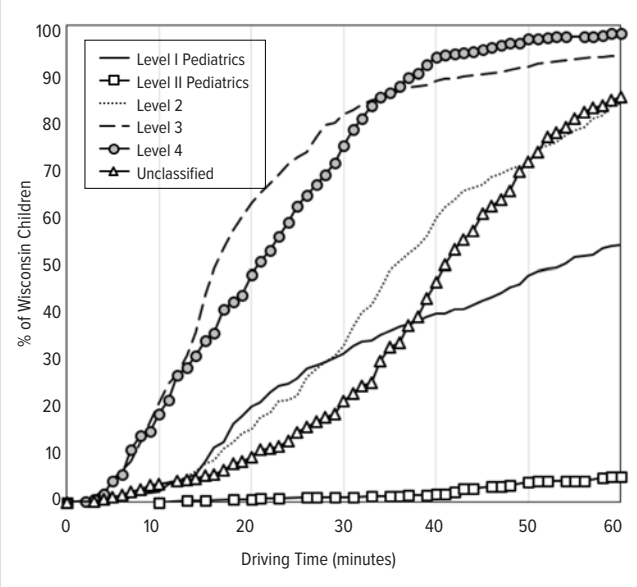


Table. Percentage of Children Within 30- and 60-Minute Driving Time of Adult and Pediatric Trauma Centers

Trauma Center Designation	% Children Within 30-Minute Driving Time	% Children Within 60-Minute Driving Time
Level I (pediatric)	31.3%	53.9%
Level II (pediatric)	1.04%	5.46%
Level II (adult)	32.7%	83.6%
Level III (adult)	81.3%	93.7%
Level IV (adult)	74.6%	98.4%

2 level I PTCs, and 53.9% live within 60 minutes. As there is only 1 level II PTC, which is located in the middle of the state in a predominantly rural area, only 1.04% of children are within 30 minutes and 5.46% are within 60 minutes. Almost one-third (32.7%) of children are within 30 minutes, and 83.6% live within 60 minutes of one of the 9 adult level II centers. As the level III and IV centers are better distributed across the state, 82% of children live within 30 minutes and 93.7% lived within an hour of one of the 44 level III centers. Seventy-five percent of children lived within 30 minutes and 98.4% live within an hour of one of the 53 level IV centers (Table).

At our level I PTC, a total of 3,697 patients were admitted for trauma care during 2015-2019. Among these, 1,995 (54.0%) of them were transferred from other regional trauma centers. Out of these transfers, 110 patients were transferred from outside of Wisconsin and were excluded for the subsequent analysis as trauma center leveling criteria are not uniform across states. Out of 1,885 patients who were transferred within Wisconsin, 1 patient (0.05%) was transferred from another level I PTC, 102 patients (5.4%) were transferred from adult level II trauma centers, 714 patients (37.9%) were transferred from level III trauma centers, 811 patients (43.0%) were transferred from level IV trauma centers, and 258 patients (13.7%) were transferred from non-trauma-designated hospitals. The mean ISS for patients who were transferred to our level I PTC and those who presented directly from the scene was 7.09 (SD 8.15) and 6.95 (SD 9.78), respectively ($P = 0.0079$). Among the patients treated at our facility with ISS greater than 15, 57.8% were triaged at another facility before being transferred to a level I PTC.

DISCUSSION

We found that about half of children in Wisconsin live farther than a 60-minute drive from a level I PTC, while the vast majority of children live within 30 minutes of a state-designated level III or IV center. We also found that among the pediatric trauma patients treated at our level I PTC, the patients who were transferred from the referring centers had slightly higher ISS than the patients who presented directly from the scene. Lastly, the majority of patients transferred to our level I PTC were triaged at levels III and IV adult trauma centers before being transferred.

Level I PTCs are the highest level of pediatric trauma care and are verified according to ACS standards. ACS-certified level II centers also meet standards for pediatric-specific training and equipment. In Wisconsin, the state designates level III trauma centers as hospitals providing assessment, resuscitation, stabilization, and emergency surgery and arrangement of the transfer to a level I or II facility for definitive surgical and intensive care as necessary. A level IV trauma center is defined by the state as hospitals providing stabilization and advanced trauma life support before transferring patients to a level I or II center. These standards are based on the 1999 edition of the ACS Resources for Optimal Care of the Injured Patient, and the state is currently in the process of revising the criteria for levels III and IV trauma centers to address pediatric trauma patient-specific resources.[14]

Although there are conflicting results among studies whether pediatric trauma patients have better clinical outcomes when treated at pediatric trauma centers versus adult trauma centers,[15-21] some of these studies showed improved outcomes at pediatric trauma centers with specific equipment and training to care for pediatric patients.[18-20] Our study did not focus on clinical outcomes of patients treated at a different level of trauma center, but it is worth noting that 54% of the trauma patients treated at our facility during 2015-2019 were transferred from non-PTC centers, and the majority were from level III and IV trauma centers. Furthermore, many of the severely injured patients with ISS greater than 15 were triaged at another facility before being transferred to a level I PTC. These findings support the importance of ensuring adequate pediatric trauma equipment and training in level III and IV trauma centers, which are the closest hospitals for most Wisconsin children.

The availability of publicly available application programming interfaces such as Google Maps has increased the accessibility of

using turn-by-turn analysis to calculate more accurate driving distances. We used this approach to calculate the distance between where children live and the nearest trauma center based on the longitude and latitude associated with ZIP codes. Using the ZIP code of individual children provides more precise calculations compared to ZIP code blocks that were used in a previous study.[22]

One of the limitations of this study is that the driving time calculated is the average driving time for nonemergency vehicles and does not account for weather. The study also does not take into account cases where patients are transferred via air. Therefore, the percentage of children living within 30 or 60 minutes of a level I or II trauma center may be higher in cases of severe trauma. However, as air transport may not always be an option and the road conditions are not always predictable, the findings of our study still highlight the need for pediatric trauma care capability in nonpediatric trauma centers.

Another limitation of this study is the use of ZIP codes instead of census tracts as a surrogate for where Wisconsin children lived. Although the census tract is more granular than the ZIP code for patient location,[23] census tracts do not allow for centroid geolocation. And ZIP code has been widely used in studies of health care access, which allows ready comparison between studies. Lastly, as pointed out by a recent study,[24] there is potential discordance between the children's residence and the location of trauma. Although injuries do not always occur near the place of residence, prior research suggests that 88% of major traumatic injuries occur within 10 miles of home.[25] In our cohort, 75% of the patients were injured within 10 miles of their home.

CONCLUSION

Granular geolocation data demonstrate that two-thirds of children in Wisconsin live beyond a 30-minute driving distance to a level I PTC, but most children live within 30 minutes of levels III and IV trauma centers. As states and hospitals balance the need to provide trauma care to children at the hospitals close to their homes with the expense of pediatric-specific resources and training, our findings highlight the need for maintaining consistent and clear standards for pediatric trauma care at local trauma centers.

Financial Disclosures: None declared.

Funding/Support: None declared.

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Trends in Mortality at a Level II Rural Trauma Center

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ABSTRACT

Background: Most studies of deaths from traumatic injury are from urban trauma centers. In contrast, rural areas have higher incidence of traumatic fatal injuries than urban areas. The objective of this research was to describe trends of injuries and mortality from a trauma center serving a largely rural population and compare results with reports from the National Trauma Data Bank (NTDB).

Methods: We conducted a retrospective study of patients admitted to a rural Wisconsin level II trauma center from 2000 through 2018. Details on injuries and deaths prior to discharge were obtained from the trauma registry. Event counts and fatality ratios were described by year, sex, age, mechanism of injury, and injury severity score (ISS). Trends were analyzed across 2000-2005, 2006-2011, and 2012-2018 calendar year eras.

Results: During 2000-2018, there were 17,334 injury events among 16,495 patients included in the trauma registry. Across the 3 eras, the proportion of injuries related to falls increased (35.6%, 40.6%, and 51.5%, respectively), and the proportion from on-road motor vehicle events decreased (37.0 %, 32.8, and 22.5%, respectively), similar to the trends from 3 corresponding NTDB reports for 2004, 2010, and 2016. There was a statistically significant decreasing trend ($P<0.001$) in overall fatality ratios across the 3 eras, 5.3% (95% CI, 4.7%-6.0%), 4.1% (95% CI, 3.7%-4.6%), and 3.9 (95% CI, 3.4%-4.4%), respectively. The fatality ratios point estimates were similar to overall fatality ratios from the NTDB reports (4.7%, 4.0%, 4.3%, respectively). The median patient age increased significantly from 42, 45, and 55 years across the 3 eras (test for trend $P<0.0001$).

Conclusion: Long-term trends of traumatic injuries and mortality were generally similar to national trends, particularly in the shift to older patients and in the increasing proportion of injury events due to falls. Further research on traumatic injuries and deaths in rural populations is needed, particularly regarding immediate deaths at the scene and longer-term deaths after discharge.

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INTRODUCTION

Trauma registries are databases that contain clinical and demographic information on injured patients admitted and treated at trauma centers. Trauma registry data are used for performance improvement of patient care, accreditation and verification of trauma service status, injury prevention initiatives, research on epidemiology and treatments of injury, and uploads to state and national trauma databases.[1]

Most studies recently published have been based on national registry data[2] or registry data from densely populated urban trauma centers[3] or large regional areas.[4,5] However, from population-based studies, rural residents have higher age-adjusted incident rates of injury and higher mortality rates compared to urban populations.[6-11]

The Marshfield Clinic Health System (MCHS) serves the north-central Wisconsin area with over 3.5 million patient encounters annually. Injured patients may be seen at the trauma center in Marshfield, with level II designations for adult and pediatric trauma. Our objective was to describe trends of injuries and mortality from the Marshfield trauma center, which has long-term experience in treating patients from a rural and small metropolitan population.

METHODS

This was a retrospective study of injured patients at the MCHS level II trauma center in Marshfield, Wisconsin. The Marshfield Clinic Research Institute Institutional Review Board approved

this study as exempted research using data collected for nonresearch purposes. Details on injuries and deaths prior to discharge were obtained from the trauma registry. The registry, which began in 2000, was certified to provide data to the Wisconsin Trauma Registry[12] in 2005 and to the National Trauma Data Bank[13] (NTDB) in 2013. To avoid sparse data conditions and to provide more stable estimates of possible trends, the registry data were summed across 3 calendar year eras defined by the years of state and national certification: 2000-2005, 2006-2012, and 2013-2018. Patients of all ages were included from 2000 through 2018. Patients were excluded if they were transferred to a level I trauma center or did not have a recorded mechanism of injury or injury severity score (ISS). The outcome of interest was death due to injury prior to discharge and included patients dying during hospitalization, in the emergency department, or dead upon arrival. Deceased patients were identified in the trauma registry data by selection of "discharge to morgue" status. The fatality ratio was the outcome measure and defined as the count of deaths divided by the count of patient events.

Table 1. Distributions of Injury Event Counts (Percentages) at Marshfield Clinic Health System Trauma Center by Sex, Injury Severity Score, Mechanism of Injury, and Calendar Year Eras and Representative National Trauma Data Bank Reports

Characteristic	Marshfield Clinic Health System Trauma Center			National Trauma Data Base		
	2000–2005	2006–2012	2013–2018	2004	2010	2016
	Count (%) of Injury Events			% of Injury Events		
Overall	4548 (100)	6983 (100)	5803 (100)	100	100	100
Sex and age, years[a]						
Female, 0-14	208 (4.6)	321 (4.6)	321 (5.5)	4.2	4.4	4.0
Female, 15-44	509 (11.2)	730 (10.5)	416 (7.2)	14.4	10.9	9.6
Female, 45-64	267 (5.9)	448 (6.4)	450 (7.8)	6.2	7.4	7.7
Female, 65-74	144 (3.2)	261 (3.7)	287 (4.9)	2.7	3.4	5.0
Female, 75-84	243 (5.3)	417 (6.0)	385 (6.6)	4.2	5.2	6.3
Female, 85+	205 (4.5)	399 (5.7)	473 (8.2)	2.0	4.8	6.8
Male, 0-14	379 (8.3)	596 (8.5)	530 (9.1)	7.5	7.7	6.5
Male, 15-44	1387 (30.5)	1828 (26.2)	1065 (18.4)	39.8	31.6	26.3
Male, 45-64	651 (14.3)	1091 (15.6)	870 (15.0)	12.6	15.3	15.3
Male, 65-74	216 (4.7)	336 (4.8)	438 (7.5)	2.9	3.7	5.2
Male, 75-84	216 (4.7)	348 (5.0)	337 (5.8)	2.6	3.4	4.3
Male, 85+	123 (2.7)	208 (3.0)	231 (4.0)	0.8	2.1	3.1
Injury severity score[a]						
<9	1712 (37.6)	3096 (44.3)	2738 (47.2)	67.6[b]	53.0	45.5
9-15	1524 (33.5)	2227 (31.9)	1981 (34.1)	12.4[b]	26.5	32.8
16-24	669 (14.7)	933 (13.4)	702 (12.1)	11.2	15.2	13.9
>24	643 (14.1)	727 (10.4)	382 (6.6)	8.8	5.4	7.8
Mechanism of injury[a]						
Fall	1621 (35.6)	2833 (40.6)	2991 (51.5)	16.7	37.0	44.2
Firearm	51 (1.1)	49 (0.7)	51 (0.9)	5.4	4.7	4.2
Motor vehicle on-road	1684 (37.0)	2287 (32.8)	1306 (22.5)	48.5	30.0	26.0
Other mechanism	731 (16.1)	976 (14.0)	867 (14.9)	19.6	22.8	21.1
Other transport	461 (10.1)	838 (12.0)	588 (10.1)	9.8	5.5	4.6

[a]Chi-square P <0.00001.
[b]National Trauma Data Bank 2004 injury severity score categories 1-9, 10-15, 16-24, >24.

Event counts and fatality ratios were described by sex, age, mechanism of injury, and ISS across the 3 calendar year eras. Mechanism of injury was determined from injury memo text fields and International Classification of Diseases external causes of morbidity and mortality codes. Categories were "fall;" "firearm;" "motor vehicle on-road" of registered motor vehicle traffic crashes; "other transport," such as pedestrian, pedal, horse, or off-road motor vehicle; and "other mechanism," which included injuries due to blunt, cutting, or piercing objects. ISS ranged from 1 to 75 (death from injury) and was classified as low (<9), moderate (9-15), severe (16-24), and very severe (>24).

Fatality ratios were calculated as binomial proportions with exact Clopper-Pearson 95% confidence intervals. Trends in mortality were described across the 3 calendar year intervals: overall and by patient sex, age, mechanism of injury, and ISS. Trends were analyzed with Cochran-Armitage tests. Results were also compared to US trauma mortality data compiled from NTDB 2004, 2010, and 2016 reports. These 3 reports were selected to be at or near the midpoint of the 3 calendar year eras. Annual NTDB reports from 2004 through 2016 are publicly available,[13] with data stratified by rurality (urban, suburban, rural, wilderness) since 2009. Finally, patient age was described by sex, ISS, and mechanism of injury across the 3 eras. Since age was not normally distributed, trends were analyzed with nonparametric Jonckheere-Terpstra tests. All analyses were conducted using SAS software, version 9.4 (SAS Institute Inc, Cary, NC).

RESULTS

There were 17,556 total injury events during 2000-2018, and 17,334 events with ISS and injury mechanism among 16,495 patients. There were 261 excluded patients transferred to level I trauma centers: 77 in 2000-2005 (1.7%), 102 in 2006-2012 (1.4%), and 82 in 2013-2018 (1.4%).

There were highly statistically significant distributional differences for sex and age, ISS, and injury mechanism across the 3 eras (Table 1, chi-square P<0.00001 for all characteristics). Notably, there were shifts to lower injury severity, with the proportion of ISS <9 increasing (37.6%, 44.3%, 47.2%, respectively) across the 3 eras and the proportion of ISS >24 decreasing (14.1%, 10.4%, 6.6%, respectively). In contrast, there was not a clear trend in proportion of injuries with ISS >24 from NTDB reports (8.8% in 2004, 5.4% in 2010, and 7.8% in 2016).

Table 2. Fatality Ratios of Marshfield Clinic Health System Trauma Center by Sex, Injury Severity Score, Mechanism of Injury, Calendar Year Eras, and Representative National Trauma Data Bank Reports

Characteristic	Marshfield Clinic Health System Trauma Center			National Trauma Data Base		
	2000–2005	2006–2012	2013–2018	2004	2010	2016
	Fatality Ratio % (95% CI)			Fatality Ratio %		
Overall [a]	5.3 (4.7-6.0)	4.1 (3.7-4.6)	3.9 (3.4-4.4)	4.7	4.0	4.3
Female, 0-14	2.4 (0.8-5.5)	3.4 (1.7-6.1)	1.3 (0.3-3.2)	2.3	1.4	2.0
Female, 15-44	2.6 (1.4-4.3)	1.8 (1.0-3.0)	1.2 (0.4-2.8)	3.1	2.5	2.4
Female, 45-64	3.8 (1.8-6.8)	4.0(2.4-6.3)	2.0 (0.9-3.8)	3.7	2.8	2.8
Female, 65-74 [c]	7.6 (3.3-12.0)	3.8 (1.9-6.9)	2.8 (1.2-5.4)	5.4	3.6	3.3
Female, 75-84	8.6 (5.4-12.9)	5.5 (3.5-8.2)	5.7 (3.6-8.5)	6.4	4.7	4.8
Female, 85+	9.3 (5.7-14.1)	7.0 (4.7-10.0)	7.4 (5.2-10.1)	7.0	5.5	7.0
Male, 0-14	2.4 (1.1-4.5)	2.0 (1.0-3.5)	1.9 (0.9-3.4)	2.2	1.3	2.2
Male, 15-44 [c]	4.1 (3.1-5.3)	2.3 (1.7-3.1)	2.8 (1.9-4.0)	4.3	3.7	3.9
Male, 45-64 [b]	5.2 (3.6-7.2)	4.7 (3.5-6.1)	2.4 (1.5-3.7)	5.2	4.2	4.2
Male, 65-74	7.4 (4.3-11.8)	6.0 (3.7-9.0)	6.2 (4.1-8.8)	8.7	6.7	6.3
Male, 75-84	12.0 (8.0-17.1)	11.5 (8.3-15.3)	10.4 (7.3-14.2)	12.8	10.1	9.4
Male, 85+ [c]	17.1 (10.9-24.9)	10.1 (6.5-15.0)	9.1 (5.7-13.6)	15.0	12.1	12.2
Injury severity score						
< 9	11.0 (0.6-1.6)	1.0 (0.7-1.4)	1.0 (0.7-1.5)	1.0	0.9	1.2
9-15	3.0 (2.2-3.9)	1.8 (1.3-2.5)	2.0 (1.5-2.7)	1.9	2.4	2.7
16-24	5.5 (3.9-7.5)	3.3 (2.3-4.7)	6.6 (4.8-8.6)	6.2	6.6	5.5
> 24 [b]	22.2 (19.1-25.7)	25.6 (22.5-28.9)	29.6 (25.1-34.4)	33.0	30.2	27.6
Mechanism of injury						
Fall [b]	6.2 (5.1-7.5)	4.8 (4.0-5.7)	4.3 (3.6-5.1)	3.9	3.5	4.4
Firearm	27.5 (15.9-41.7)	20.4 (10.2-34.3)	27.5 (15.9-41.7)	16.5	15.8	15.3
Motor vehicle on-road [c]	5.4 (4.4-6.6)	4.4 (3.6-5.3)	3.8 (2.8-4.9)	4.8	4.5	4.6
Other mechanism	3.6 (2.3-5.2)	3.2 (2.2-4.5)	3.3 (2.3-4.8)	2.7	2.1	2.4
Other transport	2.4 (1.2-4.2)	1.4 (0.7-2.5)	1.2 (0.5-2.4)	3.2	2.0	2.3

Test for trend across calendar year era: [a] $P < 0.001$, [b] $P < 0.01$, [c] $P < .05$.

In terms of injury mechanisms, the proportion of injuries related to falls increased (35.6%, 40.6%, and 51.5%) and the proportion from on-road motor vehicle events decreased (37.0%, 32.8, and 22.5%) across the eras. The proportions of injury events due to other mechanisms were relatively stable, with few due to firearms (<1.1%). The increasing trend of falls and decreasing trend of on-road motor vehicle injuries were similar from the NTDB reports. In contrast to the MCHS data, the proportion of injuries from firearms was larger, with an apparent decreasing trend (5.4%, 4.7%, and 4.2%) from the NTDB 2004, 2010, and 2016 reports, respectively.

There was a statistically significant decreasing trend in overall fatality ratios across the 2000-2005, 2006-2012, and 2013-2018 intervals: 5.3% (95% CI, 4.7%-6.0%), 4.1% (95% CI, 3.7%-4.6%), and 3.9 (95% CI, 3.4%-4.4%), respectively (Cochran-Armitage exact test-for-trend, 2-sided $P < 0.001$). Injuries due to falls also had a significant decreasing trend in fatality ratios: 6.2%, 4.8%, and 4.3%, respectively (test-for-trend, $P < 0.01$). The highest fatality ratios were patients with ISS > 24 (22.2%, 25.6%, 29.6%, $P < 0.01$ test for trend across year eras) or patients with injuries caused by firearms (27.5%, 20.4, 27.5%, test-for-trend, $P = 1$) (Table 2).

Generally, fatality ratios (FR) from 2004, 2010, and 2016 NTDB reports were within the confidence interval uncertainty of the MCHS fatality ratios across calendar year eras (Table 2). Notable exceptions were ISS > 24, with FR = 22.2% (95% CI, 19.1%-25.7%) in 2000-2005 vs NTDB 2004 FR = 33.0 or FR = 25.6% (95% CI, 22.5%-28.9%) in 2006-2012 vs NTDB 2010 FR = 30.2; and falls with FR = 6.2% (95% CI, 5.1%-7.5%) in 2000-2005 vs NTBD 2004 FR = 3.9% or FR = 4.8% (95% CI, 4.0%-5.7%) in 2006-2012 vs NTDB 2010 FR = 3.5%. While there was large uncertainty in the firearm fatality ratios, the MCHS point estimates (27.5%, 20.4%, and 27.5%) were consistently larger than those from NTDB reports (16.5%, 15.8%, and 15.3%, respectively).

From the NTDB 2010 and 2016 reports,[13] the rural fatality ratios were 3.8% and 4.2%, respectively, and urban fatality ratios were 4.1% and 4.8%, respectively. Both rural and urban fatality ratios were within overall MCHS fatality ratio confidence intervals for the corresponding 2006-2012 and 2013-2018 eras.

The median patient age at admission increased significantly from 42 years in 2000-2005, to 45 years in 2006-2012, and 55 years in 2013-2018, respectively (Table 3, test for trend $P < 0.0001$). Age trends were consistently increasing for patient sex ($P < 0.0001$), ISS ($P < 0.05$) and fall ($P < 0.0001$) or on-road motor vehicle ($P < 0.01$) mechanisms. Patient ages were essentially the same across calendar year eras for other injury mechanisms.

DISCUSSION

For over 50 years, there has been an organized medical response to traumatic injuries among residents of rural north-central Wisconsin. Since 2000, there are reliable data on characteristics of traumatic injuries and associated deaths from the trauma registry maintained at the MCHS level II trauma center in Marshfield, Wisconsin. Long-term trends of traumatic injury and mortality at the MCHS trauma center were generally similar to national trends from NTDB reports,[13] particularly in increasing proportion of injury events from older patients and injuries due to falls. This is also consistent with population-based injury statistics. While motor vehicle death rates have steadily decreased, the age-adjusted death rate from unintentional falls has increased an average of 3% annually from 1997 to 2017.[10]

The overall fatality ratio at the MCHS trauma center was

essentially similar to national-based ratios overall or for ratios aggregated from rural or urban trauma centers. This suggests that standards of trauma care are similar across various trauma center levels and the areas they are located. This points to the success of continual improvements in modern trauma care systems in the US.

The proportions of injuries from firearms were low and the firearm-related fatality ratios were higher at the MCHS trauma center compared to the NTDB reports. Although this needs further investigation, it is possible that a majority of patients with firearm injuries were immediate deaths at the scene or were transferred to level I centers. Neither of these events would have been captured in the MCHS level II trauma registry. Rural Wisconsin firearm injuries are also more likely from high-powered rifles and shotguns compared to urban areas,[14] leading to a lower comparative survival.

The proportion of patients with the most severe injuries (ISS >24) declined from 14.1% in 2000-2005 to 6.6% in 2013-2018, but the fatality ratio increased from 22.2% to 29.6%, respectively. This is not reflected in national data. A variety of factors could contribute to this observation, including age and comorbidities of injured patients, as well as improvements in prehospital care that allow more patients with severe injury to survive long enough to be admitted to a trauma center.

This study has several limitations. It provides only a partial description of mortality because data were not available for patients who died at the scene of injury. Historically, most patients with severe injuries died at the scene.[15] With the development of modern emergency medical services, more patients can survive during the prehospital phase. However, according to a recent population-based study in California,[9] the majority of injured rural trauma patients die at the scene compared to a minority of urban trauma patients. An additional limitation is loss to follow-up after the recorded discharge date in trauma registries. Some trauma-related deaths can occur several months after discharge. These limitations are inherent in any study based only on trauma registry data.[16,17]

These limitations can be overcome by a future population-based analysis of injuries within the Marshfield Epidemiologic Study Area (MESA)[18,19] combined with death certificate information. This study, along with the present analysis of MCHS trauma registry data, could provide key insights in improving the outcomes of traumatic injury among rural and small-town residents.

CONCLUSION

Long-term trends of traumatic injuries and mortality were generally similar to national trends, particularly in the shift to older patients and in the increasing proportion of injury events due to falls. Further research on traumatic injuries and deaths in rural populations is needed, particularly regarding immediate deaths at the scene and longer-term deaths after discharge.

Table 3. Median Patient Age (Interquartile Range) in Years by Sex, Injury Severity Score, Mechanism of Injury, and Calendar Year Era at the Marshfield Clinic Health System Trauma Center

Characteristic	2000–2005	2006–2012	2013–2018
Overall [a]	42 (21–65)	45 (22–69)	55 (24–75)
Sex			
Female [a]	50 (21–78)	55 (24–80)	64 (30–83)
Male [a]	39 (21–57)	41 (21–60)	49 (22–68)
Injury severity score			
<9 [a]	39 (20–61)	40 (20–65)	48 (19–71)
9–15 [a]	44 (23–70)	50 (24–74)	61 (32–79)
16–24 [a]	43 (21–67)	48 (25–66)	57 (31–73)
>24 [c]	41 (21–61)	47 (24–64)	54 (28–72)
Mechanism of injury			
Fall [a]	66 (41–82)	68 (43–82)	71 (53–84)
Firearm	32 (21–52)	37 (23–47)	28 (18–49)
Motor vehicle on-road [b]	34 (21–51)	34 (21–53)	37 (22–58)
Other mechanism	32 (15–49)	33 (16–51)	28 (12–53)
Other transport [a]	27 (16–42)	30 (17–48)	37 (16–54)

Test for trend across calendar year era: [a] $P<0.001$, [b] $P<0.01$, [c] $P<.05$.

Acknowledgments: The authors would like to acknowledge the following individuals: Brian Hoerneman, MD, Marshfield Medical Center; Deborah Gojmerac, BSN, RN, CSTR, Trauma Center, Marshfield Medical Center; Judith Hase, Erik Kronholm, Jennifer King, MPH, Oluwatosin Olaiya, MBChB, MSc, Edward Belongia, MD, Center for Clinical Epidemiology Population Health, Marshfield Clinic Research Institute.

Financial Disclosures: None declared.

Funding/Support: Funding for this study was provided by contributors to the Marshfield Clinic Research Institute.

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Rural Residence Predicts Lower Cardiac Mortality and Better Mental Health Outcomes

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ABSTRACT

Introduction: Previous studies have found higher rates of heart disease and worse mental health outcomes among individuals residing in rural areas. To our knowledge, no research has used county-level data to measure the effect of "ruralness" (the degree to which a county is rural) on heart disease and mentally unhealthy days while controlling for other sociodemographic factors. This study analyzes the effect of ruralness on heart disease death rates and the average number of mentally unhealthy days on a county-level.

Methods: Linear regressions were performed using county-level data to analyze the effect of "ruralness" on heart disease death rates and mental unhealthiness while controlling for confounding variables. Geographic analysis was also used.

Results: Higher rural-urban continuum codes predict lower rates of cardiac mortality (β = -.075 deaths per 100,000 people/continuum code, t = -4.36, $P < .001$) and fewer mentally unhealthy days (β = -.265 monthly mentally unhealthy days/continuum code, t = -16.45, $P < .001$).

Conclusion: Being from a rural area correlates with lower rates of heart disease death and mental unhealthiness after controlling for sociodemographic confounders. This adds nuance to the previously reported trend of heart disease being more prevalent in rural areas.

INTRODUCTION

Optimal health is often considered a challenge in rural regions. Life expectancy in America's rural regions is decreasing significantly faster than the national average.[1] Rural Americans are more likely to characterize their health as poor[1] and are more frequently diagnosed with diabetes, asthma, and stroke, amongst other chronic diseases.[2] They also are more likely to experience heart attacks and heart disease.[2]

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Heart Disease in Rural Areas

Heart disease risk factors are heightened in modern rural America.[3-6] They include hypertension, hypercholesterolemia, hyperglycemia, smoking, high body mass index (BMI), sedentary lifestyle, family cardiac history, history of preeclampsia, poor diet, and age.[7] High blood pressure, high cholesterol, diabetes, and prediabetes are more common in rural versus urban areas, which is due in part to increased caloric, fat, and sugar consumption among rural residents.[3] The association between rural living and these risk factors has not been explored when controlling for sociodemographic factors.

People in rural areas are more likely to smoke and use other forms of tobacco. Onset of tobacco use tends to be earlier among rural individuals than those from suburban or urban areas.[4] Rural citizens also have less access to primary care and other forms of preventive health care,[8] while access to primary care and other forms of preventive health care have been shown to decrease smoking rates.[9]

Rural Americans tend to have less healthy BMIs than urban Americans, and rural children are more likely to be overweight and less likely to be physically active than their nonrural counterparts.[5] Rural counties also have fewer resources to support healthy eating and physical activity (eg, nutrition education classes; nutritional services; obesity prevention and weight management programs; physical activities for kids, such as afterschool sports; parks; sidewalks; recreational areas; bike trails; and gyms).[5] Diet is worse amongst rural adults than urban adults, in that meals tend to have fewer nutrients but are more calorically dense.[6]

Mental Health in Rural Areas

In addition to the heightened rates of coronary health disease, mental health is another health outcome often explored in rural areas. Previously, no difference was found in mental health between rural and urban areas in the US.[10] However, in Great Britain, urban residents were more likely to suffer from psychiatric morbidity, drug dependence, and alcohol dependence than rural residents.[11] Time spent in nature has been shown to improve mental health, and people who live in urban areas likely have less access to nature.[12] Rural families also tend to have more social capital than urban families.[13] From the literature, it is unclear if there is a difference in mental health outcomes between residents of rural versus urban counties.

Research Questions

This study was guided by 2 research questions:

1. Does residing in a rural area increase one's likelihood of death from heart disease?
2. Is residing in a rural area a predictor of good mental health?

Study Objectives

Direct associations of rural living and many health conditions have been widely studied. However, these studies have not thoroughly explored mechanisms behind their associations or controlled for sociodemographic factors. Our study aims to deconstruct associations between rural living and heart disease and mental health by controlling for sociodemographic factors. Mental health was chosen for analysis because of its high prevalence. An average of 8.1% of Americans had depression over any given 2-week period during our investigation.[14] Heart disease was chosen for analysis because it consistently has been the most common cause of death in America.

METHODS

Variables

This study uses county-level data from public sources for every county in the United States. We analyzed 3 main variables. The independent variable was the degree to which a county is rural; the dependent variables were the frequency at which people in that county died from heart disease and the average number of unhealthy days for residents in that county.

Measures

"Ruralness." The degree to which an area is rural can be defined many ways. Acceptable measures include population density, total population, and percentage of gross domestic product based on agriculture. For our study, we defined rural using the 2013 Rural-Urban Continuum Codes, as determined by the US Department of Agriculture.[15] Rural-urban continuity codes range from 1 through 9, with 1 being the most urban and 9 being the most rural.[16] In this study, counties with lower rural-urban continuity codes were considered urban, and those with higher codes were considered rural.

Heart Disease. County-level data on the frequency at which people die from heart disease was taken from the Centers for Disease Control and Prevention (CDC).[17] For this data, the number of people older than 35 who died from heart disease in a county from 2012-2015, as determined by autopsies, was divided by the county's population per 100,000.

Mental Health. County-level mental health data in 2016 were gleaned from the Behavioral Risk Factor Surveillance System, in which participants were asked, "Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?".[18] The CDC then used these data to create a discrete variable for the number of mentally unhealthy days per year experienced by individuals.

Sociodemographic Factors. We controlled for education, unemployment, income, race, marriage, and divorce rates. For education, we used county-level percentages of the population with a bachelor's degree or higher from 2012 through 2016.[19] For unemployment, we used county-level data on the size of the labor force, number employed, number unemployed, and percent unemployed each year during 2012-2016.[19] For income, we used median household income of each county and median county household income as a percentage of median state household income.[19] The percentage of people who identify as White, Black, American Indian, Asian, Native Hawaiian, Pacific Islander, or 2 or more races was taken from the US Census. County-level divorce and marriage rates were shared by the National Center for Family and Marriage Research at Bowling Green State University.[20] These data were prepared by aggregating marriage and divorce legal records at the county level and dividing the number of people who have gotten married/divorced by the total county population.

Analysis

To answer our first research question, we used linear regressions to correlate incidence of death from heart disease with the "ruralness" of a county while controlling for education, income, unemployment rate, sex, and race. We then mapped heart disease death incidence to visualize the geographical distribution. To create this map, a blank map of US counties was downloaded from Wikimedia Commons.[21] Data were then converted to comma delimited (CSV) format. These data were mapped by parsing the Wikimedia Commons map (svg file) using Python, the parsing program BeautifulSoup, and a process detailed by Nathan Yau, PhD.[22]

To respond to the second research question, linear regressions were used to correlate the number of mentally unhealthy days with the "ruralness" of a county, while controlling for the same variables mentioned above. The mental health measure was mapped to visualize the geographical distribution. For reference, the distribution of rural counties was also mapped.

RESULTS

Geographic Distribution of Rural Areas and Heart Disease

The geographical distribution of rural counties, according to 2013 rural-urban continuity codes, is mapped in Figure 1. Highly rural areas are located primarily in the center of the country and in Alaska. The geographical distribution of incidence of death by heart disease per 100,000 people per year—averaged 2012-2016—is mapped in Figure 2. The highest level of heart disease was present mostly in the South and in Appalachia. The average number of mentally unhealthy days is mapped in Figure 3; many Midwestern counties had low averages for mentally unhealthy days while many southern counties had high averages.

Simple Linear Regressions

One of the main goals of this study was to measure the effect of the "ruralness" of counties on county-level heart disease death rates and on the average number of mentally unhealthy days in 2016 for residents of counties. To measure these effects, we ran 2 regressions.

The first regression measured the effect of 2013 rural-urban continuity codes on the average number of mentally unhealthy days in 2016, controlling for the percent of residents who have a bachelor's degree or higher (averaged 2012-2016), the unemployment rate in 2016, median household income in 2016, the proportion of males and females in 2016, marriage rates, and the proportion of Black, American Indian, Asian, and Hispanic residents in 2016 (Table 1). All betas were statistically significant, except the proportion of Asian residents and male residents. As was the case in 2015 with mentally unhealthy days, higher 2013 rural-urban continuity codes predicted lower levels of mentally unhealthy days in 2016 ($\beta = -.265$, $t[3140] = -16.45$, $P < .001$).

The second regression measured the effect of 2013 rural-urban continuity codes on heart disease death rates per 100,000 people per year (averaged 2012-2015), controlling for the same variables as the first regressionm (Table 2). All betas were statistically significant, except the proportion of American Indian, Asian, White, and Black residents. 2013 rural-urban continuity codes were found to predict heart disease death rates in a similar way to mentally unhealthy days: higher 2013 rural-urban continuity codes predicted lower rates of heart disease deaths ($\beta = -.075$, $t[3141] = -4.36$, $P < .001$).

DISCUSSION

The purpose of this study was twofold: to explore congruence among previous findings that rural residents are more likely to die from heart disease and to clarify ambiguous findings regarding the impact of being from a rural area on mental health. After controlling for several demographic factors, being from a more rural county predicted lower rates of death from heart disease. Similarly, after controlling for the same factors, being from a more rural county predicted fewer mentally unhealthy days.

A key finding of this study was that a county's "ruralness" pre-

Figure 1. Map of Rural Counties in the United States

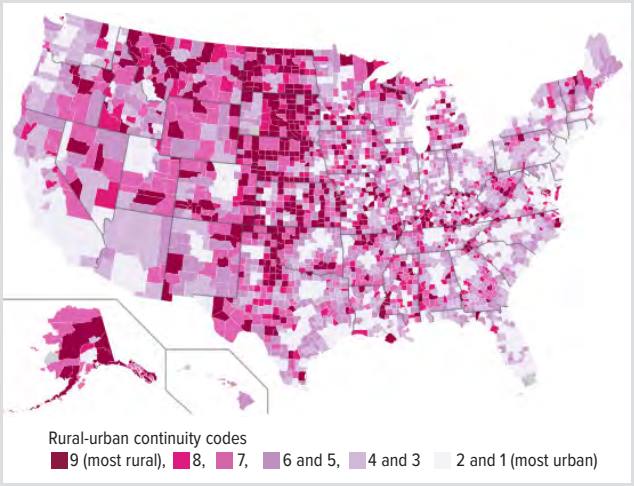

Figure 2. Map of US Counties Based on Incidence of Death by Heart Disease per Year, per 100,000; Averaged 2012-2016

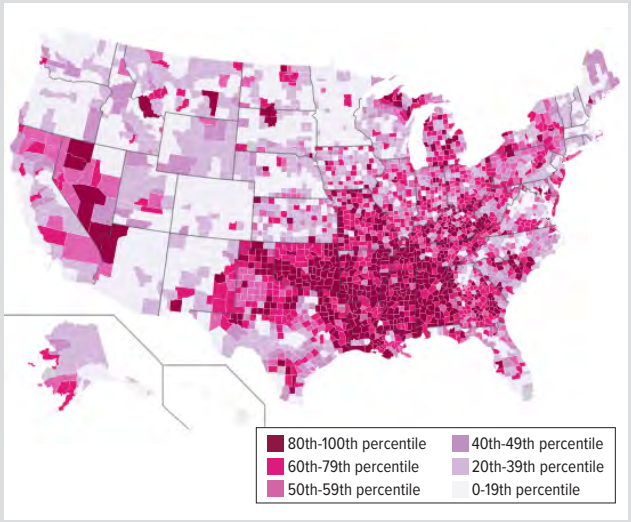

Figure 3. Map of US Counties Based on Average Number of Mentally Unhealthy Days in 2016

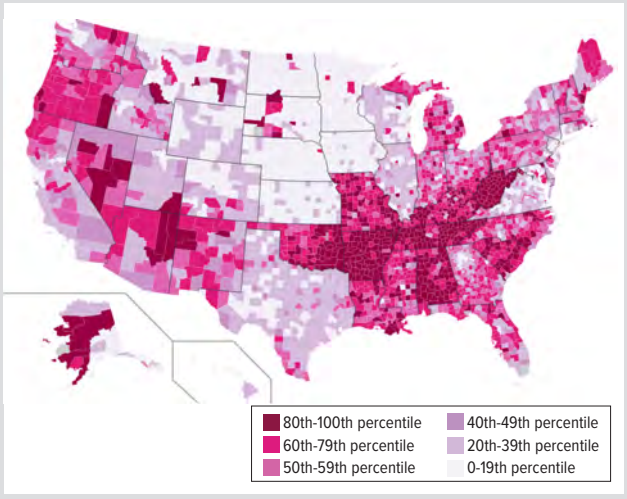

Table 1. Linear Regression, Mentally Unhealthy Days, 2016

ANOVA	Sum of Squares	df	Mean Square	F	*P* value	Adjusted R^2
Regression	540.706	14	38.622	192.167	.000	.465
Residual	616.809	3069	.201			
Total	1157.515	3083				
Coefficients	**Beta**	**t**	***P* value**			
Rural-urban continuum code	-.265	-16.451	.000			
Unemployment rate	.290	17.794	.000			
Income	-.474	-21.617	.000			
Male	.008	.161	.871			
Percent college educated	-.056	-2.782	.005			
Female	1.486	6.368	.000			
White	-1.627	-6.917	.000			
Black	-.404	-5.849	.000			
American Indian	-.129	-4.300	.000			

Table 2. Linear Regression, Heart Disease Death Rates (per 100,000), 2013-2015, Adults Ages 35+ by County

ANOVA	Sum of Squares	df	Mean Square	F	*P* value	Adjusted R^2
Regression	9239883.23	14	659991.659	145.133	.000	.396
Residual	13956283.1	3069	4547.502			
Total	23196166.3	3083				
Coefficients	**Beta**	**t**	***P* value**			
Rural-urban continuum code	-.075	-4.358	.000			
Unemployment rate	.169	9.754	.000			
Income	-.190	-8.167	.000			
Male	-.574	-10.361	.000			
Percent college educated	-.310	-14.575	.000			
Female	.820	3.306	.001			
White	-.269	-1.078	.281			
Black	.117	1.598	.110			
American Indian	-.044	-.118	.906			
Asian	-.005	-.127	.899			
Hispanic	-.268	-11.043	.000			
Marriage	.196	3.714	.000			

dicted mental health, with residents of more rural counties having fewer mentally unhealthy days. This finding supported prior research in the United Kingdom wherein people in urban areas had higher rates of psychiatric morbidity and certain mentally unhealthy behaviors than those in rural areas.[11] This may be a result of the relative ease of access to green space for rural individuals compared to their urban counterparts. Proximity to green spaces has been associated with good mental health.[12] This also may be a result of people from rural areas having more support from their family compared to their urban counterparts. Previous studies have highlighted this as important social capital that is positively associated with emotional health.[13] Also, a higher proportion of rural residents are religious, and religion has been associated with good mental health.[23] Both regressions yielded negative relationships between "ruralness" and mentally unhealthy days. We also found that being from a rural area was a predictor of better mental health. However, even though this finding was in line with previous research, it is important to note that seeking mental health care is more highly stigmitized in rural areas, and rural individuals may be more likely to underreport mentally unhealthy days.[24]

Perhaps the most remarkable finding of this study was that being from a rural county predicted lower rates of heart disease death. This adds nuance to research that has found rural areas to have higher levels of heart disease than urban areas.[2] More unemployment in rural areas—coupled with less education and income—can be contributing factors to the higher rates of heart disease.[25] These characteristics likely mediate the relationship between being from a rural area and dying from heart disease. However, controlling for these factors leads to the intriguing finding that some fundamental aspect of rural counties may be protective against heart disease. Rural communities have been shown to offer more social support than urban communities, and social support downregulates the hypothalamus-pituitary-adrenal axis, which decreases the risk of heart disease.[13] Regardless, this finding suggests that some characteristic of rural counties, not controlled for in this study, predicts lower rates of heart disease.

Additionally, without controlling for sociodemographic factors, rural living has been associated with higher rates of heart disease mortality. After controlling for sociodemographic factors, this study finds rural living to predict lower rates of cardiac mortality. This means that certain sociodemographic characteristics of rural areas controlled for in this study account for increased heart disease death rates, including unemployment, income, and college education. Rural areas have higher levels of unemployement and lower income and education, which all are associated with increased cardiac mortality. These 3 factors also predict increased number of mentally unhealthy days. These results imply that cardiac mortality and mental health could be improved in these areas by decreasing unemployment and increasing income and college education.

Limitations

Data were taken from a county rather than individual level. County-level data is not ideal because it does not account for all variation within counties. Data from people of all sexes, races, backgrounds,

and experiences were grouped together to form generalized "snapshots" of each county. For the sake of this study, perhaps the most important intracounty variation that was disregarded was the degree to which an individual lived in either an urban or rural area. For example, San Bernardino County is given a rural-urban continuum code of 1 (the most urban); however, San Bernardino County extends from the eastern edges of the Los Angeles metropolitan area across the Mojave Desert to the Nevada border; the vast majority of land in San Bernardino County is unambiguously rural. So, many people in San Bernardino county—and other counties—live in rural areas but are grouped as urban residents in this study. In addition, some people who live in urban areas are grouped as living in rural areas, but this phenomenon is less common. Also, this analysis does not account for migration between rural and urban areas.

The following limitations are also important to consider. The proportions of men and women consistently added up to more than 1.0; this happened because a different population survey was used to estimate sex than was used to estimate population statistics. Also, data were taken from different years; it would be most effective for all data to be taken from the same years.

Future Directions

A logical next step is to extend this study by controlling for additional factors in measuring the effect of "ruralness" on heart disease incidence. Further investigation of religion, family support, and green spaces may help explain the connection between rural living and heart disease and mental health. Additionally, analyzing the effect of our controlled sociodemographic factors can be helpful in identifying targetable interventions to improve outcomes of rural residents.

CONCLUSION

People from rural counties have decreased cardiac mortality and better mental health than their urban counterparts after controlling for sociodemographic factors, such as education and income. Although overall heart disease death rates are higher in rural counties, this trend reverses after accounting for relevant confounders. Being from a rural area appears to be protective against cardiac mortality and mental illness through unknown mechanisms. This further emphasizes the impact of social determinants of health and the need for further investigation.

Financial Disclosures: None declared.

Funding/Support: None declared.

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Medical Student Burnout as Impacted by Trait Emotional Intelligence – Moderated by Three-Year and Four-Year Medical Degree Programs and Gender

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ABSTRACT

Introduction: Medical student burnout has received increasing attention in recent years due to greater acceptance of psychological and emotional vulnerability in the health care profession. Given the significant investment of personal and financial resources in this demanding profession, continued evaluation of factors contributing to burnout in medical training is necessary. A midwestern medical college with a longstanding 4-year medical degree program created 2 regional campuses that utilize a calendar-efficient 3-year medical degree program. The objective in this study is to examine if medical student burnout scores are higher for students on the 3-year campuses and how that is affected by emotional intelligence.

Methods: First- and second-year medical students voluntarily completed the Maslach Burnout Inventory for Students (scale: 1=never, 7=every day) and the Trait Emotional Intelligence Questionnaire (scale: 1=completely disagree, 7=completely agree). Multifactor analysis of variance assessed mean differences in burnout between campus and gender. Multivariate linear regressions were used for predicting burnout from emotional intelligence.

Results: Three-year campus students reported significantly ($P<0.010$) higher mean [SD] scores (8.3 [2.0]) than the 4-year campus students (7.4 [2.4]), and female students reported significantly ($P<0.049$) higher scores (8.2 [2.0]) than male students (7.6 [2.4]). Five emotional intelligence facets were independently associated with increased burnout scores ($R^2=0.26$, $P<0.001$) but significantly varied with campus and gender.

Conclusions: There were higher burnout scores in students studying on the two 3-year campuses compared to students on the traditional 4-year campus and higher scores for female students than male students. Different facets of emotional intelligence mitigated student burnout by campus and gender.

INTRODUCTION

Medical student burnout has received increasing attention in recent years due to greater acceptance of psychological and emotional vulnerability in the health care profession.[1] Given the significant investment of personal and financial resources in this demanding profession, continued evaluation of factors contributing to burnout in medical training is necessary.[2] Mental health problems such as anxiety,[3] depression,[4] and suicide[5] have been reported to be more common in physicians than their peers, and early identification could help prevent these disorders. Analyzing burnout, along with associated psychological antecedents that may be protective, could improve early detection in health professionals at a higher risk. This approach to develop predictor models could assist in anticipating future mental health problems and in informing prevention efforts.[6]

Emotional intelligence is a personal quality reported to mitigate the effects of burnout.[7] People who are found to possess higher levels of emotional intelligence have a better capacity to manage emotions and to handle interpersonal relationships empathetically.[8] As an inherent personal trait, emotional intelligence is a measurable construct whose internal structure consists of many interrelated intrapersonal and interpersonal elements. Intrapersonal intelligence, as originally described by Gardner, refers to the ability to perceive one's own feelings, desires, strengths, and weaknesses.[9] Interpersonal intelligence describes the ability to identify

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and respond to the moods, temperaments, and desires of other people. The hierarchical structure of trait emotional intelligence[10] consists of both the intrapersonal factors of well-being and self-control and the interpersonal factors of emotionality and sociability. Broadband factors such as self-control are reliable measures of emotional intelligence but can attenuate underlying information in the narrowband facets, such as emotion regulation, impulse control, and stress management.[11] Each of these detailed measures of emotional intelligence may be categorically related to medical student burnout.

The impact of emotional intelligence on burnout requires detailed analysis on the 15 faceted intrapersonal and interpersonal elements.[12] The intrapersonal emotional intelligence factor of well-being includes facets of self-esteem, optimism, and happiness. The interpersonal emotional intelligence factor of emotionality includes facets of emotion perception, empathy, relationships, and emotion expression. Another interpersonal factor—sociability—includes facets of social awareness, emotion management, and assertiveness. Motivation and adaptability are additional independent facets that contribute to the overall measure of emotional intelligence.[13]

Recently, a midwestern medical college with a longstanding 4-year medical degree program created 2 regional campuses that utilize a calendar-efficient 3-year medical degree program.[14] For those not familiar, differences in contact hours between these types of curricula are measured in weeks or months because of the elimination of summers off and the shortening of vacations and intercessions in typical 3-year programs.[14] Potential advantages of 3-year programs are reduction in student debt load, rapid entry into clinical practice, close mentoring in clinical training, and—in our case—smaller cohort sizes. First-year medical students on the 3-year campus start their curricula in the summer, 6 weeks earlier than their 4-year counterparts on the central campus. Although the students on all 3 campuses participate in identical basic science courses during the first year, there are increased time demands for the 3-year campus students due to early preclinical courses. Following their first year, 3-year campus students begin their first clinical clerkships, while 4-year campus students have a 12-week break over the summer. In the second year of the curriculum on the 3-year campuses, students are engaged in longitudinal clinical rotations, in addition to their remaining foundational science courses. Students on the 3-year campuses then enter the match during their third year of medical school, although students are given the option of adding a fourth year.

The literature has reported mixed results for the impact of gender on burnout in medical students, with some studies reporting statistically significant higher scores for 1 gender,[15] while in other studies no significant difference was detected.[16]

Similarly, the relationship of gender on emotional intelligence for medical students has produced mixed results that need further examination to resolve the variation likely due to situational differences. Some researchers[17-19] have reported higher emotional intelligence for female medical students, while others[20] have reported higher faceted emotional intelligence scores for male medical students. Other reports yielded no significant differences due to gender.[21,22]

Our objective in this study is to examine if burnout scores are higher for students on the 3-year campuses given the calendar efficiency of that program. Most medical students reported some reoccurring level of burnout by their first year of medical school, which has previously been observed by others.[2,23] Given the significant relationship of emotional intelligence with mental health,[20] burnout,[24] and performance outcomes[25] in academic environments, it is logical to examine how specific facets affect burnout for medical students. The categorical measure of gender was included in this study as it has been reported to interact with emotional intelligence[17,22] and burnout for medical students.

METHODS

Subjects

Medical students enrolled in the first- and second-year medical school classes of a private Liaison Committee on Medical Education-accredited medical institution were invited to participate in a survey in February of the 2017-2018 academic year. The institution included a traditional 4-year campus (admitting 204 students in each class) and 2 regional campuses that feature an accelerated 3-year curriculum and are focused on training physicians to address workforce shortages in the state (admitting a total of 25 students in each class). Regional campuses were established within the study institution beginning in 2015 and 2016. Invitations were sent via email to all enrolled students at all 3 medical school campuses, and students were provided with lunch when they attended a session to complete the survey.

Measures

As part of a larger survey examining various aspects of the curriculum, students were asked to complete the 15-item Maslach Burnout Inventory for Students (scale:1 = never, 7 = every day) and the 30-item Trait Emotional Intelligence Questionnaire Short Form (scale: 1 = completely disagree, 7 = completely agree). Burnout scores were determined from adding 5 items of emotional exhaustion. An analyst not part of this research study linked the surveys by AAMC ID number and associated them with institutional-reported gender scores. All students participating in this research study reported as female or male gender. The AAMC ID was removed from the survey dataset by the analyst before forwarding to the research group for statistical analysis.

Analysis

Multifactor analysis of variance was used to assess mean differences in burnout between campus and gender. Cohen's *d* reported effect sizes. Pearson correlations and multivariate linear regressions were used for predicting burnout from emotional intelligence.

Table 1. Mean Score Differences of Burnout Split by Campus, Gender, and Class

Variable	Group	N	Mean (SD)	Difference	*P* value	Cohen's *d*
Campus	3-year	82	24.8 (6.0)	2.6	0.010 [a]	0.41
	4-year	123	22.2 (7.2)			
Gender	Female	99	24.5 (6.1)	1.8	0.049 [a]	0.27
	Male	106	22.7 (7.2)			
Class	2nd year	75	23.9 (7.1)	1.1	0.192	0.18
	1st year	130	22.8 (5.9)			
Overall		205	23.6 (6.7)			

[a]Denotes statistical significance.

Table 2. Mean Score Differences of Emotional Intelligence Split by Campus and Gender

Emotional Intelligence Facet	Group	N	Mean (SD)	Difference	*P* value	Cohen's *d*
Self-esteem[a]	3-year	82	5.4 (1.2)	0.5	0.003 [c]	0.45
	4-year	123	5.9 (1.0)			
Motivation[a]	3-year	82	5.0 (1.3)	0.5	0.003 [c]	0.42
	4-year	123	5.5 (1.1)			
Empathy[b]	3-year	82	5.1 (1.5)	0.4	0.017 [c]	0.30
	4-year	123	5.5 (1.1)			
Empathy[b]	Female	99	5.5 (1.3)	0.4	0.023 [c]	0.31
	Male	106	5.1 (1.3)			
Optimism[a]	Female	99	5.8 (1.0)	0.4	0.009 [c]	0.34
	Male	106	5.4 (1.3)			
Assertiveness[b]	Female	99	4.9 (1.2)	0.3	0.041 [c]	0.23
	Male	106	4.6 (1.4)			
Emotion[b] management	Female	99	4.6 (1.3)	-0.2	0.038 [c]	0.17
	Male	106	4.8 (1.1)			

[a]Intrapersonal emotional intelligence.
[b]interpersonal emotional intelligence.
[c]Denotes statistical significance.

Table 3. Pearson Correlations of Burnout and Facets of Emotional Intelligence

	Element of Emotional Intelligence		Correlation	
Intrapersonal or Interpersonal	Factor	Facet	r	*P* value
Interpersonal	Emotionality	Emotion perception	-0.20	0.003[a]
		Emotion expression	-0.05	0.459
		Empathy	-0.04	0.528
		Relationships	-0.20	0.003[a]
	Sociability	Assertiveness	-0.13	0.059
		Social awareness	-0.03	0.672
		Emotion management	-0.03	0.704
Intrapersonal	Self-control	Stress management	-0.33	0.001[a]
		Emotion regulation	-0.32	0.001[a]
		Impulse control	-0.29	0.001[a]
	Well-being	Happiness	-0.24	0.001[a]
		Optimism	-0.19	0.007[a]
		Self-esteem	-0.07	0.286
	—	Adaptability	-0.30	0.001[a]
	—	Motivation	-0.24	0.001[a]

[a]Denotes statistical significance.

Inter-item reliability was determined by Cronbach alpha. IBM SPSS 26.0 generated the statistical analysis. Statistical significance was set at $P < 0.050$.

Human Subjects Approval

This research was reviewed and approved by the institution's Institutional Review Board. Informed consent documentation was sent by email to the medical student 1 week prior to completing the surveys. The signed forms were printed on paper and signed by the student, which were sent back to the principal investigator by email or handed to him in person.

RESULTS

Of 498 eligible medical students, 205 (41%) completed the survey. This included 130 (52%) first-year students and 75 (30%) of second-year students. Responses were received from 123 (30%) 4-year campus students and 82 (91%) 3-year campus students. The responses included 106 male (39%) and 99 female (43%) students.

Mean [SD] burnout (alpha = 0.7) scores for all respondents was 7.8 [2.2]. Medical student mean score differences of burnout determined by multifactor analysis are reported in Table 1. Statistically significant differences in burnout scores were reported for campus ($P < 0.010$) and gender ($P < 0.049$) but not for class ($P < 0.192$). Three-year campus students reported higher scores (8.3 [2.0]) than the 4-year campus students (7.4 [2.4]), and female students reported higher scores (8.2 [2.0]) than male students (7.6 [2.4]). In addition, a statistically significant interaction ($P < 0.001$) was reported between campus and gender, with increasing burnout scores for the 4 subgroups. Ranked from lowest to highest, the 4 groups were: (a) male student on the 4-year campus (6.7 [2.4]), (b) female students on the 3-year campuses (8.0 [1.9]), (c) female students on the 4-year campus (8.4 [2.1]), and (d) male students on the 3-year campus (8.5 [2.1]).

Fifteen facets of emotional intelligence differed based on whether students were on a 3-year or 4-year campus or by gender (Table 2). Students on the 4-year campus showed consistently higher results than 3-year students in self-esteem, motivation, and empathy, while women scored higher on empathy, optimism, and assertiveness measures. In contrast, male students scored higher in emotional management. These 7 facets of emotional intelligence did not report a statistically significant interaction term between campus and gender, and no subgroup analysis is reported.

When we analyzed correlations between burnout and emotional intelligence facets (Table 3), we found that 9 of 15 Pearson correlations (60%) between burnout and the fifteen individual emotional intelligence facets were negative and statistically significant ($P < 0.050$). These included two facets of interpersonal elements of emotional intelligence (emotion perceptions [r = -0.2] and relationships [r = -0.2]) along with 7 intrapersonal elements of emotional intelligence (emotion regulation [r = -0.3], impulse control

[r = -0.3], stress management [r = -0.3], happiness [r = -0.2], optimism [r = -0.2], adaptability [r = -0.3], and motivation [r = -0.2]).

When we performed a linear regression of burnout adjusting for each of the 15 emotional intelligence facets (Table 4), we found five emotional intelligence facets were independently associated with increased burnout scores ($R^2 = 0.26$, $P < 0.001$). Two of these were the interpersonal elements of emotion management (beta = 0.20) and emotion perception (beta = -0.16) and the remaining three were the intrapersonal elements of impulse control (beta = -0.25), adaptability (beta = -0.22), and stress management (beta = -0.18).

Finally, additional regression models were generated after splitting the respondents by campus and gender. The 2 regression models based on gender had 2 statistically significant predictors. The 2 regression models for campus had 3 significant predictors each. Female medical students and 3-year medical students showed associations between burnout scores and the intrapersonal elements of emotional intelligence as significant predictors. Significant predictors of burnout scores in male students and 4-year campus medical students were the interpersonal and intrapersonal elements of emotional intelligence.

Table 4. Linear Regression of Burnout on Emotional Intelligence Facets Split by Campus and Gender

		Individual Predictor		Overall Regression	
Group	**Emotional Intelligence Facet**	**Beta**	***P* value**	**R^2**	***P* value**
Female	Happiness[a]	-0.38	0.001[c]	0.32	0.001[c]
	Emotion regulation[a]	-0.30	0.003[c]		
Male	Impulse control[a]	-0.33	0.001[c]	0.19	0.001[c]
	Emotion perception[b]	-0.25	0.009[c]		
3-year	Happiness[a]	-0.55	0.001[c]	0.34	0.001[c]
	Self-esteem[a]	-0.46	0.001[c]		
	Adaptability[a]	-0.33	0.001[c]		
4-year	Stress management[a]	-0.41	0.001[c]	0.28	0.001[c]
	Motivation[a]	-0.27	0.009[c]		
	Emotion management[b]	0.31	0.002[c]		

[a]Intrapersonal emotional intelligence.
[b]Interpersonal emotional intelligence.
[c]Denotes statistical significance.

DISCUSSION

Burnout

Among medical students in their first 2 years of study at a private, midwestern medical school, we found higher burnout scores in students studying on the two 3-year campuses compared to students on the traditional 4-year campus. Potential differences could be attributed to the recent development of these campuses, as well as structural differences between the 3-year and 4-year programs, suggesting that some specific aspects of the learning environments may account for the differences. The response rate differences (91% of 3-year campus students vs 30% of 4-year campus students) could have affected the reported differences and are consistent with trends others have reported: that students attending schools in nonurban areas are more likely than students in urban areas to participate in surveys. While there are curricular similarities between the 2 types of programs, students at the 3-year campuses begin their term in July with a condensed clinical skills course, while students on the 4-year campus start 6 weeks later and have the clinical skills course distributed over a semester. The two 3-year campuses are also much smaller (20 and 25 students in each class), which may offer reduced opportunity to build social support structures compared to the 4-year campus that enrolls 204 students each year, although the literature shows mixed results on this. The larger campus size also provides more opportunity for social interactions between first-year through fourth-year students, which may help reduce the interrelated measures of social isolation and anxiety for students in the early years of their education. Another factor to consider is an observation in a related study with this same student population[26] noting differences between the student populations on the 3-year campuses compared to the 4-year campus. In that study, it was observed among matriculated students that those at the regional 3-year campuses are nearly 4 times more likely to come from a rural county and have slightly higher Medical College Admission Test scores. While this study did not directly address differences among the matriculated student populations, they could play a yet-to-be-determined role in the observed difference in burnout.

Second-year students did report higher levels of burnout than first-year students. This finding is not surprising given that on the 3-year campuses, students continue their clinical work throughout the summer, and on the 4-year campus, students have 12 weeks they can devote to vacation, research, or other individual pursuits. However, it should be emphasized that the wide range of scores among students in the second year decreased the precision of our measurements and may have prevented the mean score difference from being statistically significant.

The year in which these surveys were completed in relationship to the establishment of the 3-year programs also could contribute to the reported student burnout. In 2017, at the time of this study, neither regional campus had graduated its first cohort of students, and the clinical instruction was in the early stages of its development. As such, students at the 3-year campuses experienced a learning environment that was emerging rather than established and had no peers that had graduated from their institutions to guide them in the process. Three-year students in their first year of the curriculum began their clinical rotations in June of that year. Notification pertaining to this coursework occurs in early spring (February-March), and the prospect of clinical coursework prior to completing pathophysiology coursework could be a contributor to increased burnout. There is recent evidence[27] of increasing burnout as students enter their clinical coursework. At the time, second-year students on the 4-year campus were preparing for the

United States Medical Licensing Examination (USMLE) Step 1 and their first clinical experiences, while 3-year campus students also had Step 1 but experienced their initial clinical experience the year prior. These aspects of the learning environment—some related to calendar efficiency and others related to the establishment of the campus programs—could account for the observations on burnout at the 3-year and 4-year campuses.

We also found that female students reported higher levels of burnout than the male students, with a significant interaction observed between gender and campus. Of the 4 subgroups generated between gender and campus, male students on the 3-year campus reported the highest level of burnout, while their male counterparts on the 4-year campus reported the lowest. Intermediate scores between the 3 subgroups of male students were the 3 subgroups of female students. Presently, results are mixed on the impact of gender on burnout, so it is not surprising that an interaction term emerged between gender and campus on mean scores or that the regression models were moderated by either predictor. Situational differences may be contributing to outcome variation and need to be resolved. The use of female or male binary gender identifications also may cloud this interpretation, as students who identify as nonbinary or transgender were not distinguished in the survey design. Unfortunately, the facets of emotional intelligence that had significant differences in campus and/or gender did not produce an interaction to account for the burnout observations.

Emotional Intelligence

Many facets of emotional intelligence also showed significant differences on mean scores due to campus and gender. Self-esteem, motivation, and empathy were 3 facets of emotional intelligence that reported higher mean scores for 4-year campus students than 3-year students. The higher motivation scores of 4-year students seem counterintuitive since one might assume it requires greater motivation to progress through medical school in a shorter timeframe. Given the increasing academic demands that emerge as medical school continues, medical students may not maintain the same levels of intrinsic and extrinsic motivation. The motivation items on the emotional intelligence instrument do not differentiate between intrinsic and extrinsic motivation. Additional study is needed to fully resolve the interaction of motivation, campus, and burnout.

Empathy, optimism, and assertiveness were 3 facets of emotional intelligence that were reported higher for female students than male students. Male students reported higher levels of emotion management. These findings collectively align with the mixed reports from the literature.[17,18] In this study, gender had more numerous effects on emotional intelligence than campus did, although the facet of optimism was the sole intrapersonal element to report significant differences in mean scores. Higher empathy scores for female medical students indicate a greater understanding of other people's perspectives, higher optimism generates a more positive outlook of the future, and elevated assertiveness suggests being more forthright.[12] Emotion management is the ability to manage other people's emotional states—which was slightly higher for male students—but its significant impact on burnout was not moderated by gender.

The 3-year campus predictive model of burnout included 3 intrapersonal facets of emotional intelligence and zero interpersonal facets, suggesting that burnout on those campuses is wholly driven by the internal capacity to control and express one's emotions. In order of decreasing impact, happiness, self-esteem, and adaptability were significant predictors of burnout. As the most important predictor of burnout for the 3-year campus, finding ways to have moments of happiness in a schedule with less personal downtime is important to offset burnout. As the second most important predictor of burnout, self-esteem is also an important driver of achievement and recently has been reported with a significant association between performance-based self-esteem and exhaustion,[28] which is surprising as it is counterintuitive. Increasing self-esteem might be anticipated to increase rather than decrease burnout if it drives performance. Adaptability—the student's ability to remain flexible and adapt to change—may be of greater concern on the 3-year campuses as students adjust to the faster pace of the learning environment and its other unique aspects compared to the 4-year campus.

The 4-year campus burnout model included 2 elements of intrapersonal and 1 interpersonal facet of emotional intelligence, suggesting that an integrative framework will manage relationships through emotion and stress management. In order of decreasing impact, stress management, emotion management, and motivation were significant predictors of burnout. The 4-year campus students can keep burnout lower with higher levels of stress management and motivation, which seems self-evident given the challenges to complete medical school. External pressures, such as stress, are necessary to drive achievement but can reach a critical impasse if not managed properly. Since all other emotional intelligence facets were negatively related to burnout, it was surprising that the interpersonal element of emotion management was a significant and only direct predictor of burnout. In other words, spending time managing other people's emotional states increases burnout and would be counterproductive. Although this is speculative, there is at least 1 report of a direct relationship of female emotion management and burnout in an academic setting.[29]

Other research suggests that burnout may be associated with specialty trajectories.[30] Students selecting higher income specialties and those that provided more lifestyle control had lower frequency of burnout than students interested in lower income specialties and those with less controllable lifestyles, such as primary care. The two 3-year campuses have a mission focus emphasizing future primary care and psychiatry providers, a mission not shared at the 4-year campus that could also contribute to some of the differences observed for burnout between campuses—even during the early stages of the medical school curriculum.

Study Limitations

A weakness of this study is that we did not include students who were doing their intensive clinical rotations in the third year of medical school. Since most students on the 3-year campus complete their training at the end of this year, the third year is more intense for these students, which may contribute to increased burnout.

An additional factor to consider in this study is timing of the survey with the "opening" of the regional campuses. At the time of the survey, neither regional campus had graduated its first class, and the relative newness of the campuses also may have influenced this data. Gathering this data at the formative time in the early establishment of the 3-year campuses was important for us to understand the student experience at these campuses and may prove beneficial to others attempting to do the same. It will be beneficial to repeat this study when the 3-year campuses are more established and have matched multiple cohorts into the residency of their choice and then compare if any changes in burnout levels occurred between a more established 3-year program and one it is formative phase.

Also concerning is the difference in student response rates to the survey between the regional campuses and the main campus (91% vs 30%, respectively). We have no direct means to explain this difference, but the high response rates at the regional campus suggest that the study has great confidence in the data generated from the regional campuses. A response rate of 30% on the main campus suggests that data set suffers from a nonresponse bias of 70%. One contributing factor that has been observed to improve survey response rates is personalization.[31] The smaller cohort size on the regional campuses (25 students on each campus vs > 200 on the main campus) may have dramatically increased the personalization of the survey environment (lunch upon completion of the survey) on the regional campuses compared to the main campus. The surveys were completed in February, a few weeks away from spring break. This would be a good time to complete surveys in terms of student availability, but enthusiasm and energy may be diminished when compared to other times of the academic year, which could lower participation rates.

CONCLUSIONS

There were higher burnout scores in students studying on the two 3-year campuses compared to students on the traditional 4-year campus and higher scores for female students than male students. Different facets of emotional intelligence mitigated student burnout by campus and gender.

Funding/Support: None declared.

Financial Disclosures: Dr Hueston reports receiving consulting fees from the Hong Kong Health Services Research Fund for grant review. All proceeds donated to the Hong Kong Red Cross.

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Quality of Dietary Intake in Children With Developmental Disabilities: A Pilot Study

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ABSTRACT

Background: Children with developmental disabilities have a high prevalence of overweight and obesity. The role and contribution of their diet to weight status is poorly understood.

Objectives: This pilot study describes the dietary quality of children with spina bifida and Down syndrome compared with typically developing peers.

Methods: Dietary intakes of 8 children with spina bifida or Down syndrome and 4 children without developmental disabilities, aged 8 to 18 years, were collected using six 24-hour dietary recalls through Facetime. Dietary quality was assessed by application of the Healthy Eating Index (HEI).

Results: Children with spina bifida and Down syndrome had higher HEI scores when compared to typically developing peers (48.3, 52.9, and 46.2, respectively) and vegetable consumption (1.9, 2.6, and 1.4, respectively). All groups had undesirable intakes of saturated fat, added sugar, and sodium. Within this small sample, children with spina bifida and Down Syndrome had similar diet quality to their typically developing peers.

Conclusions: Further investigation in a larger sample is recommended to support the development of methods to optimize weight management in children with developmental disabilities.

INTRODUCTION

Obesity is an epidemiologic issue that results in increased health care costs, morbidity, and mortality.[1] Obesity is multifactorial in its origin, but common areas of focus in its etiology are diet (energy intake) and activity (energy expenditure). A large subset of research has focused on understanding and preventing pediatric obesity as the next generation comes of age in this obesogenic environment. Several groups of children encounter greater challenges and subsequent inequalities in obesity prevalence, including children with spina bifida and Down syndrome.[2-4]

Spina bifida is a neural tube defect where a portion of the spinal cord does not close properly during gestation.[5] Depending on where the spinal cord is affected, orthopedic, bowel, and bladder abnormalities and lower extremity paralysis can occur.[5] Down syndrome is a chromosomal condition associated with intellectual disabilities and hypotonia.[6] Research focused on obesity in children with spina bifida and Down syndrome has been limited in comparison to typically developing peers. Published reports have identified several determinants of weight status in both cohorts. Weight status in children with spina bifida has been associated with a decreased energy expenditure at the metabolic level and related characteristics (limited ambulation, decreased muscle mass, and excess adiposity in lower extremities),[7,8] along with dietary changes.[9] Similarly, in children with Down syndrome, decreased resting energy expenditure, altered lipid metabolism, increased leptin, comorbidities, and unfavorable diets have been associated with weight status.[7,10,11] However, studies on energy or nutrient intake for individuals with these diagnoses have focused primarily on dietary assessment methods, energy expenditure, and body composition[12,13] and have not examined a relationship between dietary quality and weight status.[14]

For all populations, dietary quality is a contributing factor

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in the development of several chronic conditions (eg, cardiovascular disease, obesity, cancer, and diabetes).[15] Examples of poor dietary quality can include a decreased consumption of fruit, vegetable, and whole-grain foods and an increased consumption of calorically dense snack foods.[16] Nutritional habits are often formed early in life and can continue into adulthood.[17] Diet quality and the amount of energy intake is particularly critical during childhood, as it can have lasting effects on the balance of energy, development of overweight and obesity, and risk of comorbidities.

Previous studies have assessed dietary quality in American children and adolescents using nutrition data from the National Health and Nutrition Examination Survey (NHANES) and by applying data to the Healthy Eating Index (HEI).[18] The HEI measures diet quality by assessing food group intake in comparison to the Dietary Guidelines for Americans (DGA), which describes nutritionally adequate food group servings based on caloric intake.[19] Children with developmental disabilities are not included in the NHANES data, leaving the dietary quality of this at-risk population unexamined. This pilot study aimed to use the HEI, a dietary assessment method previously employed with typically developing children, to describe dietary quality in a small sample of children and adolescents with spina bifida and Down syndrome.

METHODS

Study Design and Participants

This descriptive, cross-sectional analysis is part of a larger pilot study measuring energy expenditure in children (age 4-18 years) with and without developmental disabilities.[7] Participants included a subset (n=12) of children aged 8 to 18 years diagnosed with spina bifida, Down syndrome, or no developmental disability. Participants were asked to attend a clinic visit and participate in 2 weeks of testing for data collection. Before starting this portion of the study, approval from the Institutional Review Board and written consent and assent from the parent and child were obtained.

Measures

Anthropometrics

Weight and height were obtained from each participant during the original data collection.[7] Based on the participants' ability to stand independently, arm span was used as a surrogate measure for standing height. Full details on these measures were reported previously.[7]

Dietary Intake and Assessment

Each participant completed 6 multiple-pass 24-hour dietary recalls collected by a registered dietitian via Facetime. Data collection occurred during late summer and fall seasons, and participants were instructed to eat as usual. Measuring cups and spoons, a deck of cards, and 2-dimensional portion size tools were provided to assist with estimating portion sizes during the recalls. Participants sought input from a proxy (eg, parent) if they were unable to recall eating events or details of foods and beverages consumed. All dietary recalls were recorded and entered into Nutrition Data Systems for Research (NDSR), Nutrition Coordinating Center, University of Minnesota, software version 2016.

Dietary Quality - HEI Scores

The HEI-2010 scores were used to measure dietary quality. HEI-2010 includes 12 components that are summed to a maximum score of 100 points. Higher scores equate to a higher quality of diet. The components capture food groups and nutrients that are encouraged for adequate nutrient intake (whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein from meat, seafood and plant proteins, and fatty acids) as well as foods and nutrients that should be consumed in moderation (refined grains, sodium, and empty calories) within the DGA 2010.[19]

Analysis

Descriptive statistics were used to assess child anthropometrics and family demographics. Caloric, nutrient, and food group intake data were analyzed using the NDSR. Food group serving sizes are based on the recommendations of the DGA 2010. Average values from six 24-hour dietary recalls were used for nutritional descriptive analyses. The nutritional data did not have a normal distribution; therefore, median values were used when reporting these data.

RESULTS

This analysis includes 6 male (50%) and 6 female (50%) participants age 8-18 years, with a mean age of 13.2 (±3.4). Of the 12 participants, 4 were diagnosed with Down syndrome, 4 with spina bifida, and 4 without a developmental disability. Most participants reported their race as Caucasian (83%), followed by Asian (8%) and other (8%). The majority of parents were married (n = 11, 92%), with 1 family of divorced parents (8%); combined family income varied, with 7 families (58%) reporting their income between $75,000 and $100,000 followed by 2 families (17%) reporting combined income of $30,001 to 50,000.

Using the Centers for Disease Control and Prevention's Body Mass Index (BMI) percentile charts for boys and girls aged 2 to 20 years, 2 children with Down syndrome were categorized as normal weight (5% to <85%), 1 was categorized as overweight (85% to <95%), and 1 as obese (≥95%). Two children with spina bifida were categorized with a normal BMI (5% to <85%) and 2 as obese (≥95.1%). Three controls were classified as normal weight and 1 as overweight.

Six 24-hour dietary recalls were collected—2 weekend and 4 weekday days—and analyzed from each of the 12 participants. All recalls were considered complete (ie, multiple meals and snacks were reported for each), resulting in 24 recalls per group and 72 recalls total. From the dietary recalls, average values for each

participant were obtained; group median values of dietary components are listed in Tables 1 and 2.

Energy intake was highest in children with Down syndrome. Consumption of vegetable, greens, and bean servings were higher among children with spina bifida and Down syndrome than children without developmental disabilities (1.9, 2.6, and 1.4, respectively). Whole fruit intake was similar across all cohorts, with the group diagnosed with Down syndrome having the highest intake of total fruit servings. The group with Down syndrome also had the highest seafood and plant-based protein servings when compared to children diagnosed with spina bifida and control group (1.2, 0.7, and 0.4, respectively). Children with spina bifida and Down Syndrome had higher intakes of lean meat servings when compared to those without developmental disabilities (2.9, 2.8, and 1.6, respectively). Sweetened beverage intake of children with Down syndrome was collectively higher than both the spina bifida and control group (1.5, 0.0, and 0.3, respectively). Children without developmental disabilities had a lower intake of starchy vegetable servings and a higher intake of unsweetened water. All groups had high intakes of sodium, added sugar, saturated fat, and refined grain servings.

Table 1. Dietary Nutrient Intake by Diagnosis Group

Dietary Nutrient	Down Syndrome n = 4	Spina Bifida n = 4	Control n = 4	All n = 4
Calories (kcals)	2322.2 (1800, 2710)	1640.5 (1529, 3208)	1865 (1051, 1902)	1865.5 (1051, 3208)
Fat (g)	100.3 (73.4, 114.8)	62.9 (51.9, 143.1)	65.6 (54.8, 70.0)	70.9 (51.9, 143.1)
Carbohydrate (g)	268.0 (224.1, 303.3)	213.6 (194.4, 353.7)	261.7 (90.5, 275.8)	256.7 (90.5, 353.7)
Protein (g)	93.2 (70.5, 120.0)	67.6 (60.4, 135.9)	56.0 (53.1, 69.5)	70.0 (53.1, 135.9)
Saturated fatty acids (g)	34.3 (28.1, 40.4)	26.7 (17.8, 51.0)	23.1 (20.0, 26.1)	27.1 (17.8, 51.0)
Dietary fiber (g)	15.3 (13.5, 17.1)	13.3 (8.8, 25.4)	11.6 (7.1, 15.2)	14.4 (7.1, 25.4)
Sodium (mg)	3870 (2281, 4886)	3077 (2619, 5615)	2549 (1577, 2710)	2703 (1577, 5615)
% Fat calories	37.4% (35.7, 39.3)	33.1% (28.2, 38.2)	33.0% (30.1, 45.8)	35.8% (28.2, 45.8)
% Carbohydrates kcals	44.8% (44.1, 48.2)	49.8% (43.9, 55.6)	52.9% (31.7, 58.1)	48.4% (31.7, 58.1)
% Protein calories	16.8% (16.2, 18.5)	17.0% (15.7, 18.9)	14.3% (11.2, 22.5)	16.2% (11.2, 22.5)
% Sat fat calories	13.3% (12.8, 14.5)	12.8% (9.8, 16.0)	12.4% (10.1, 16.9)	13.2% (9.8, 16.9)
Added sugars (g)	68.6 (58.5, 95.6)	51.8 (32.0, 54.5)	60.7 (26.2, 116.4)	58.8 (26.2, 116.4)

Median values (minimum, maximum).

Table 2. Healthy Eating Index (HEI) Score and Total Food Serving Intakes

HEI Score and Food Servings	Down Syndrome n = 4	Spina Bifida n = 4	Control n = 4	All n = 12
HEI-2010	52.9 (47.7, 59.6)	48.3 (33.4, 54.1)	46.2 (41.2, 59.6)	51.1 (33.4, 59.6)
Total fruit	1.5 (0.8, 4.4)	1.1 (0.0, 2.2)	1.1 (0.5, 2.5)	0.8 (0.0, 2.4)
Whole fruit	0.8 (0.3, 2.4)	0.9 (0.0, 2.2)	0.8 (0.5, 2.0)	1.4 (0.0, 4.4)
Total vegetable	2.6 (2.1, 3.4)	1.9 (0.7, 5.7)	1.4 (0.5, 2.7)	2.3 (0.5, 5.7)
Starchy vegetable	1.2 (0.9, 2.0)	0.8 (0.4, 0.9)	0.5 (0.2, 0.8)	0.8 (0.4, 2.0)
Greens and beans	0.9 (.07, 1.1)	0.4 (0.0, 0.4)	0.2 (0.0, 0.5)	0.4 (0.0, 1.1)
Total grain	6.1 (3.7, 8.1)	7.1 (4.6, 10.9)	5.3 (4.2, 6.3)	6.0 (3.7, 10.9)
Whole grain	0.1 (0.0, 2.1)	0.6 (0.3, 0.8)	0.4 (0.0, 1.9)	0.4 (0.0, 2.1)
Refined grain	5.0 (3.5, 7.2)	5.0 (4.3, 9.2)	4.4 (3.9, 5.1)	4.5 (3.5, 9.2)
Total protein food	7.7 (6.3, 8.9)	3.4 (1.8, 9.2)	3.8 (3.0, 4.6)	4.4 (1.8, 9.2)
Lean meat	2.8 (0.9, 4.9)	2.9 (0.0, 5.3)	1.6 (0.4, 2.6)	2.3 (0.0, 5.3)
Nonlean meats	5.4 (4.9, 6.5)	1.6 (1.0, 5.1)	2.5 (0.7, 4.2)	3.7 (1.0, 6.5)
protein	1.2 (0.0, 2.0)	0.7 (0.0, 1.4)	0.4 (0.3, 1.1)	0.6 (0.0, 2.0)
Total dairy	3.3 (2.1, 6.0)	4.4 (1.4, 5.0)	2.0 (1.0, 4.0)	3.4 (1.0, 6.0)
Full fat dairy	0.3 (0.0, 0.8)	1.0 (0.2, 2.3)	0.5 (0.0, 0.8)	0.5 (0.0, 1.5)
Reduced-fat dairy	1.6 (1.0, 2.9)	0.4 (0.0, 0.8)	0.4 (0.2, 1.1)	0.7 (0.0, 2.9)
Low fat or fat-free dairy	0.5 (0.0, 2.4)	1.5 (1.0, 2.4)	0.0 (0.0, 1.7)	0.9 (0.0, 2.4)
Total fat	4.3 (3.2, 4.7)	3.4 (2.4, 10.6)	1.6 (0.3, 4.2)	3.5 (0.3, 10.6)
Total beverage	2.3 (0.5, 3.6)	1.6 (0.2, 3.5)	4.1 (2.3, 10.3)	3.0 (0.3, 10.3)
Sweetened milk	0.8 (0.0, 1.9)	0.0 (0.0, 0.8)	0.0 (0.0 ,0.0)	0.0 (0.0, 1.9)
Sweetened soft drinks	0.5 (0.0, 1.4)	0.0 (0.0, 0.3)	0.3 (0.0, 0.5)	0.1 (0.0, 1.4)
Sweetened fruit drinks	0.2 (0.0, 1.0)	0.0 (0.0, 0.3)	0.3 (0.0, 2.3)	0.1 (0.0, 2.3)
Unsweetened water	0.9 (0.0, 2.6)	1.6 (0.2, 2.5)	2.4 (1.3, 10.3)	1.8 (0.0, 10.3)
Empty calorie intake (% calories)	28% (24.9, 29.7)	24% (21.4, 27.4)	29% (24.0, 37.2)	27% (21.4, 37.2)

Median values (minimum, maximum).
Serving sizes were assigned to each Nutrition Data Systems for Research food based on the recommendations made by the Dietary Guidelines for Americans 2010.

DISCUSSION

When comparing dietary intake to the DGA 2010 in this sample of children with spina bifida and Down syndrome, quality of diets was similar compared to children without developmental disabilities. For a few healthy nutrients and food groups, the quality of intake was better in children with spina bifida or Down syndrome, as evidenced by the sample reporting higher HEI scores. However, the Down syndrome cohort reported higher calorie intake and total fruit (including calorically dense sweetened juice drinks), suggesting total caloric intake may be more contributory to weight status than diet quality alone. Due to the pilot nature of the study and sample size, statistical analysis of the difference could not be performed to assess for significance.

The average HEI score for typically developing children (2-17 years of age) from the 2015-2016 NHANES data set, using the HEI-2015 scoring system, is 53.9.[20] However, the HEI-2015 scoring system is slightly different than the HEI-2010 used in this study. HEI-2015 replaced the "empty calories" component with added sugar and saturated fat components.[21] To date, the last NHANES' HEI score published for children using the HEI-2010 scoring system used data collected in 2011-2012 and reported an average HEI score of 55.07.[20] The HEI scores

presented in this study from all groups are below these national averages. The lower HEI scores in the spina bifida and Down syndrome groups of the present study were also observed in an adult population with intellectual and developmental disabilities, reporting an average HEI of 46.7, which is lower than the national average of 58.3 for healthy adults.[14]

Due to the range of age and unknown activity levels within our sample, the DGA daily serving recommendations for each food group could not be applied to see if each participant group was meeting daily food group serving recommendations. Although, when applying the DGA's nutrient intake recommendations for added sugar and saturated fat intake, all groups exceeded the recommendations. All groups also exceeded the Tolerable Upper Intake Level for sodium. These nutrient findings correspond with limited reports from other dietary assessment studies conducted within developmentally disabled populations[14,22,23] and reflect the dietary intakes of all Americans.[24]

The method of using Facetime to collect the dietary 24-hour recalls increased reliability. Being able to visually see an individual's face—especially children's faces—helped identify visual cues about their ability and willingness to recall all items. It was also beneficial to have parents and family members present during the Facetime recalls to aid with prompting forgotten foods and give detail on brands, types, and amounts of foods. This methodology provided a more comprehensive approach and potentially increased the accuracy of the child's dietary intake.

In this pilot study of children with spina bifida and Down syndrome, findings suggest that diet quality may not have as significant of a role in weight status as a lower energy expenditure when compared to typically developing counterparts. These findings could be due to the small sample size, as well as other unknown determinants. Obesity is multifactorial in its origin, and other factors need to be considered. It is documented that spina bifida and Down syndrome cohorts are known to have a lower energy expenditure, which has an instrumental role in an individual's weight status, and it would be reasonable to assume that it may be exacerbated when other factors are present.[7] A primary example includes socioeconomic status, which has been associated with food choices, weight status, and energy intake.[25] While family income was obtained for participants, the influence was not examined due to the small sample size. Future studies are recommended to include socioeconomic status and dietary quality in a larger sample to determine combined influences on weight status.

Future studies would benefit from recruiting a larger sample of 1 cohort and measure spectrums within to strengthen statistical analyses and accurately generalize data. Limiting age range or stratifying age groups per DGA food group serving recommendations will also strengthen statistical analyses. Collecting physical activity and energy expenditure measurements will help determine calorie requirements and if there is a deficit or surplus of daily energy. Additionally, understanding socioeconomic status and food-related habits of family members may be useful.

A strength of this study is that this is one of the first to examine diet quality in children with intellectual and developmental disabilities using reliable methods. While there are no common therapies for preventing high BMIs in lower energy expenditure phenotypes, further exploring the relationship between weight status and energy expenditure, along with caloric and nutrient intakes, may discern effective interventions to combat the obesity prevalence in children with developmental disabilities.

CONCLUSION

The use of this study's dietary assessment method and application of the HEI provides a guide to better understand dietary quality in children with developmental disabilities. Understanding the nutritional quality of these children is understudied and yet critical for developing achievable interventions and providing education to families on the development of healthy habits related to food. This study's findings only begin to identify what is known and not known about the diet quality and habits of children with developmental disabilities and their families.

Funding/Support: This work was supported by the National Institutes of Nursing Research (NINR) of the National Institutes of Health (NIH) under Award Number P20NR015339 and the Clinical and Translational Science Institute of Southeastern Wisconsin through the Advancing a Healthier Wisconsin Endowment of the Medical College of Wisconsin under the award 8UL1TR000055.

Financial Disclosures: None declared.

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Does a Centralized Scheduling Process Improve Referral Timeliness?

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ABSTRACT

Background: Timely, necessary specialist care is associated with better patient health outcomes and lower costs. This assessment looks at the effects of centralized scheduling, as well as patient and referral-level factors on referral completion rates. We hypothesized that centralized scheduling would increase access to specialty care, as evidenced by higher referral completion rates.

Methods: We analyzed data for specialty referrals to cardiology, nephrology, gastroenterology, and neurology from 6 months before to 6 months after implementation of a centralized scheduling system within a midwestern academic health system. We considered a referral complete if an appointment occurred within 3 months following an order for service.

Results: Overall, referral completion rates modestly increased (63.7% to 69.9%, $P<0.01$), but this was driven by improvement within a single specialty (gastroenterology, 54.2% to 67.3%, $P<0.05$). Other specialties saw either no significant change (neurology, nephrology) or a decrease (cardiology, 87.3% to 78.6%, $P<0.05$). The time to schedule, or cycle time, improved overall from 21 days (SD 8-38) to 15 days (SD 8-30), $P<0.05$.

Conclusions: Centralized scheduling had inconsistent effects on referral completion across specialties, though the process (cycle time) improved. Variable implementation fidelity and microenvironments likely contributed to uneven findings across specialties. Centralized scheduling may improve timely access but likely depends on implementation and buy-in.

INTRODUCTION

Referrals from primary care physicians to specialists represent a major link for patients to have their needs met by the health care system. The referral process touches on all 6 pillars of what the National Academy of Medicine considers a well-functioning health care system, namely that care should be safe, effective, patient-centered, timely, efficient, and equitable.[1] The referral process also plays an important role in ensuring that patients receive the specialty care they need, when they need it, and how they need it. Inefficiencies or inequities in the referral process can pose threats to safe and effective care.

Primary care serves as the first point of contact for most Americans with the health care system. When conditions are sufficiently complex, primary care physicians refer to, and coordinate care with, specialists. Around 1 in 10 office visits results in a referral to a specialist, yielding an estimated 50 million new referrals and 430 million specialty visits every year.[2,3] When appropriate and effective, this primary care-specialist coordination can lead to better health outcomes for patients. In chronic kidney disease, for example, specialist co-management of patients is associated with reduced incidence of end stage renal disease, and in more advanced cases of kidney disease, leads to a 37% reduction in mortality.[4-6] Heart failure patients who are co-managed by an internist and a cardiologist have decreased costs of care and are less likely to be admitted to the hospital.[7] Conversely, when patients fail to complete referrals and receive necessary, timely specialist care, they are at risk for worse health outcomes and higher costs.[8]

Patient-centered scheduling efforts have centered around trying to improve patient access to care, but approaches to achieve this goal have varied. In several studies, implemented changes included same-day appointments, after-hours care, and increased

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opportunities for walk-in care.[9] Studies have shown open-access scheduling, which emphasizes patient-driven scheduling, to be beneficial for reducing no-show rates and wait times, although effects on patient satisfaction have been mixed.[10] Concerns remain over continuity of care with open-access scheduling and the risks for patients with chronic conditions to fall through the cracks.[10,11] Further, local schedulers are likely more familiar with the subset of clinical conditions seen by their clinicians, and they may also "bump" appointment requests to clinicians for triage. While patient-centered scheduling efforts have been well-defined in primary care, the effects of these efforts on access to specialty care have been less well-characterized and have been limited mainly to single specialty studies.[12-14]

Another component related to the referrals process and access to specialty care is ensuring that access to specialty care is consistent across different groups and demographics. This plays into the National Academy of Medicine's aim of making health care more equitable. One area of identified inequity in health care is racial disparities in use of, and access to, health care. Prior to 2014, access and insurance coverage were identified as primary factors contributing to racial disparities in health care utilization.[15] While the full implementation of the Affordable Care Act has been shown to have reduced racial disparities through increased insurance coverage and access to health care, work remains to be done in making access to health care more equitable.[15]

With a drive to improve access, timeliness, and the patient experience, our health system implemented a new process with the centralized management of patient referrals. The process uses a centralized call center with workflows to improve the matching of patients and clinicians at locations most convenient for patients. In this analysis, we aimed to identify the effects of centralized scheduling on access to specialty care, represented by referral completion rates, by reviewing referral data from a large regional academic health system. We also sought to identify other patient and referral-level factors (age, ethnicity, sex, marital status, insurance financial class, and referral priority) that might be associated with higher or lower referral completion rates. By assessing processes, including time to appointment and referral completion, we sought to assess if the process was measurably more efficient. In assessing patient factors, we sought to proactively look at equity and assess for any differences across patient groups—including race, income, and language—such that those could be actively addressed. We hypothesized that centralized scheduling changes would increase access to specialty care, as evidenced by higher referral completion rates. To focus our assessment, we looked at 4 specialties: cardiology, nephrology, neurology, and gastroenterology.

METHODS

Setting

Froedtert and the Medical College of Wisconsin (MCW) is a regional health network serving 9 counties in southeastern Wisconsin. The health network has 3 hospitals, including a 604-bed academic campus, and 38 satellite health centers that provide ambulatory, laboratory, and radiology services. The network has over 900,000 annual outpatient visits, and network physicians have close to 800,000 annual patient visits at its health centers and clinics. Froedtert and MCW implemented these patient-centered, centralized referral management changes, by specialty, over the course of 2015-2017, to help increase patient access to, and satisfaction with, care.

Description of Centralized Scheduling Process

During the centralized scheduling changes implemented during this project, clinicians used provider order entry within an electronic health record (EHR) (Epic Systems, Verona, Wisconsin) to place referrals. Prior to centralized scheduling, clinicians ordered referrals by location, specifying the clinic location where the patient was to be referred. Each referral location was a unique order. Staff within those clinics would then use a work queue to reach out and call patients, or patients would telephone the clinic directly, to schedule those appointments. Through the centralized scheduling process, orders were altered such that clinicians could refer to a specialty using a single order for all locations. Clinicians had the option within the order to specify a patient-preferred location or preference for the first available appointment within the region. Staff at a centralized call center operated these work queues rather than the individual clinics. Scheduling grids were created that outlined the scope of services available at each clinic and scope of practice for individual doctors, such that specialized knowledge that was held within the clinic staff could be scaled to the centralized schedulers. Providers received information about the new process and information about how the order process was modified for centralized scheduling. Schedulers received information and educational inservices about how to access scheduling grids.

Data Sources

We used data from the EHR detailing referrals and appointments for 4 specialties that were high priorities for improving access: cardiology, nephrology, gastroenterology, and neurology. We used referrals as ordered in the EHR by affiliated primary care physicians (PCP) who used the health system's EHR, inclusive of general internal medicine, family medicine, or medicine-pediatrics practices. We excluded referrals that were later cancelled by any clinician. We included patients who had a PCP within the health system and who were 18 years or older when the referral was placed to limit the analysis to electronic orders. Only office visits were included, not referrals for procedures such as endoscopy or cardiovascular or neurological testing because these procedures continued to be scheduled by departments. To assess whether a referral was completed, we used the scheduling system to determine if the patient had a completed appointment within 90 days of the referral being placed. Referral cycle time, measured

Table 1. Centralized Scheduling Dates and Clinician Counts 6 Months Before and After Implementation

Specialty	CS Implementation Date	Clinicians Before CS	Clinicians After CS
Neurology	8/12/2015	55	53
Cardiology	6/22/2016	45	46
Gastroenterology	4/12/2017	63	71
Nephrology	4/12/2017	21	20

Abbreviation: CS, centralized scheduling.
Counts were statistically similar ($P = 0.55$).

in days, was defined as time from referral placement to appointment completion. We assessed implementation fidelity with key informant meetings with ambulatory services leaders. We assessed the number of clinicians seeing patients by a unique count of clinicians within ambulatory clinics during the 6 months before and after the implementation. Differences were compared by paired *t* tests. Data on clinical effort (ie, percent of time seeing ambulatory patients) was not available for this analysis.

We abstracted referrals 6 months before and 6 months after the implementation of the centralized scheduling process at each department, looking for appointments within 90 days of the referral (Table 1).We abstracted demographic information from the EHR to capture patient details at the time of the referral, including age, sex, insurance status, marital status, ethnicity, race, ZIP code, and language. We also abstracted details about the referral, such as its priority in the system (urgent vs routine).

Statistical Analysis

We explored descriptive statistics by specialty, comparing referral completion by implementation of the new centralized scheduling process. The unit of analysis was the referral. If patients had multiple referrals to a single specialty within the time frame, we used the first referral. We used multilevel logistic regression on referral completion using SAS version 9.4 with generalized estimating equations using PROC GLIMMIX, clustering by patient given that patients may have had more than 1 referral. Coefficients, *P* values, odds ratios, and confidence intervals were calculated and reported for all variables of interest. A *P* value of <0.05 was required for a variable effect to be considered significant.

RESULTS

During the 6 months prior to and after their respective adoptions of centralized scheduling, 10,974 patients had 11,761 referrals placed to cardiology, nephrology, gastroenterology, and neurology (Table 2). Of these patients, 3719 (33.9%) had at least 1 incomplete referral by our 90-day criteria. Through 4 key informant interviews (vice president of ambulatory services, senior medical director for ambulatory care, director of enterprise scheduling, and chief transformation officer), we assessed implementation fidelity, defined as following through with centralized scheduling rather than local scheduling. Participants identified that cardiology continued to send referrals to local clinics to facilitate scheduling, while the other specialties had a strong fidelity to the intervention. The number of clinicians providing care to patients in the pre- and post-implementation periods increased modestly, driven by a 13% increase in gastroenterology, though the difference was not statistically different (Table 1).

The overall referral completion rate for all 4 specialties of interest was 66.7%, with the completion rate climbing significantly from 63.7% during the time before centralized scheduling implementation to 69.9% after implementation (Table 3). Of the specialties, cardiology had the highest overall completion rate (80.9%); however, it saw its completion rate fall slightly but significantly from pre-centralized scheduling to post-centralized scheduling (83.7% to 78.7%). Conversely, gastroenterology had the lowest overall completion rate (60.2%) but saw its completion rate rise significantly from 54.2% to 67.3%. Neither nephrology nor neurology saw significant changes in the referral completion rates pre- and post-centralized scheduling.

The median time from referral order to specialist appointment (the cycle time) was 18 days, with that number falling significantly from 21 days before implementation of centralized scheduling to 15 days after implementation. Cardiology, gastroenterology, and neurology all saw their median cycle times improve from pre-implementation to post-implementation, although only the changes for neurology (27 to 20) and gastroenterology (21 to 15) were statistically significant. Conversely, nephrology saw its median cycle time rise, from 11 days pre-implementation to 14 days post-implementation, although not significantly.

DISCUSSION

In this assessment of primary care to specialty referrals within a single academic health system implementing a centralized scheduling and referral process, we identified that the centralized scheduling process modestly improved referral completion for patients, though we identified that this was driven almost entirely by throughput in a single specialty of gastroenterology. This may be due, in part, to variable implementation fidelity. We did see that cycle time overall was reduced by about 6 days (or nearly 30%), also driven by both gastroenterology and neurology improvements, which had the highest cycle times at baseline. While the changes in completion were small, any change is important given that the intervention was focused only on scheduling processes. With cycle time more notably improved, it adds credence to how scheduling and administrative processes impact care delivery.

In proactively assessing equity, we identified differences in referral completion by race, a finding that merits closer attention. The results were mixed, with non-White patients having improved referral completion rates compared to White patients in gastroenterology but lower in neurology. In general, we saw that patients on Medicare and/or Medicaid were less likely to complete referrals after adjusting for age categories.

Given the inconsistent results for referral priority and the other variables studied across the 4 specialties, we suspect that each specialty represents its own microsystem, and that the variable fidelity of the centralized scheduling process affected the outcomes. As such, due to either differences in patient population characteristics or different, persistent cultural and organizational practices, it is possible that results cannot necessarily be predicted with the implementation of a standardized process, but, like most process improvement activities in health care, must be assessed to ensure that desired results are achieved.

Moving away from local scheduling to scalable, centralized processes has important implications for health systems that are moving forward with enabling several scheduling improvements, such as the ability for patients to self-schedule online, assistants in primary clinics to directly schedule patient appointments, and the ability to create a single customer service center. Ensuring that barriers to scheduling, such as a single scheduling point within clinics or for individual physicians, are minimized are expected to facilitate the above innovations. Our data for gastroenterology likely show the clearest picture of the impact: with centralized scheduling embraced, cycle time dropped and referral completion improved.

We hypothesize that the mechanism of better referral completion is mediated by easier scheduling or giving the patient more flexibility for choosing times or optimal locations. Additionally, as opposed to open-access scheduling, where there have been concerns about decreased continuity of care, scheduling standardization and more consistent scheduling practices achieved through adoption of centralized scheduling might have prevented patients from being lost to follow-up.[10] Other factors, such as appointment reminder telephone calls, went unchanged during this time period, although the effects of staff changes would need to be better analyzed and understood.

Our results appear consistent with prior assessments in patient-centered scheduling improvements in areas where implementation fidelity was judged to be high, such as in gastroenterology. Similar to Rose et al, we identified improvement in access metrics, in the form of reduced wait times and no-show rates.[10] Importantly though, given that patient-centered scheduling effects have been better characterized in a primary care setting, it is possible that there are specialty-level variations that need to be considered and better studied before more coherent results can be synthesized.

Table 2. Patient Demographic Breakdown

	Cardiology		Gastroenterology		Nephrology		Neurology		Total	
No. of referrals	2290	%	5656	%	777	%	3038	%	11732	%
Language										
English	2272	99%	5584	99%	757	97%	3009	99%	11622	99%
Non-English	18	1%	72	1%	20	3%	29	1%	139	1%
Ethnicity										
Non-Hispanic	2235	98%	5447	96%	749	96%	2933	97%	11364	97%
Hispanic	55	2%	209	4%	28	4%	105	3%	397	3%
Race										
White	1896	83%	4756	84%	518	67%	2479	82%	9649	82%
Non-White	387	17%	885	16%	258	33%	552	18%	2082	18%
Marital status										
Married	1252	55%	3077	54%	369	47%	1511	50%	6209	53%
Non-married	1038	45%	2579	46%	408	53%	1527	50%	5552	47%
Insurance										
Medicare/Medicaid	1263	55%	3313	59%	410	53%	1833	60%	6819	58%
Non-government	1027	45%	2343	41%	367	47%	1205	40%	4942	42%
Age group										
18-39	253	11%	1114	20%	92	12%	732	24%	2191	19%
40-64	945	41%	2837	50%	280	36%	1307	43%	5369	46%
65+	1092	48%	1705	30%	405	52%	999	33%	4201	36%
Centralized scheduling										
Before	1029	45%	3081	54%	384	49%	1492	49%	5986	51%
After	1261	55%	2575	46%	393	51%	1546	51%	5775	49%
Sex										
Female	1229	54%	3428	61%	397	51%	1937	64%	6991	59%
Male	1061	46%	2228	39%	380	49%	1101	36%	4770	41%
Priority										
Urgent	270	12%	470	8%	68	9%	157	5%	965	8%
Routine	2017	88%	5169	92%	705	91%	2874	95%	10765	92%

Table 3. Completion Percentages and Referral Counts by Specialty

	Cardiology	Gastroenterology	Nephrology	Neurology	Total
Total Referrals	2287	5656	777	3038	11758
Completed Referrals	1850	3403	575	2016	7847
Overall Completion %	80.9%	60.2%	74.0%	66.4%	66.7%
Pre-CS Completion %	83.7%	54.2%	74.7%	66.6%	63.7%
Post-CS Completion %	78.6%[a]	67.3%[a]	73.3%	66.1%	69.9%[a]
Overall Median Cycle Time	15 (7-29)	18 (8-35)	14 (7-24)	22 (11-41)	18 (8-35)
Pre-CS Median Cycle Time	16 (7-30)	21 (9-41)	11 (7-24)	27 (13-44)	21 (8-38)
Post-CS Median Cycle Time	14 (7-28)	15 (7-29)[b]	14 (8-26)	20 (9-37)[b]	15 (8-30)[b]

Abbreviation: CS, centralized scheduling.
[a]$P < 0.05$ by chi-square.
[b]$P < 0.05$ by Wilcoxon rank-sum.
[c]Cycle time measured in days, defined as time from referral placement to appointment completion.
Appointments that weren't completed did not have a cycle time and were thus omitted from these calculations.

Looking at race and equity in health care, being a race other than White was associated with increased odds of a completed referral in gastroenterology but decreased odds of a completed referral in neurology. These mixed results are somewhat unexpected, given the findings from other studies uncovering racial disparities in health care access and utilization.[15] Further assessment looking at more granular details, such as transportation access and geography may be helpful to understand these results in more detail. Proactively monitoring equity for patients across different groups should be explored for any changes that relate to access.

Our analysis has limitations that should be considered. We assessed fidelity of the implementation through key informant interviews but do not have quantifiable data about this aspect of the project available. Nonetheless, the information provides important context for why we may see differences by specialty. We used 90-day cutoffs for when appointments were to be scheduled, but it is possible that some elective referrals may have been completed outside of that window. We only captured referrals that were completed within our health network; it is possible that patients may have had referrals completed at outside systems but did not have claims data available. While this "leakage" may overestimate uncompleted referrals, we do not expect that leakage would have differed before or after implementation of centralized scheduling. We did not look at appointment scheduling time because of limitations with cancellations and reschedules affecting the clarity of the picture. Our models contained a significant number of potentially relevant pieces to the referrals puzzle. However, we were not able to include all the desired variables in our research model, including other patient contextual factors that are likely to be relevant, such as transportation access, childcare availability, or financial information such as copayment requirements. Organizational factors, such as staff turnover and physician leader engagement, were also not included in our model. Limited analysis of provider counts in each of the specialties before and after centralized scheduling implementation showed a mild increase in the number of gastroenterology providers but was otherwise insignificant. However, this analysis did not include any calculation or consideration of full-time equivalents. Future research would add additional variables through focused patient-surveys or incorporation of other contextual data to paint a more complete picture of factors affecting referral completion.

CONCLUSION

As attempts are made to improve access to care, it is important to ensure that these measures are having their intended effects. Where the centralized scheduling changes were most completely adopted, improvements in referral completion rates appear to have been the highest. Variable implementation fidelity and microenvironments within the different specialties, among other things, likely led to uneven findings across specialties, with some specialties failing to improve their completion rates significantly. There were similar uneven findings with racial equity and likelihood of completion of specialty referrals, hinting at currently unmeasured variables that might explain why the relative referral completion rates by race differs significantly across specialty. A more in-depth focus on the granular scheduling details—both past and present—of each specialty, along with characterization of patient socioeconomic factors, would help us better understand why we saw such divergent results for an organization-wide initiative and what needs to be done to ensure more consistent improvements to access to care with future interventions.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Electronic Vaping Product Use Among Adolescents in the Era of the COVID-19 Pandemic: An Updated Scientific Review for Clinicians

Pravesh Sharma, MD; Taharat Sheikh; Christopher Williams, MD

ABSTRACT

Introduction: In light of increased rates of hospitalizations among adolescents diagnosed with severe symptoms of COVID-19, as well as the prevalence of electronic vaping product (EVP) use among this population, this review highlights the public health and clinical implications of EVP use during an ongoing respiratory disease pandemic.

Objectives: This review assesses evidence of pulmonary effects of EVP use from pathophysiological and epidemiological research and explores EVP use as a risk factor for COVID-19.

Methods: An updated, yet concise, literature review of recent scientific evidence examining trends of EVP use among adolescents during the COVID-19 pandemic was conducted. Included in this review are studies examining the pulmonary effects of EVP use and scope of the problem relating to its use among adolescents within the context of COVID-19.

Conclusions: Preclinical and theoretical models establish pulmonary harm associated with EVPs. Based on the limited epidemiological studies, the contribution of EVP use to the risk of contracting COVID-19 is mixed. EVP-associated lung injury could present as a diagnostic challenge for clinicians during COVID-19 and requires greater attention. Clinicians should effectively screen for and discourage EVP use among adolescents.

INTRODUCTION

Electronic vaping products (EVP) are battery-powered devices that heat a liquid (e-liquid) to create an inhalable aerosol. The e-liquid in an EVP contains solvent propylene glycol (PG) and vegetable glycerin (VG) with flavorings. EVPs are often used with an optional addition of nicotine, tetrahydrocannabinol (THC) extract, or other addictive substances, thereby increasing the harmful effect of the vaped or inhaled aerosol.[1] The use of EVPs is commonly referred to as "vaping" or "juuling."[2,3] Aerosols from heated e-liquid containing PG and VG consist of more than 100 volatile organic compounds, such as propylene oxide, acrolein, acetaldehyde, and formaldehyde, with diverse toxic properties. Additionally, some studies have reported that potentially carcinogenic and teratogenic compounds, aldehydes, and heavy metals may be formed during the heating process of EVPs.[4]

During 2017-2018, a national survey noted an increase in EVP use of 78% (from 11.7% to 20.8%) and 48% (from 3.3% to 4.9%) among high-school and middle-school students, respectively.[5] The use of EVP-cannabis among high school students doubled from 2018 to 2019—the second-largest 1-year increase in the history of Monitoring the Future survey,[6] a nationwide survey by the National Institute on Drug Abuse deployed annually to adolescent students. The drastic increase in EVP use among younger people led the US Surgeon General to declare youth EVP use an epidemic in 2018.[7] On a positive note, the rapid increase of adolescent EVP use from 2017 to 2019 plateaued during early 2020. Factors that contributed to this pause were the emergence of the e-cigarette or vaping product use-associated lung injury (EVALI) epidemic during the summer of 2019 and a national media campaign that warned adolescents and young adults against EVP use.[8] US Food and Drug Administration policies restricting the manufacture and sale of certain EVP flavors, such as fruit and mint flavors,[9] and Tobacco 21 legislation[10] that increased the mini-

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mum age for the sale of tobacco products from age 18 to 21, also played a role in limiting EVP access to adolescents. Despite these regulations, mint and fruit flavors were still the most commonly used EVP flavors by adolescents in 2020.[8] Given that EVP content varies markedly and national surveys define EVP differently, prevalence rates of EVP use should be interpreted with caution.

EVP use among adolescents and young adults is especially concerning because nicotine, THC, and other potentially addictive substances are often used in the EVP e-liquid. These substances negatively affect the developing brain due to their ability to alter neurochemistry.[11] In addition, the use of addictive substances in this age group is correlated with future medical harms and psychiatric comorbidities.[12] Adolescents often use EVPs as a way of using cannabis because of easy concealment in public spaces.[13] The lack of awareness that exists among adolescents and young adults regarding the type of e-liquid they use is also problematic. A study found that 63% of youth were unaware that popular EVP "JUULL" contains nicotine and unknowingly used EVPs that contained nicotine.[14] These results suggest that self-reported data may not be accurate, and current data on the use of EVP nicotine among adolescents and young adults is likely underestimated.[15] Even though there has been a recent change in perceived risk,[8] a significant number of young people still perceive use of EVPs as less harmful, less addictive, and a healthier alternative to combustible or traditional cigarettes.[16-19] This misattribution of the level of danger leads to greater use of these products, potentially exposing users to harmful substrates. EVP manufacturing companies claim that their products assist in tobacco smoking cessation and, thus, reduce medical comorbidities associated with tobacco smoking, but mounting evidence suggests that many adolescents and young adults who use EVPs have never tried traditional cigarette smoking.[20,21] In addition, studies show that EVP use is associated with later smoking of tobacco cigarettes among nonsmokers,[22] and those who smoke cigarettes may continue to smoke cigarettes despite using EVPs.[23,24]

As society at large currently grapples with the COVID-19 pandemic, it is especially important to consider the implications that EVP use has on a disease that has deleterious effects on the lungs. In light of the increased hospitalization rates among young people diagnosed with severe symptoms of COVID-19, this review highlights serious yet preventable health risks of EVP use among adolescents amidst the COVID-19 pandemic. It will assist clinicians in initiating EVP use prevention and treatment efforts, in addition to current public health attempts to decrease EVP use.

Pulmonary Effects of EVP Use

In 2018, several youth including adolescents were diagnosed with EVALI. Their symptoms ranged from shortness of breath and fever to compromised lung function.[25] Approximately 95% of patients with EVALI were hospitalized, and one-fourth of those patients required intubation and mechanical ventilation.[26] A longitudinal analysis of Population Assessment of Tobacco and Health Waves 1, 2, and 3 (2013–2016) showed that individuals who use EVPs increase their risk of developing lung disease by about 30% compared with nonusers and that EVP use could be an independent risk factor for developing respiratory diseases.[27] Preclinical studies have demonstrated that, similar to tobacco cigarette smoke, EVP use is damaging to pulmonary structures and alters platelet function, resulting in alveolar airspace enlargement and disappearance of peripheral vasculature.[28] In addition, EVP use increases the inflammatory profile of respiratory pathogens through an increase in platelet-activating factor receptor expression, thus increasing susceptibility to pneumonia.

The first and only human trial to assess biological responses to EVP use among 10 never smokers and individuals without exposure history to EVP found that acute inhalation of EVP aerosols resulted in altered transcriptomes of small airway epithelium and alveolar macrophages for all subjects (with and without nicotine).[29] Mounting evidence suggests that the pulmonary effect of EVP use depends on its constituents in e-liquid. PG and VG are the solvent carriers for flavors and nicotine in e-liquids and are "generally regarded as safe" by the US Food and Drug Administration (FDA) when used in foods and cosmetics. In animal models, however, heated PG and VG lead to increased inflammatory infiltrates, cytokine production, lung infections, reactive oxygen species, and gene expression.[30] To assess the effects of EVP use with only PG and VG (no nicotine or flavors) on human lungs, Song et al conducted a series of bronchoscopies over 4 weeks in never smokers (n = 30), where subjects were randomized to 2 groups (intervention or no-use control group) and found that intervention (PG and VG) did not exhibit change in mRNA or miRNA gene expression. In addition, no significant differences were observed in changes in bronchoalveolar lavage fluid inflammatory cell counts or cytokines between baseline and follow-up, comparing the control and intervention group.[31]

EVP-Associated Lung Injury During COVID-19 Pandemic: A Diagnostic Dilemma

The symptomatic (pulmonary, gastrointestinal, and constitutional symptoms), radiological (bilateral multifocal ground glass opacities), and laboratory results (inflammatory markers) showing similarities between EVALI and COVID-19 present a unique diagnostic dilemma. Several cases have been described in the literature highlighting these diagnostic challenges.[32,33] These similarities emphasize the importance of eliciting history of EVP use and a high index of suspicion for EVALI in adolescents who present with unexplained respiratory distress while excluding COVID-19. Highlighting these complexities and diagnostic challenges, physicians should counsel their patients—especially adolescents—against using EVP.

EVP Use a Risk Factor for COVID-19?

Recent evidence shows that smokers and chronic obstructive pulmonary disease (COPD) patients are shown to be at a higher risk of contracting COVID-19 infection due to increased expression of angiotensin-converting enzyme II (ACE-2) expression (cellular entry receptor used by the SARS-CoV-2 virus that causes COVID-19) in small airways, which is mediated by α7-subtype nicotinic receptors (α7-nAChR).[34] The detrimental effects of EVP use on lung function and structure described above and the association between nicotine/tobacco and ACE-2 raised concerns that EVP use also may increase the risk and severity of COVID-19.[35] To explore this particular association, Lee et al compared a cohort of EVP users (with and without nicotine and flavorings) and tobacco smokers based on ACE-2 expression and inflammatory response. They found that, as reported in prior studies, tobacco cigarette use increased ACE-2 expression, but EVP use—irrespective of nicotine status—did not increase the expression of ACE-2, a finding that differs from prior preclinical studies. Of note, however, EVPs with only nicotine/flavor, as opposed to nonflavored and nonnicotine-containing, led to cytokine dysregulation and potential inflammasome activation.[36]

Epidemiological studies examining the association of EVP use and development of COVID-19 infection are limited. The studies that exist vary markedly in their findings and are limited in scope to studying the risk of contracting COVID-19 infection and not the severity of the illness. For example, a cross-sectional study conducted among US adolescents and young adults aged 13–24 years showed that ever EVP-nicotine users—but not current users—were 5 times more likely to be diagnosed with COVID-19.[37] Conversely, a study conducted among individuals >18 years old in the United Kingdom found no difference in self-reported COVID-19 infection between never, current, and past-EVP users.[38] Two other US studies reported conflicting findings as well.[39,40] Larger epidemiological studies and meta-analysis would be helpful to confirm theoretical models to examine this association and to better guide clinicians.

Pattern of EVP Use During COVID-19 Pandemic

A cross-sectional study among adolescents and young adults conducted in May 2020 found that half of the participants (56.4%) reported changes in their EVP use since the beginning of COVID-19 pandemic. Out of those who reported a change, one-third quit EVP use, another third reduced EVP use, while the rest switched to another nicotine or cannabis product.[41] Another study among adolescents compared past 30-day EVP use before (January 1–March 13, 2020) and after (March 14–June 29, 2020) stay-at-home directives during the COVID-19 pandemic and found that EVP use was significantly lower during the stay-at-home directives.[41] Decreased accessibility to EVPs because of stay-at-home orders and closed shops during the pandemic were the most-cited reason in aforementioned studies.[41,42] The results of these studies show that access to EVP is one of the major determinants for EVP use among adolescents and young adults. Interventions to limit access to underage youth may accelerate a downward trajectory of adolescent and young adult EVP use.

Management of EVP Use Among Adolescents

To date, no published randomized trials exist for vaping cessation among adolescents. A variety of treatment strategies exist for smoking cessation among adults, including behavioral and pharmacotherapy. However, relevance of these guidelines in relation to EVP use cessation among adolescents still needs to be investigated. EVP use treatment strategies are complicated because of varying motivation to quit and willingness to enter an EVP cessation program, diverse EVP use patterns and nicotine level in devices, and co-use of other substances. Discussions with young people on the reasons that motivate them to use EVPs could be helpful. For example, some adolescents use EVPs to socialize, some use them to quit smoking cigarettes, and some perceive EVP use as less harmful than smoking cigarettes. Interventions identifying these subgroups and targeting the reasons that motivate them to use EVPs through education and involving support services were found to be helpful.

CONCLUSION

The correlation between EVP use and COVID-19 is mostly drawn from preclinical and theoretical models. Based on current but limited epidemiological research, the evidence for EVP use as a risk factor for COVID-19 is mixed. Large-scale epidemiological studies are needed to concretely establish the association between EVP use and occurrence of COVID-19. From a clinical standpoint, since COVID-19 respiratory failure and respiratory failure due to EVALI have many overlapping clinical presentations, clinicians need to be vigilant when managing these cases and thoroughly discuss EVP history with patients—especially adolescents and young adults. The existing evidence demonstrates the need for clinicians to screen for EVP use among adolescents and educate them about potential harms associated with use, especially during the ongoing pandemic.

Financial Disclosures: Dr Sharma receives research funding and support from Mayo Clinic and Mayo Clinic Health System.

Funding/Support: None declared.

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Adverse Childhood Experiences: Perceptions, Practices, and Possibilities

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ABSTRACT

Background: Adverse childhood experiences are negative life events occurring in childhood that can have long-term health effects. Many health professionals do not receive formal education surrounding childhood trauma, and few providers screen for adverse childhood experiences.

Objective: This scoping review examines how current literature describes the perceptions, attitudes, and practices of health professionals and trainees regarding childhood trauma, identifies educational opportunities aiming to increase awareness for child trauma, and discusses screening for adverse childhood experiences.

Methods: PubMed, PsycInfo, and Google Scholar were used to find articles. Key search terms included "adverse childhood experiences" or "ACEs," combined with terms such as "screening implementation," "Education, Professional" (Medical Subject Headings [MeSH]), "Education, Medical, Graduate" (MeSH), "Curriculum" (MeSH), "Health Knowledge, Attitudes, and Practices" (MeSH), and "Attitude" (MeSH).

Results: A large proportion of providers and trainees are unaware of the effects of adverse childhood experiences. Training opportunities can increase knowledge about adverse childhood experiences and promote trauma-informed care practices. However, the long-term effects of these trainings remain largely unexplored. Barriers such as a lack of time, resources, comfort, or consensus regarding how to ethically screen impede broader efforts to implement systematic screenings for adverse childhood experiences.

Conclusions: Adverse childhood experiences are a public health concern. However, health professionals and trainees are undereducated about their pervasive effects. Further research is needed on how to better educate health professionals about adverse childhood experiences and trauma-informed care. Adverse childhood experiences screenings could promote the early identification of childhood trauma, yet the ethics and effectiveness of screening must be further studied.

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INTRODUCTION

Adverse childhood experiences (ACE) are defined by the Centers for Disease Control and Prevention (CDC) as an array of harmful exposures occurring from birth to age 17 that may negatively impact one's physical and mental well-being, as well as one's future social and economic opportunities.[1] In 1998, the landmark ACE study by Felitti et al[2] was published, outlining 10 ACEs relating to the categories of abuse, neglect, and household dysfunction: physical, sexual, and emotional abuse; physical and emotional neglect; and family member incarceration, mental illness, substance abuse, divorce, and intimate partner violence. While there has been previous literature about topics relating to ACEs, such as "childhood trauma," "early life adversity," and "toxic stress," the landmark ACE study was the first of its kind to use the language of "adverse childhood experiences." In this study, researchers found that more than half of respondents reported at least 1 ACE, and they found a graded relationship between the number of categories of childhood exposure and future adult risk behaviors and disease.[2] Increased ACE exposure was linked to increased risks for chronic conditions, including heart disease, diabetes, obesity, stroke, and cancer. In addition, this study concluded that ACEs increased one's risk for mental health conditions, such as depression and suicidality. Subsequent research has revealed that children who experience ACEs have decreased graduation and

Table 1. Overview of Short-Term ACE-Specific Educational Opportunities

Study/Year	Population	Design	Intervention	Outcome
Olsen, Warring[12] 2018	ADN students	Mixed-methods approach using quasi-experimental pretest-posttest design; thematic analysis of focus group data measured IPE effect on ACE knowledge	Experimental: 18 students participated in 4-hour IPE seminar featuring ice-breaker, documentary, guided discussion, and interprofessional panel Control: 17 students received usual instructional activity (viewing documentary on childhood trauma) followed by discussion	Qualitative analysis focused on impact of IPE on ACEs knowledge 4 themes emerged: knowledge of ACEs increased as a result of learning activity; trust and idealized care is essential; desire to know more about ACEs; and need for community education, funding, and resources
Pearce et al[23] 2019	Health, social care	Qualitative interviews conducted from participants at 4 pilot sites; data analyzed using thematic analysis	7 health and social care practitioners underwent both the 2-day, REACh in-person training with regular follow-up sessions with REACh trainers and participated in an interview	Emerging themes: positive change in knowledge and practice; emotional impact of disclosures; confidence in asking about ACEs and responding appropriately; understanding impact of ACEs on clients; understanding how and when to ask about ACEs
Pletcher et al[22] 2019	Medical students	Post-workshop, multiple choice assessment tested for ACE knowledge; online evaluation of workshop conducted 9-10 months later	During 2016-2019, 535 1st-year medical students participated in a 3-hour workshop followed by facilitated case discussion in small groups exploring ACE survey tool and resilience questionnaire	Average grade on post-session quiz was 95% in 2018 (range 60%-100%); average in 2019 was 96% (range 58%-100%) (SD = 0.92) Evaluations: A majority felt that learning objectives for ACE workshop were met to a considerable/very high degree. Students largely felt their knowledge improved and that additional training would be beneficial
Randall et al[13] 2020	PT, OT students	Pretest-posttest survey of training; quantitative and qualitative data analyzed	26 PT and OT students completed PATH, a 4-hour, simulation-based training featuring lecture, presentation of PATH model, standardized patient encounters and simulations, and debrief	Results showed increased scores from pre- to posttests for PT and OT students regarding self-efficacy ($P = 0.005$), hope ($P = 0.001$), and knowledge of ACE and TIC ($P < 0.001$) Qualitative analysis: Students appreciated participating in training model, learned from their experiences, noted they would like more instruction on how to work effectively with patients who have ACE history
Schmitz et al[10] 2019	Pediatric residents	Pretest-posttest survey of module using 5-point Likert scale	91 residents completed a 25-minute module about ACEs, TIC, toxic stress, and resiliency during their child advocacy and protection rotation; 29 residents completed presurvey, 11 residents also completed post-survey sent out 1-3 months after their rotation	Presurvey results demonstrated residents were not confident discussing ACEs, TIC, or resiliency (median = 2). Despite perceived importance of having these discussions with families (median = 5), they rarely occurred in clinic (median = 1 or 2) Matched pre/post data showed significant increases in knowledge, confidence, discussion frequency
Stefanski, Mason[25] 2017	Pediatric residents	2-part curriculum followed by written feedback regarding curriculum	18 2nd- and 3rd-year pediatric residents participated in a pilot 2-part curriculum with online module and 1-day workshop	Feedback themes: Surprise at high prevalence of ACEs; positive attitudes toward interactive activities and resources; current need to provide resources to families and have more frequent conversations with families regarding ACEs The most common practice change residents reported was more systematically screening patients for ACEs; follow-up survey needed to track long-term changes
Strait, Bolman[21] 2017	Graduate health students	Pretest-posttest survey of workshop	967 graduate students from 9 health professions programs at 2 campuses participated in three 2-hour IPE workshops on ACEs and TIC: lectures, discussion, and simulation	Results showed increases in students "extremely likely" to administer and assess ACE questionnaire (13.6% of respondents pre-curriculum vs 42.0% post-curriculum) Confidence levels in helping a patient with trauma history increased. Those reporting feeling "somewhat confident" increased from 37.3% on pre-curricular survey to 67.5% on post-curricular survey Participants who voluntarily assessed their ACE score had increased familiarity with clinical and scientific findings of ACE study ($P < 0.001$) and familiarity with TIC ($P < 0.02$)
Wen et al[14] 2014	Primary care residents	Qualitative online survey conducted 2-5 months after training	59 residents from family medicine and internal medicine residency programs participated in PATH, a simulation-based training 4-hour program	Of 32 respondents, a majority agreed that PATH training enhanced understanding of ACEs (64.5%), reflected realistic encounters (68.8%), and helped apply concepts and principles in practice (65.6%) Most noted that faculty feedback from simulation was helpful (77.4%) and planned to implement skills learned through simulation in clinical practice (62.5%)

Abbreviations: ACE, adverse childhood experience; ADN, associate degree in nursing; BSN, bachelor of science in nursing; IPE, interprofessional education; OT, occupational therapy; PATH, Professional ACE-informed Training for Health Professionals; PT, physical therapy; REACh, Routine Enquiry into Adversity in Childhood; TIC, trauma-informed care.

employment rates, inhibiting their economic opportunity and creating profound costs for society at large.[1]

Current survey data of adults in the United States suggest ACEs are common today. In fact, over 60% of adults surveyed have experienced at least 1 ACE, with nearly 25% having experienced 3 or more.[1] It is important to note the inequitable burden of ACEs, especially among low-income families and children of racial or ethnic minority groups.[3] Screening is one way to provide early identification of individuals who may have experienced ACEs. However, ACEs are not routinely screened for in pediatric clinics.[4] The purpose of this literature review is to (1) examine the knowledge, attitudes, and perceived barriers of medical students, residents, and clinicians regarding ACE education or screening, (2) identify educational opportunities implemented to increase ACE awareness and to change attitudes and behaviors toward ACE screening, (3) provide an overview of studies that have implemented ACE screening for pediatric populations within clinic settings, and (4) explore benefits and cautions associated with ACE screening.

METHODS

The primary database used for this scoping review was PubMed. All selected articles were written in English. There were no restrictions on the publication dates of articles. However, since the study of ACEs is a relatively new field, most articles were published within the last 5 years. Articles were found using the search terms "adverse childhood experiences" or "ACEs," in combination with terms, including "screening implementation," "Education, Professional" (Medical Subject Headings [MeSH]), "Education, Medical, Graduate" (MeSH), "Curriculum" (MeSH), "Health Knowledge, Attitudes, and Practices" (MeSH), and "Attitude" (MeSH). PsycInfo and Google Scholar were used as supplementary databases to find any pertinent articles or gray literature not found in PubMed. A medical librarian provided consultation prior to the article screening process. One investigator conducted all searches and article screenings. Unclear articles were discussed with another investigator. Articles were organized based on research findings and central themes.

RESULTS

Knowledge, Attitudes, and Perceived Barriers toward ACEs Screening

Even though the original ACE study was published over 20 years ago and current literature outlines the long-term effects of ACEs on health, various studies demonstrate disparities in familiarity with ACEs among health care trainees and professionals. For example, a study in Michigan revealed that over 80% of participants had never heard of the ACE questionnaire.[5] Research shows that knowledge of ACEs, perceived importance of ACEs, and attitudes toward ACEs influence whether or not health care professionals screen for ACEs in their practice.[4,6] A previous study found that the frequency of ACE screening was associated with factors such as one's medical specialty and one's knowledge about the impact of ACEs on physical health.[7] In addition to a lack of knowledge, health care professionals frequently experience conflicting attitudes toward ACE screening. Many clinicians have a basic understanding of the effects of ACEs and believe it is their role to screen for ACEs.[8] However, health professionals often report feelings of inadequacy or fear in regard to discussing ACEs and, as a result, may avoid the topic with patients.[6] Likewise, though clinicians often desire to screen for ACEs, very few do so regularly due to numerous barriers.[4,5] In addition to a lack of knowledge or confidence, commonly reported barriers include a lack of time,[5-9] referral resources,[6,7] proper screening tools and guidelines,[4] adequate reimbursement for screening,[9] and larger organizational support.[6]

ACE Educational Opportunities

Across health disciplines, there are clear gaps in knowledge regarding ACEs and barriers that prevent health professionals from incorporating ACE awareness into a trauma-informed practice. In order to address these challenges, numerous studies have implemented educational opportunities to assess their effects on changing student and provider thoughts, attitudes, and practices regarding ACEs. Some opportunities were short-term ACE-focused training, using either online or in-person platforms. Other short-term ACE trainings were incorporated into larger training sessions focused on trauma-informed care (TIC). Finally, there has been some initiative to integrate ACE education longitudinally into health care-related curriculums.

When searching the literature, ACE-specific educational opportunities were presented in various short-term formats (Table 1). Knowing that health professionals already have busy schedules that do not always allow for in-person training, online modules are 1 strategy to disseminate ACE education to a wide audience. One study demonstrated that a simple, 25-minute online module was effective at increasing participants' knowledge, confidence, and discussion frequency of ACEs.[10] However, most ACE educational opportunities were provided through in-person experiences, as participants enjoyed learning in interactive, small-group sessions.[11] An interprofessional education seminar may be another useful format to help facilitate discussion and collaboration among professionals of various backgrounds about ACEs and their impact on well-being.[12] In order to boost student engagement, various health professional programs have implemented simulations into their ACE trainings.[13,14] Simulations can be an effective strategy because they give participants the opportunity to learn how to have conversations with patients about ACEs and their effects on long-term health goals, as well as engage in collaborative decision-making about treatment plans. This may help mitigate feelings of inadequacy or fears when discussing trauma.

In other cases, ACE educational opportunities were incorporated into TIC trainings (Table 2). The National Child

Table 2. Overview of Short-Term ACEs and TIC Combined Educational Opportunities

Study/Year	Population	Design	Intervention	Outcome
Cannon et al[16] 2020	Undergrad/ graduate students	Pretest-posttest survey of curriculum; quantitative/qualitative data analyzed	TIC intervention provided in a 75- to 160-minute lecture/discussion with voluntary surveys conducted immediately before and after lecture; 128 students completed both surveys	Content improved nursing students' knowledge ($P<0.001$), attitudes ($P<0.001$) and skills related to providing TIC $P<0.001$). TIC curriculum was acceptable for undergraduate and graduate students and was transferable to non-nursing students
Dueweke et al[11] 2019	Pediatric residents	Pretest-posttest survey of training; chart review to assess screening changes; follow-up interviews for qualitative analysis	33 residents completed 2-hour, in-person training; 9 residents selected for follow-up interviews regarding training	Residents reported increases in favorable attitudes ($P=0.065$) and perceived competence ($P<0.001$) and decreases in perceived barriers ($P=0.001$ to 0.521) to implementing TIC Chart reviews revealed increase in completed trauma screens ($P<0.001$) but no difference in referrals for mental health services ($P=0.200$)
Elisseou et al[17] 2019	Medical students/ faculty	Pretest-posttest survey of curriculum using 5-point Likert scale	148 1st-year medical students and 40 faculty engaged in a 3-hour, in-person course featuring group lecture with standardized patient and small group clinical skills practice	5-point scales evaluated students' knowledge gained from session and overall satisfaction. Satisfaction with session was rated 4.08 (SD = 0.81); students indicated that session was highly effective in defining trauma-informed physical examination (4.29, SD = 0.70)
Goldstein et al[18] 2018	Medical students	Qualitative assessment of training using 5 open-ended questions delivered after training	20 students completed three 2-hour, in-person workshops featuring lectures, discussion, and simulation practice	From students' perspectives, the course increased their ability to recognize various clinical manifestations of ACE exposure in adult patients. Students learned how to ask about and respond to ACE disclosures and identify necessary resources to responsibly implement TIC in medical settings
Niimura et al[19] 2019	Mental health pros	Pretest-posttest design with 3-month follow-up assessment	65 mental health professionals completed a 4.5-hour, in-person training featuring lecture and group discussion; 56 participants completed 3-month follow-up assessment	Mean score of the Attitude Related Trauma-Informed Care scale scores increased from 5.1 during pretraining to 5.5 immediately after training (mean difference: 0.4; 95% CI, 0.3–0.5) and 5.4 after 3 months (mean difference: 0.3; 95% CI, 0.2–0.4) 48% of participants claimed to have implemented TIC practices in daily clinical settings at 3-month follow-up.
Shamaskin-Garroway et al[20] 2020	Primary care clinicians	Pretest-posttest survey of curriculum	21 primary care clinicians participated in five 1-hour interprofessional sessions featuring lectures, group reflections, and skills practice	Results showed increased self-reported knowledge ($P<0.001$), trauma-informed attitudes ($P<0.001$), and self-reported trauma-informed practice ($P<0.001$) Qualitative feedback: Role play and interactive exercises were helpful; training aided in delivery of patient-centered care

Abbreviations: IPE, interprofessional education; TIC, trauma-informed care. prof, professionals.

Traumatic Stress Network defines a traumatic experience as "a frightening, dangerous, or violent event that poses a threat to a child's life or bodily integrity."[15] These experiences can initiate strong emotional and physical reactions that can have enduring negative effects throughout a child's lifespan if not addressed. While ACEs are not equivalent to trauma, many are considered traumatic. As such, conversations about ACEs recently have been incorporated into interventions centered around TIC. Most of these TIC sessions were either incorporated into a class lecture[16,17] or formatted into a short-term training.[11,18-20] One TIC training by Goldstein et al[18] was short-term, yet comprehensive. This curriculum connected education on ACEs with ways to integrate that knowledge into a trauma-informed practice. Each participant also completed their own ACE and resilience questionnaires. Research has shown that voluntarily assessing one's own ACEs score is associated with increased knowledge and awareness of ACEs and TIC practices.[21] Another innovative educational strategy is teaching medical students how to perform a trauma-informed physical examination, in addition to providing traditional background information on different forms of trauma and their effects on health.[17]

Short-term ACEs education offers several benefits. Studies have shown that after an ACE training experience, participants felt more confident in their knowledge of ACEs and their effects on health.[22-24] ACE education also can lead to greater implementation of systematic ACE screening practices.[25] Even if systematic screening practices were not implemented, participants commonly stated that ACE training increased their confidence when asking about ACEs and when responding to patients who disclosed a history of trauma.[18,22,23] Short-term TIC trainings also led to perceived increases in knowledge, attitudes, and skills among participants in regard to recognizing the signs of trauma and establishing practices that are sensitive to patients with histories of trauma.[11,16-20] One study found that TIC trainings helped participants view TIC

as a "standard precaution," assuming that all patients may have experienced some sort of trauma in their lifetime.[16] Another study noted that 3 months following a TIC training, half of the participants continued to implement TIC practices using TIC principles to assess patient behavior and to communicate more effectively.[19]

Barriers for Education

One existing barrier has been integrating ACE knowledge into clinical settings to potentiate trauma-informed and multidisciplinary practices.[22] Another study utilized pre- and post-training surveys to explore the effectiveness of a TIC training and found that the training was associated with positive changes to residents' attitudes regarding the importance of TIC, increased comfort when interacting with families who may have experienced trauma, and increased documentation of trauma screening practices. However, the training did not significantly impact the number of patient referrals made for psychological/psychiatric services.[11] This could be due to noted barriers, including a lack of affordable referral resources, time, and institutional support for implementing coordinated TIC models.[18,24] In addition, many participants reported an interest and a need for additional training to further increase their confidence in practicing and advocating for TIC models in health care systems.[13,16-18,22,24] Some suggestions for enhancing ACE and TIC trainings include adding additional interactive components, hearing perspectives of trauma survivors, and reviewing more practical examples of how to incorporate TIC principles into one's clinical practice.[16]

Another consideration is that ACE screening tools are often introduced into academic medical settings by residents and faculty who are passionate about this emerging field. While this enthusiasm is catalyzing important screening efforts, ACE education must consider provider turnover, including residents, nursing staff, and medical students. To address the increased interest in learning about ACEs, some programs are beginning to integrate ACE education into health professional curriculums. One bachelor of science in nursing program has created an outline for integrating ACE knowledge into specific nursing classes over the 5-semester program.[26] Though this program is still in the evaluation phase, it may serve as an outline for how other programs can thread ACE education into existing health professional curriculums.

Finally, when considering implementing ACE or TIC educational opportunities, the curriculum itself should be created in a trauma-informed way—noting that participants themselves may have experienced trauma. Previous research has shown that if participants' histories are not considered, training of this nature may trigger retraumatization in participants, leading to secondary traumatic stress symptoms.[27] Trainings could aim to avoid this by allowing students to excuse themselves at any point during the training or by providing counseling or other support services during and/or after training sessions. Another limitation of ACE or TIC educational opportunities is that while they effectively gauge short-term changes in participants' knowledge and attitudes, it is more challenging to know if these trainings have long-term effects on their knowledge, attitudes, and practices in health care settings.

ACE Screening Implementation

Numerous screening tools have been developed to assess for ACEs among children and families. A study by Bethell et al[28] identified 14 ACE assessment tools appropriate for screening children or adult populations, only 5 of which were designed for clinic settings. These screenings are not intended to diagnose patients but instead to initiate conversations with families about the importance of building safe, nurturing relationships and promoting resilience. In addition, a recent study by Oh et al[29] identified 32 tools to measure childhood adversity, 14 of which were recommended for clinic settings based on time, cost, and training requirements. Of those 14 recommended screeners, 4 outlined the validity and reliability of each screener. However, no specificity and sensitivity measures were reported.

The development of an array of ACE screenings demonstrates the concern for how child trauma affects development and future health outcomes. Despite growing interest in incorporating ACE screening into primary care practices, clinic settings have been slow to investigate ACE screening feasibility and acceptability. This could be due to the numerous decisions that must be made, including which patients to screen, which questionnaire to use, and how to conduct ACE screening within the context of a clinic visit. Clinics that have piloted ACE screenings demonstrate this range of variability. For example, some clinics screened expecting parents for their ACEs, in order to discuss the role of toxic stress on child development and the role of positive parenting in promoting healthy child development and preventing the continuation of intergenerational trauma.[30,31] Other studies screened for ACEs in child and adolescent patient populations to talk not only about how trauma affects one's health, but also to discuss the role of protective factors in promoting youth resilience.[32-40] Finally, a few studies screened adults on their past childhood experiences to gain better insight on how child trauma may have affected their current health status.[34,41,42] In addition, some studies implemented a paper or electronic version of an ACE questionnaire; others preferred verbal inquiry.[39]

The focus of this literature review was to identify ACE screening implementation studies specifically in pediatric populations (Table 3). When looking at this subset of studies, most researchers implemented ACE screening in the format of a questionnaire. The original ACE study was used often as the foundation for these types of questionnaires. Other screenings expand upon these original ACEs by adding other community and environmental factors—such as poverty, food insecurity, and discrimination—that may cause adversity in a child's life. Finally, some screening tools are distinct from the original ACE questionnaire; however, they inquire about similar themes relating to child

Table 3. Overview of ACE Screening Implementation for Pediatric Populations

Study/Year	Clinic	Patient Population	Intervention	Outcome
Choi et al[32] 2019	Urban, FQHC	Children ages 3-16, screen completed by caregiver if child ≤12 years	TESI for Primary-Care ACE Screening (24 questions for youth, 27 questions for caregiver)	261 children screened. Adapting TESI as a primary care screener had face validity because mapping demonstrated geographic overlap between participant-reported ACEs and objective violent-crime data. Screen identified 3 ACE subgroups. Children in highest group had higher odds of a clinically significant Pediatric Symptom Checklist score (OR = 3.83) and clinical-level attention problems (OR = 3.58), even after accounting for child resilience and parent depression.
DiGangi, Negriff[33] 2020	6 pediatric primary care clinics in urban settings	Children ages 3, 5, 10, and 13, completed by caregiver if child <13 years	Original ACE screen with wording from CYW screen	Since July 2018, 3241 three year olds (53% of target population), 2761 five year olds (53%), 545 ten year olds (37%), and 509 thirteen year olds (13%) were screened. 15% of 3 year olds screened had ACE score ≥1; 17.5% of 5 year olds had ACE score ≥1; 30.5% of 10 year olds had ACE score ≥1; 33.8% of 13 year olds had ACE score ≥1. Screening was feasible, but challenges include providing follow-up care to those who screen positive.
Eismann et al[43] 2019	3 primary care clinics in mixed urban, suburban, and rural settings	Children ages 0-5, screen completed by caregiver	SEEK Parent Questionnaire: screens psychosocial risk factors	All clinics successfully implemented SEEK. Screening completion rates ranged from 75% to 93% and brief intervention rates ranged from 61% to 81%. Major parental stress (14%) and food insecurity (11%) were most commonly noted. Qualitative interviews revealed that providers found SEEK worthwhile for improving knowledge and ability to address psychosocial concerns and provide whole person care. Barriers included limited time/resources, incomplete resource knowledge, and lack of follow-up.
Kia-Keating et al[35] 2019	Urban, community medical clinic	Infants ages 3-11 months and their parents	Adaptation of CYW ACE Questionnaire	Feasibility data indicated that 92% of eligible patients were screened for infant and parent ACEs. Of families who screened positive, 77% accepted prevention services. Qualitative interviews with providers affirmed screening acceptability.
Koita et al[36] 2018	Urban, pediatric care clinic	Children under age 12, screen completed by caregiver	Pediatric ACE and other Determinants of Health Questionnaire (17 questions)	Screen piloted with 28 caregivers. Cognitive interviews conducted among caregivers and 16 health providers and clinic staff resulted in wording changes and addition of examples in items to increase face validity. Questionnaire acceptability was high. Preference for administration methods was split between tablet and paper formats. The final screener had high face validity and acceptability for use within primary care settings. Final screener is being validated, which will allow for broader implementation.
Marie-Mitchell et al[39] 2019	Urban, pediatric resident clinic	Children 0-11 years	WCA: expanded ACE questionnaire	Implementation of WCA occurred over course of 6 improvement cycles that involved obtaining and responding to stakeholder feedback, streamlining paperwork and workflow, and providing physician education. 1100 charts from well-child visits were reviewed. Use of WCA increased identification of multiple ACEs vs no screening and revealed reports of multiple ACEs increased with age. WCA provides acceptable, feasible way to screen for ACEs in pediatric settings.
Marie-Mitchell. O'Connor[38] 2013	Urban, FQHC	Children ages 4-5, screen completed by caregiver	6- or 7-item ACE screen	102 children screened. Adjusted odds of behavior problems were higher for children with higher vs lower 7-item Child ACE score (aOR 3.12; 95% CI, 1.34–7.22), as were odds of developmental delay (aOR 3.66; 95% CI, 1.10–12.17), and injury visits (aOR 5.65; 95% CI, 1.13–28.24), but lower for obesity (aOR 0.32; 95% CI, 0.11–0.92). Both tools were brief and results were readily accessible in medical chart. Thus, screening for child ACEs can be feasible in pediatric practice.
Marsicek et al[37] 2019	Urban, pediatric resident continuity clinic	Children ages 9 mos through adolescence, screen completed by or in presence of caregiver	CYW screening: 10 original ACE questions and 7 or 9 other questions about additional adversities depending on child's age	1,206 patients screened. Screening for ACEs increased from 0% to 60%. Standardized ACE screening can be implemented in a general pediatric clinic. Barriers include increasing comfort when discussing ACEs with families and increasing resources for children who have experienced ACEs.
Selvaraj et al[40] 2019	4 academic pediatric primary care clinics in urban settings	Children ages 2 weeks to 17 years, completed by caregiver	ASK Tool: 13-question assessment for 6 unmet social needs, 6 ACEs, and resilience	2569 families completed screen: 49% reported ≥1 stressor; 6% had ≥1 ACE; 47% had ≥1 unmet social need. At 1 site, community referral rates increased from 2.0% to 13.3% ($P < 0.0001$) after screening implementation. Screening implementation was feasible and acceptable to families.

Abbreviations: ACE, adverse childhood experience; aOR, adjusted odds ratio; ASK Tool, Addressing Social Key Questions for Health Questionnaire; CYW, Center for Youth Wellness; FQHC, Federally Qualified Health Center; SEEK, Safe Environment for Every Kid; TESI, Traumatic Events Screening Inventory; WCA, Whole Child Assessment.

trauma. For example, a study by Eismann et al[43] successfully implemented the Safe Environment for Every Kid (SEEK) model addressing psychosocial risk factors for maltreatment across primary care settings. This evidenced-based screening is designed for children ages 0-5 years, and it screens for 3 ACEs (parental depression, parental substance abuse, and intimate partner violence), as well as other risk factors. While the implementation of ACE screening varies with each study, they all demonstrated that this type of screening is acceptable and feasible for pediatric clinic settings. For example, 1 study successfully screened 92% of eligible patients.[35] Another study demonstrated that both providers and patients felt that ACE screening was acceptable.[36] Importantly, caregivers stressed that having a trusting relationship with their provider made conversations about childhood trauma more comfortable.

ACE Screening Cautions and Possibilities

The American Academy of Pediatrics states that identifying children who are at high risk for toxic stress is the first step in providing them with the appropriate support they need to thrive. As such, the American Academy of Pediatrics recommends screening for toxic stress but does not recommend a specific screening tool.[44] In fact, there is controversy about whether or not screening for ACEs is feasible and ethical. First, there is a lack of consensus about which childhood events are considered ACEs. Some studies only screen for the 10 original ACEs from Felitti's study, but other researchers are calling for the expansion of the idea of adversity to include community factors, such as racism, witnessing violence, bullying, and involvement in foster care.[45] Furthermore, ACE screeners typically report a cumulative score for the total number of ACEs a child has ever experienced. This is a relatively simplistic model that fails to assess for the frequency, intensity, or chronicity of different exposures.[46] Historically, an ACE score of 4 or greater has been identified as high risk; however, even children with a single traumatic exposure may need supplementary resources depending on the degree of trauma and existing support.[47] In addition, there are concerns that completing an ACE screening may cause discomfort or even retraumatize a child or caregiver. There is a growing body of evidence, however, demonstrating that patients are largely comfortable being asked these questions.[48] Finally, screening children for histories of trauma could increase the risk for the "expectancy effect," in which adults look for negative behaviors as confirmation of the poor outcomes predicted by an ACE screening.[47] One way to combat this concern is to reiterate that ACE screening is not a diagnostic tool. Instead, it is intended to begin a conversation with families about how trauma can affect child development. This conversation ultimately should be strength-focused by emphasizing how to best prevent trauma or mitigate the effects of trauma through various protective factors.[28] Research has shown that protective factors, such as having a supportive family, trusting mentors, and safe places to learn, live, and play, are crucial in buffering the effects of trauma.[3] This conversation focused on strengths rather than deficits could be facilitated if ACE screenings were coupled with screenings that look for protective factors.

Regardless of how ACE screenings are designed, there are still concerns about whether or not screening for ACEs is ethical. Typically, screenings are conducted to help aid in early identification of risk factors to prevent the development of a disease. However, there is still little longitudinal evidence for whether or not screening children for ACEs leads to decreased risk for developing chronic conditions in the future.[49] Some researchers argue that screening for ACEs may be unethical if the community does not have the proper resources to meet the needs of children who have experienced them. One way ACE screening could be implemented more ethically and effectively—while also acknowledging that structural inequities disproportionately place racial and ethnic minority youth at higher risk for experiencing ACEs—is through the use of wellness navigators. In a study by Barnett et al,[50] wellness navigators ensured that ACE screenings were conducted and documented, assessed families for their needs, and helped families make referrals to appropriate community resources. These wellness navigators often more accurately reflected patients' cultural and linguistic backgrounds, helping establish trust with patients and ultimately allowing the navigators to better provide holistic care for families.

DISCUSSION

The CDC recognizes ACEs as a serious public health problem with enduring effects throughout one's life.1 As such, it is imperative that trainees and health professionals are aware of the detrimental effects of ACEs. This literature review reveals that, to date, many health care providers lack knowledge about the effects of child trauma on future health outcomes. This lack of knowledge may contribute to negative attitudes or apprehension about screening for ACEs or advocating for greater TIC practices. While an increasing body of evidence supports the use of educational training to help change student and provider perceptions, attitudes, and practices regarding ACEs, TIC, and resilience, most of these trainings are short-term and are designed without a control group. As such, it is challenging to conclude whether educational training leads to long-term behavioral changes. Moving forward, ACE education should be incorporated in a way that is sustainable and enduring, so that incoming residents, medical students, nurses, and other team members are able to provide TIC that ensures patient comfort and care continuity.

The effects of ACEs are pervasive, and they have lasting effects on the well-being of children in our communities. As such, formal education about ACEs and TIC for health care professionals is a paramount first step in combatting this public health

crisis. For communities that have resources to support struggling families, we recommend the implementation of ACE screening in health care settings. While we recognize the limitations of screening, it serves as a means for early identification of children who may be experiencing negative effects from early life experiences. In communities where resources are not available to support interventions for patients with positive ACE screens, health care providers should advocate for continued development and expansion for resources to support implementation of screening in the future. The potential harms associated with screening pale in comparison to the harms associated with continued ignorance of ACEs.

Future longitudinal research is needed to better understand if early screening and appropriate interventions lead to better health outcomes for youth who have experienced ACEs. It will be imperative to critically compare the utility and acceptability of different interventions aimed to prevent or mitigate the effects of ACEs. Finally, research will be needed to assess if early interventions to address ACEs are cost-effective by reducing future burdens on the health care system. This cumulative body of future research will equip health professionals with information on how to most effectively screen for ACEs, how to treat children who screen positive, and how to sustainably integrate ACE screening and overall TIC as standardized procedures within health care systems.

While we conducted a broad scoping review, a limitation is that we were not comprehensive in discussing all potential research articles pertaining to the 4 main purposes of this review. Furthermore, it does not take into account any ACE educational curricula or ACE screening protocols currently being developed, implemented, or evaluated. We also acknowledge the limitations of only having 1 investigator conduct the searches for this review, as this could potentially increase the risk for a biased selection of articles. However, as this is a scoping review to identify knowledge gaps and to clarify research concepts and not a systematic review, bias in the article selection was less significant. This review provides a foundational framework for efforts that have aimed to increase awareness of ACEs among medical trainees and health care professionals and serves to spark discourse about necessary steps that must be taken to create an equitable health care system committed to preventing ACEs and promoting healthy childhood development for all.

Acknowledgements: The authors would like to thank Dipesh Navsaria, MPH, MSLIS, MD, for serving as faculty advisor for the Applied Practice Experience project, part of the Master of Public Health (MPH) program at the University of Wisconsin-Madison. They are also grateful for the direction of Barbara Duerst, MS, MPH, University of Wisconsin-Madison MPH program.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Rapid Transition to Telemedicine During the COVID-19 Pandemic: Medical Genetics Experience

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ABSTRACT

Background: The coronavirus SARS-CoV-2 (COVID-19) pandemic interrupted delivery of outpatient health care to minimize risk of exposure. This pandemic threatened to increase longstanding national concerns about access to both initial and follow-up genetics clinics services. The University of Wisconsin-Madison Waisman Center Medical Genetics Clinic (WCMGC) rapidly transitioned to offering appointments using telemedicine in March 2020 when the public health emergency for COVID-19 pandemic was declared.

Methods: Datasets were reviewed for the periods April – July 2019 (pre-COVID baseline) and April – July 2020 (COVID project data). Patient schedules were accessed to determine the number of appointments kept, no-shows, and late cancellations. A telephone survey was utilized to assess patient satisfaction with telemedicine.

Results: Fewer appointments were missed and providers completed more clinic visits after transitioning to telemedicine. Patients and their families were equally satisfied with care received and were amenable to telemedicine use in the future. Telemedicine allowed WCMGC to continue serving patients during a period of restricted on-site services, suggesting its continuation would improve access to genetic services.

BACKGROUND

The coronavirus SARS-CoV-2 (COVID-19) pandemic is an unprecedented event for all sectors of society, especially health care. COVID-19 required health care systems and clinicians to quickly adapt to a frequently changing landscape to safely provide emergent and routine care. A quick transition from traditional on-site, in-person visits to telemedicine occurred to allow continuity of care for patients while minimizing risk of COVID-19 exposure for patients and providers.

Integration of genetic assessment, diagnostic, and management services across a wide range of health care specialties is increasing. Notwithstanding this growth, a 2015 national survey of genetics professionals indicated increasing wait times and too few genetics health care professionals.[1] A 2020 systematic review of the literature on clinical genetics workforce found long wait times for referrals, from months to over a year.[2] Other factors contributing to decreased access to services include geographical and financial barriers, such as poor insurance coverage, travel costs, and lost work time.[3]

In Wisconsin, access to genetic services has been limited for over 10 years, including at the University of Wisconsin-Madison Waisman Center Medical Genetics Clinic (WCMGC). WCMGC serves pediatric and adult patients from much of northern, central, and southcentral Wisconsin and northern Illinois. WCMGC is 1 of 4 clinics in Wisconsin to provide diagnostic pediatric and adult genetic services. In the last 5 years, referrals to WCMGC have increased while the number of genetics professionals decreased. This trend is not unique to WCMGC and has resulted in the inability of Wisconsin genetics providers to meet the growing demand. Data from WCMGC in December 2018 showed 630 people waited for a clinic visit, including over 400 new patients. Approximately 40 new referrals were received weekly. In fiscal year 2018, 773 visits were completed with a no-show/late cancellation rate of 23%. Eighty-three percent of patients waited more than 21

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days for a visit, and visits were scheduled up to a year in advance.

Telemedicine is recognized as a means to increase access and reduce cost and wait times, while remaining acceptable to patients.[2] Models for telemedicine use exist in cancer genetic counseling and medical genetics clinics.[3-5] A regional model for pediatric medical genetics, with a local pediatrician and genetic counselor triaging patient care and referring to a geneticist by telemedicine, has provided services for chronically underserved regions with low wait times.[4] Genetics providers rank telemedicine highly to meet future needs and help serve patients.[1] However, a 2018 survey of medical genetics practices in the US showed less than 18% of providers used telemedicine (20.8% of genetic counselors, 15.8% of geneticists).[1] Despite arguments in favor of telemedicine, public and private insurance telemedicine reimbursement policies are restrictive, limiting implementation. The COVID-19 pandemic instigated national and state public health emergency declarations, creating insurance policy waivers and acting as a catalyst for change.

In Wisconsin on March 12, 2020, the governor declared a public health emergency. On March 16, WCMGC began a rapid transition to telemedicine, initially by telephone (TM-P) and then by video (TM-V) format. Prior to March 16, 2020, there were no outpatient telemedicine services at WCMGC.

During the rapid transition, data were collected to evaluate the impact of telemedicine on appointments completed. Patient satisfaction surveys also were conducted.

METHODS

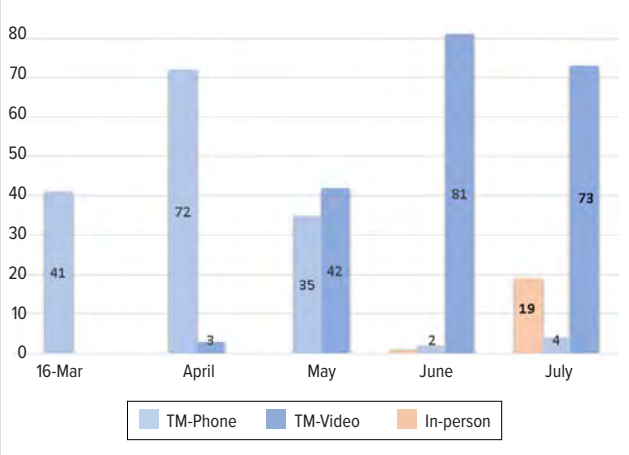
Two data sets were reviewed: pre-COVID baseline (April – July 2019) and COVID project data (April – July 2020). WCMGC patient schedules—archived in the UW Health electronic medical record (EMR)—were accessed weekly to obtain the number of visits scheduled and visits kept. For visits not kept, no-show and late cancellation data were collected. WCMGC defines late cancellation as an appointment cancelled less than 2 weeks before the scheduled appointment. Genetic counselors require 2 weeks for preparation to review the EMR. Late cancellations result in unfilled appointments. No-show rates were calculated as a proportion of total visits scheduled. Likewise, late cancellation rates were calculated as a proportion of total visits scheduled. "Visits completed/kept" values were obtained by subtracting the number of no-show and late cancellation visits from total visits scheduled.

Visit Type

From April 22 through July 31, 2019, all patients were seen in-person. From April 20 through July 31, 2020, the service delivery method was recorded as in-person (provider[s] and patient were at the Waisman Center), TM-P, or TM-V.

Beginning March 16, 2020, patients scheduled for in-person visits were converted to TM-P visits. If an in-person visit was needed, it occurred at the American Family Children's Hospital. UW Health expanded telemedicine capabilities and, on April 22, implemented a secure video application that allowed patients to use smartphones, tablets, or computers with webcams from a personal (nonclinic-based) location. With the transition to TM-V, scheduled patients were converted to a TM-V visit. Limited outpatient on-site visits at WCMGC resumed July 1, 2020. Clinic visits included meeting with a medical genetics physician or nurse practitioner and a genetic counselor.

Figure 1. Visit Type in the Medical Genetics Clinic, March 16-July 31, 2020 (N=373)



Abbreviations: TM-P, telemedicine-phone; TM-V, telemedicine-video.
Each visit was categorized based on method of service delivery: in-person (n=20), TM-P (n=154), or TM-V (n=199). The total number of visits in each category changed monthly as implementation of telehealth technology progressed and county/institution public health guidelines evolved.

Patient Satisfaction

To assess patient satisfaction with telemedicine, a series of survey projects were designed and completed. Survey projects were evaluated by the University of Wisconsin-Madison Quality Improvement/Program Evaluation Self-Certification Tool and did not require institutional review board approval.

A telephone survey was implemented for patients seen in July 2020. The telephone interview instrument, completed by nonclinician staff, was designed for use in several Waisman Center clinics. Interviewers gathered demographic and technology information, as well as opinions on ease of use and satisfaction with telemedicine. Quality of care and potential future use of telemedicine were assessed, in addition to open-ended questions about the telemedicine visit. (See Appendix for survey instrument.)

Interviewers entered responses into a REDCap database in real time. A coding frame was developed based on a thematic analysis of the interview transcripts. Codes were categorized as either positive (7 categories) or negative (3 categories) themes by 2 independent coders (92.7% of agreement). Coders discussed divergences and came to consensus for all cases.

RESULTS

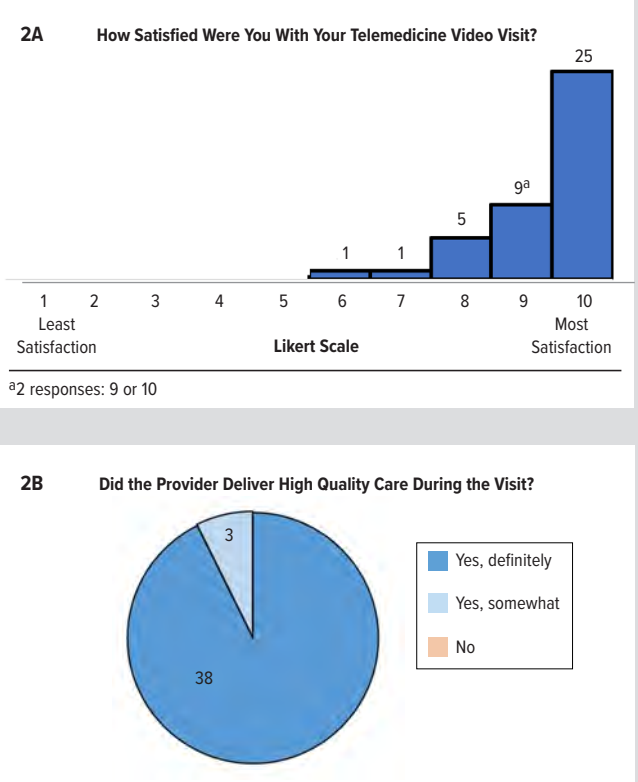
During the last 2 weeks of March 2020, 91.3% (42/46) of sched-

Table. No-show/Late Cancellation Rates

	April - July 2019 (N = 306)		April - July 2020 (N = 352)	
	No.	%	No.	%
Kept	225	73.5	306	86.9[a]
No-show	47	15.4	10	2.8[a]
Late cancellation[b]	33	10.8	36	10.2

[a]$P < 0.05$.
[b]Late cancellation is defined as an appointment that is cancelled < 2 weeks before the scheduled visit.

Figure 2. Patient Satisfaction for Telemedicine in Waisman Center Medical Genetics Clinic (N = 41)



[a]2 responses: 9 or 10

uled visits were converted from in-person to TM-P (Figure 1). In April, 72 of 75 visits were completed using TM-P, and TM-V was piloted for 3 of the 75. TM-V visits increased in May (42/77) and June (81/84). When the anticipated surge in positive COVID-19 cases did not occur, on June 1, 2020, UW Health reopened a limited number of outpatient clinics—including the WCMGC—for limited in-person visits. In July, of 96 visits, 73 were TM-V, 4 were TM-P, and 19 were in-person.

From April 22 through July 31, 2019, of 306 scheduled visits, 225 (73.5%) were kept. Of the 80 visits not kept, 47 (15.4%) were no-shows and 33 (10.8%) were late cancellations. From April 20 through July 31, 2020, of 352 scheduled visits, 306 (87%) were kept. Of the 46 visits not kept, 10 (2.8%) were no-shows and 36 (10.2%) were late cancellations (Table). Increased 2020 scheduled visits is also consequent to reduced provider time off and the addition of a nurse practitioner.

Patient Satisfaction

The telephone survey completed for July appointments had a 66% response rate (41/62). Respondents' information includes 44% new patient visits, 100% had a TM-V visit, and 90% of the patients were under 18 years with their caregiver completing the survey. The mean distance from the Waisman Center was 1.53 hours. The reason for the appointment was not collected as part of the survey. Respondents were satisfied with TM-V (mean 9.4, range 6-10) (Figure 2). All respondents felt high quality health care was provided. When asked if technology had ease of use, all respondents indicated yes, definitely (95%) or yes, somewhat (5%). No respondent indicated that the technology was difficult to use. The most common patient satisfaction themes included the ease of the appointment (46%), time savings due to no travel (44%), and decreased risk of COVID-19 (22%).

DISCUSSION

Telemedicine may help overcome well-established barriers to genetic service access, such as geographic barriers and workforce shortages. However, many health care systems have been hesitant to embrace telemedicine because of reimbursement restrictions and concerns about quality of care. To meet patient needs and improve access to care, a change to the service delivery model was needed.[2] The rapid, successful transition to telemedicine during the COVID-19 pandemic at the WCMGC not only met the immediate needs of patients to receive genetics care but also demonstrated that telemedicine could increase patient volume while maintaining patient satisfaction.

The Centers for Medicare and Medicaid Services (CMS) telehealth waiver expanded coverage for visits, including those at the patient's residence, and use of a platform that connects to mobile devices like cell phones. From our clinic's experience and survey, telemedicine technology has been user-friendly and convenient for both providers and patients/families. While many outpatient clinics decreased patient volume during the COVID-19 pandemic, the WCMGC surpassed the 2019 clinic volumes consequent to decreased no-show rates.

Limited literature exists regarding patient satisfaction with telemedicine in medical genetics. Survey data from a randomized trial for cancer genetic counseling found no difference in patient satisfaction between in-person versus telemedicine counseling.[6] The current study indicates high patient satisfaction with WCMGC telemedicine services.

Although telemedicine proved useful for diagnostic and management visits, the clinic's recent experience showed it is not effective for all indications or situations. A flexible hybrid model allowing for in-person or telemedicine services may be required to

further improve access while maintaining patient satisfaction and quality care. Future work includes quantifying and characterizing visit types amenable for telemedicine postpandemic and identifying criteria for in-person versus telemedicine visits.

Multiple barriers limit access to genetics care: geographic, workforce shortages, inadequate insurance coverage, and misconception about nature of services.[1] Given many Wisconsinites reside a significant distance from care facilities, telemedicine can help serve individuals in rural areas as well as those with financial barriers. Future surveys may examine technology barriers for providers and patients/families. A limitation of the survey is no survey was completed for those needing interpretation services.

Health care systems and service delivery models will likely undergo substantial changes after the pandemic ebbs. There will be a transition back to in-person care. Retaining telemedicine options will likely depend on whether restrictions are eased and reimbursement policies are improved.

This pilot study suggests improved access and patient satisfaction with genetic services provided via telemedicine during the pandemic. Further studies are needed to better understand the type of visit that best meets the patient's needs as well as other defining barriers to using telemedicine as a tool to increase access to medical genetics services. Also, the setting of this data was a unique time during a global pandemic, indicating follow-up study is crucial to understand telemedicine's role in medical genetics services—as well as other pediatric subspecialty services—in the future.

Financial Disclosures: None declared.

Funding/Support: None declared.

Appendix: Available at wmjonline.org.

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Community Assessment of Extreme Heat Preparedness in Milwaukee, Wisconsin

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ABSTRACT

Background: This article describes the first Community Assessment for Public Health Emergency Response (CASPER) rapid needs assessment project to be conducted in Wisconsin. The project focused on extreme heat preparedness.

Methods: Fifteen teams conducted household surveys in 30 census blocks in the city of Milwaukee, Wisconsin.

Results: Survey results indicated that the majority of households were unaware of the location of a nearby cooling center. Although the vast majority of households reported some form of air conditioning in their house, over half felt too hot inside their home sometimes, most of the time, or always.

Discussion: The community partnerships ensured that this project was conducted with local partner input and that the data could be used to inform extreme heat response.

BACKGROUND

Extreme heat can cause negative health impacts, including heat illness, heat-related mortality, and exacerbations of chronic medical conditions.[1,2] The Centers for Disease Control and Prevention (CDC) defines extreme heat as "summertime temperatures that are much hotter and/or humid than average."[3] The Wisconsin Initiative on Climate Change Impacts, a statewide collaboration of scientists and stakeholders, anticipates that Wisconsin will double the number of days above 90 degrees Fahrenheit from 5-12 to 12-25 by mid-century due to climate change.[4] In 2019, over 70 health organizations declared climate change a public health emergency.

Many factors can increase risk for heat illness, including age, exposure to hot weather, lack of air conditioning, certain medications, and underlying medical conditions. The social determinants of health (SDOH)—the conditions in which people are born, grow, live, work, and play[5]—significantly determine people's vulnerability to climate change-related effects. Utilizing data about these risk factors and SDOH, a Wisconsin Heat Vulnerability Index developed by the Wisconsin Division of Public Health (DPH) identified Milwaukee as a location that may be more vulnerable to heat.[6]

To better understand the needs of a community vulnerable to extreme heat, the Climate and Health Program at DPH conducted a Community Assessment for Public Health Emergency Response (CASPER) in the city of Milwaukee. CASPER is a CDC rapid community needs assessment methodology. This project involved engaging with multiple groups, including the City of Milwaukee Health Department (MHD), UniteMKE, Sixteenth Street Community Health Centers, and WestCare. These partners were involved in the planning, survey collection, evaluation, data analysis, and result dissemination. These community partnerships ensured input, participation, and ability to use the findings for local extreme heat planning.

The objective of this project was to assess extreme heat preparedness in Milwaukee households, and this brief report describes the methodology, findings, and lessons learned.

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Table 1. Questionnaire Response Rates

Questionnaire Response	Percent	Rate
Completion Rate[a]	41.9	88/210
Cooperation Rate[b]	47.3	88/186
Contact Rate[c]	21.4	88/412

[a] Percent of surveys completed in relation to the standard goal of 210.
[b] Percent of contacted households that were eligible and willing to participate.
[c] Percent of randomly selected households that completed an interview.

METHODS

The CASPER methodology is a validated, inexpensive, and efficient way to perform a community needs assessment. CASPER utilizes a 2-stage sampling methodology to obtain a fixed target sample size of 210 households as described in CDC's CASPER Toolkit Version 2.0.[7] The sampling frame for the project was defined as the city of Milwaukee. In stage 1 of sampling, 30 census blocks (clusters) were randomly selected using a population-level weighting probability. In stage 2, seven households from each of the 30 clusters were selected using systematic random sampling. The total number of households in each cluster was divided by 7 to calculate N; every Nth household was selected for an interview. This project received approval from the DPH Human Subject Protection Committee; review by an institutional review board was not required because it was determined the project constituted public health practice.

A 2-page paper questionnaire of 40 questions (39 close-ended, 1 open-ended) was developed in English and Spanish. Questions collected household-level information regarding emergency preparedness and readiness for extreme heat. Survey items were adapted from an extreme heat CASPER survey completed by the Maricopa County Department of Public Health in Arizona and were tailored with input from community partners.[8]

Awareness of the project was raised with input from community partners and through public messaging, including flyers, social media, and a press release. Project staff attempted to contact apartment managers to gain access for the survey days but were unsuccessful in reaching all apartments. On Thursday, September 13, 2018, a just-in-time training session was held from 9 AM to 5 PM. The training reviewed household selection methods, questionnaire content, interview techniques, and volunteer safety. Fifteen survey teams of 2 individuals were each assigned 2 clusters. Public health staff from DPH and MHD were paired with community health workers (CHW) from UniteMKE, Sixteenth Street Community Health Centers, and WestCare in Milwaukee. Teams recorded survey responses from an eligible household respondent on a survey form. Any household member at least 18 years of age was eligible to respond. Households that did not respond were approached on 3 occasions before replacement. Data were collected on Friday, September

Table 2. Household Demographic Characteristics

	Frequency	Percent
Structure, N = 88		
Single family	43	48.9
Multiple unit	44	50.0
Mobile home	1	1.1
Other	0	0.0
Home ownership, N = 88		
Own	39	44.3
Rent	47	53.4
Don't know/refused	2	2.3
Number in household, N = 88		
1	15	17.0
2-4	55	62.5
5+	17	19.3
Don't know/refused	1	1.1
Age, N = 88[a]		
Less than 2 years	8	9.1
2-17 years	33	37.5
18-44 years	57	64.8
45-64 years	39	44.3
65-84 years	15	17.0
85 years or older	1	1.1
Don't know/refused	3	3.4
Adults in household that don't speak English, N = 88		
Yes	8	9.1
No	79	89.8
Don't know/refused	1	1.1
Race of household members, N = 88		
American Indian/Alaska Native	0	0.0
Asian	2	2.3
Black or African American	44	50.0
Native Hawaiian or Other Pacific Islander	0	0.0
White	21	23.9
Other	19	21.6
Don't know/refused	2	2.3
Ethnicity of household members, N = 88		
Hispanic or Latino	16	18.2
Not Hispanic or Latino	70	79.5
Don't know/refused	2	2.3
Highest level of education of household members, N = 88		
Less than high school	9	10.2
High school or GED	18	20.5
Some college	22	25.0
College graduate or more	34	38.6
Don't know/refused	5	5.7
Any household members that work outdoors, N = 88		
Yes	22	25.0
No	63	71.6
Both indoor and outdoor	2	2.3
Don't know/refused	1	1.1
Any household member that works indoors without air conditioning, N = 88		
Yes	14	15.9
No	73	83.0
Don't know/refused	1	1.1

[a] Respondents could indicate more than one age category for their household, so the percent does not sum to 100 for this measure.

Table 3. Knowledge of Heat Stress, Coping Mechanisms, and Access to Resources

	Frequency	Percent
Member of household had symptoms due to heat, N = 88		
Yes	28	31.8
No	60	68.2
Don't know/refused	0	0.0
Household members have felt too hot inside the home, N = 88		
Always	4	4.5
Most of the time, but not always	14	15.9
Sometimes	31	35.2
Rarely	15	17.0
Never	24	27.3
Don't know/refused	0	0.0
How household kept cool, N = 88 [a]		
Central A/C	38	43.2
Window A/C	47	53.4
Portable A/C	14	15.9
Closed shades or blinds	50	56.8
Ceiling fan	46	52.3
Portable fan	63	71.6
Shade trees	36	40.9
Nothing	0	0.0
Other	3	3.4
Don't know/refused	0	0.0
Reasons household would not use A/C, N = 88 [a]		
Don't have A/C	8	9.1
No electricity in home	1	1.1
Cost of electricity	23	26.1
A/C unit does not work	6	6.8
Cost of repairs	7	8.0
Noise	4	4.5
Medical reasons	2	2.3
Safety concerns with window unit	2	2.3
Nothing prevents use	44	50.0
Other	7	8.0
Don't know/refused	0	0.0
Know where a nearby cooling center is located, N = 88		
Yes	29	33.0
No	55	62.5
Don't know/refused	4	4.5
Leave the home to cool off, N=88		
Yes	30	34.1
No	58	65.9
Don't know/refused	0	0.0
Where household goes to cool off, N = 30 [a]		
Mall	9	30.0
Church	2	6.7
Library	9	30.0
Park	14	46.7
Museum	9	30.0
Supermarket	11	36.7
Public bus	3	10.0
Beach	13	43.3
Restaurant	8	26.7
Shelter	2	6.7
Movie theater	7	23.3
Community center	2	6.7
Friends/neighbors	12	40.0
Pool or splash pad	14	46.7
Other	6	20.0
Don't know/refused	0	0.0
Barriers to going to a cooled place, N = 88 [a]		
Hours of operation	10	11.4
Disability	5	5.7
Distance from home	12	13.6
Lack of transportation	10	11.4
Personal safety	10	11.4
Cannot bring pets	7	8.0
Lack of information	17	19.3
Building is not ADA accessible	3	3.4
Never needed to go to a cooled place	21	23.9
No, nothing prevents me	45	51.1
Other	3	3.4
Don't know/refused	4	4.5

Abbreviations: A/C, air conditioner; ADA, Americans with Disabilities Act.

[a] Respondents could select all responses that apply for their household, so the percent does not sum to 100 for these measures.

14, 2018, from 12 PM to 6 PM and Saturday, September 15, 2018, from 9 AM to 4 PM.

Survey data were entered into Epi Info 7, and tracking form data were entered into Microsoft Excel 2010 (Microsoft Corporation, Redmond, Washington). Weights were not applied to each surveyed household because the sample size was insufficient. Unweighted frequencies were calculated for each question using Epi Info 7 (CDC, Atlanta, Georgia). Respondents who selected no race, other race, or more than 1 race were classified as other.

RESULTS

The survey teams completed 88 interviews, resulting in a completion rate of 41.9% (Table 1). Compared to the 2010 Census, the CASPER survey sample had a higher percentage of African American participants (50.0%) and lower percentage of White participants (23.9%). (Table 2).

Survey questions assessed knowledge of heat stress, experience with extreme heat, coping mechanisms, and access to cooling resources. To stay cool during extreme heat conditions, the majority of households drank water or other liquids (95.5%). Twenty-eight households (31.8%) had symptoms due to heat the past summer. Eight households (9.1%) reported having no air conditioning, which includes central air, window air conditioning, and portable air conditioners. Primary reasons that households didn't use air conditioning included the cost of electricity (26.1%), cost of repairs (8.0%), and nonfunctional air conditioning units (6.8%). The majority of households (62.5%) indicated they did not know where a nearby cooling center was located. Most residents (65.9%) did not leave the home to cool off. Of those who did leave the home (34%), parks (46.7%) and pools/splash pads (46.7%) were the most commonly chosen places. Approximately 38% of households reported at least 1 barrier locating a cooled place; the most common barriers included lack of information (19.3%) and distance from home (13.6%) (Table 3).

DISCUSSION

Because the survey completion rate was below 80%, the data collected were not generalizable to the entire city of Milwaukee; however, the findings merit further investigation.

Even though a very high percentage of households (91%) had some form of air conditioning in their home, 56% felt hot in their homes sometimes, most of the time, or always in the summer of 2018. This exploratory finding suggests air conditioning is not being used or is not sufficiently cooling the home. Survey results showed that 49% of households did not use air conditioning for 1 or more reasons. Consistent with other studies, cost was the largest barrier to use.[9,10] These findings suggest the need for further investigation into utility assistance programs and additional barriers to air conditioning use.

Another notable finding was the lack of knowledge among surveyed households about the location of a nearby cooling center. When asked about barriers going to a cooled place (eg, a cooling center), half of respondents indicated no barrier, but 20% cited a lack of information as a barrier. Discussions with community partners revealed that the terminology "cooling center" is not effective as residents don't know what this means or have negative preconceptions about it. A qualitative heat study of Detroit residents found that some people perceive that cooling centers are intended for homeless individuals;[9] messaging about the intended audience for cooling centers could clarify this potential misconception.

This project had many strengths and was the first CASPER conducted in the state of Wisconsin. The survey was developed with input from community partners to ensure the data were useful for extreme heat planning and the tool was culturally appropriate. Local partner involvement enhanced the implementation, analysis, and dissemination of results. Local partners recruited CHWs to be on survey teams and provided insight when discussing key survey findings, including on the structure and delivery of the survey questions. While conducting surveys, the local partners shared local resources to support residents' stated needs. Finally, the data has been disseminated to local organizations working on related topics, such as the Branch Out Milwaukee Campaign and Milwaukee Heat Task Force.

There are several important limitations. Most significantly, the low survey response rate prevents generalizing the results to the entire city of Milwaukee. One unique challenge conducting a CASPER in an urban environment is accessing apartment complexes due to locked entrances and difficulties determining the number of households. The fact that this was a prospective and nonemergency CASPER about extreme heat conducted in September presented an additional challenge. A third limitation was DPH staff's lack of cultural diversity and experience working with communities of color. Some limitations related to this issue included inconsistent attendance from CHWs on the survey teams. The CASPER methodology was unfamiliar and contrary to many CHWs' experience engaging with the community; furthermore, extreme heat was not a topic that resonated with most CHWs since they are accustomed to dealing with more immediate community concerns.

CONCLUSION

This project engaged key community stakeholders, ensured that the project was conducted with local input, and provided findings to inform extreme heat planning. While this project did not reach the target number of surveys, the process did elucidate the challenges and benefits involved with a prospective approach, a low salience issue, and an urban setting. These findings can be used to inform planning of future CASPERs.

Acknowledgements: The authors thank the following individuals who dedicated their time to the project: Amy Schnall from the Centers for Disease Control and Prevention, who provided technical assistance; Maggie Thelen from Wisconsin Division of Public Health (DPH) for her assistance with creating maps; Josh Wolf for his assistance with the initial planning; Kate Goodwin (Maricopa County Department of Public Health) for her advice; Jose Rodriguez, formerly of City of Milwaukee Health Department (MHD), Lindsey Page (MHD), Ramona Lake (DPH), Dave Rozell (DPH), Svea Erlandson (DPH), and Disa Patel (DPH) for serving as team leads; and staff from UniteMKE, WestCare, Sixteenth Street Community Health Centers, City of Milwaukee Health Department (MHD), University of Wisconsin Population Health Fellowship, and DPH for conducting surveys on interview teams. Authors also thank the many organizations that reviewed the survey: MHD; DPH epidemiologists, Minority Health Office, Southeast Regional Office, Office of Preparedness and Emergency Health Care, Bureau of Aging and Disability Resources, Wisconsin Climate and Health Program Health Equity Action Team and Science Advisory Group; Milwaukee Heat Task Force; Milwaukee County Office of Emergency Management; National Weather Service; The Nature Conservancy; University of Wisconsin Survey Center; Sixteenth Street Community Health Centers; and Northern Illinois University students. Finally, we would like to thank the Milwaukee residents who participated in the survey.

Funding/Support: Ms Christenson, Ms Moran, and Dr Meiman report a grant from the Centers for Disease Control and Prevention during the conduct of the study (Award Number NUE1EH001326); Ms Grant reports a grant from the Wisconsin Department of Health Services Bureau of Environmental and Occupational Health during the conduct of the study.

Financial Disclosures: None declared.

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Opioid Overdose Mortality Trends in Wisconsin, 2004-2019

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ABSTRACT

Background: Opioid-related mortality in Wisconsin by race differs from national trends: Black Wisconsinites are nearly twice as likely as Whites to die by opioid overdose. These trends warrant further study by other demographic factors on the state level.

Methods: We characterize trends in mortality due to opioid overdose in Wisconsin using CDC WONDER data for 2004-2019 by race, age, and sex. ICD-10 (International Classification of Disease, Tenth Revision) codes were selected per national guidelines for identifying opioid-related overdose deaths.

Results: Opioid overdose mortality increased 415% during the study period. Black or African American and American Indian or Alaska Native populations had consistently higher risk than White populations, with an older age distribution.

Conclusion: We identify inequities in opioid overdose mortality that have persisted over time in Wisconsin. Different age distributions by race may indicate different pathways to overdose and require further investigation to guide upstream mitigation strategies.

INTRODUCTION

Opioid-related mortality represents a global public health crisis.[1] The domestic response to this crisis has included a wide array of public health interventions, particularly those aimed at preventing overdose deaths. Understanding trends in mortality due to opioid overdose is key in guiding these efforts.

Drug overdose deaths have been rising across the United States.[2] In Wisconsin, the mortality rate due to opioid overdose is greater than that of the nation as a whole, and the mortality rate due to synthetic opioids — to which much of the recent growth in opioid-related deaths is attributed —increased nearly 11-fold from 2004 through 2019.[3,4] A detailed look at these trends over time in Wisconsin is warranted.

Wisconsin has persistent racial health disparities, with counties with larger Black and American Indian/Alaska Native (AI/AN) populations performing worse on a wide range of health measures than all other Wisconsin counties.[5] Wisconsin's Premature Death Inequality Ratio is 2.1, the 10th worst in the nation.[6] (This indicator was created by the American Public Health Administration and is defined as "ratio of the racial/ethnic group with the highest premature death rate before age 75 to the white population.") Opioid-related mortality is no exception: Black Wisconsinites are nearly twice as likely to die by opioid overdose when compared to White Wisconsinites.[7] This diverges from national data, where White Americans have a higher mortality rate due to opioid overdose than Black Americans.[2,8] The narrative of an opioid epidemic affecting White Americans and mobilization of treatment efforts contrasts with the historic criminalization of Black and Latinx drug users and highlights the differentials of privilege and power that exist in the US.[9] Despite this narrative, recent national trends have shown the highest increase in mortality to be among Black Americans.[10]

In this brief report, we aim to characterize the trends in mortality due to opioid overdose in Wisconsin, compare rates between groups by age and race, and compare these rates to other US states

METHODS

This was a descriptive study analyzing trends in opioid-related overdose mortality in Wisconsin compared to other US states.

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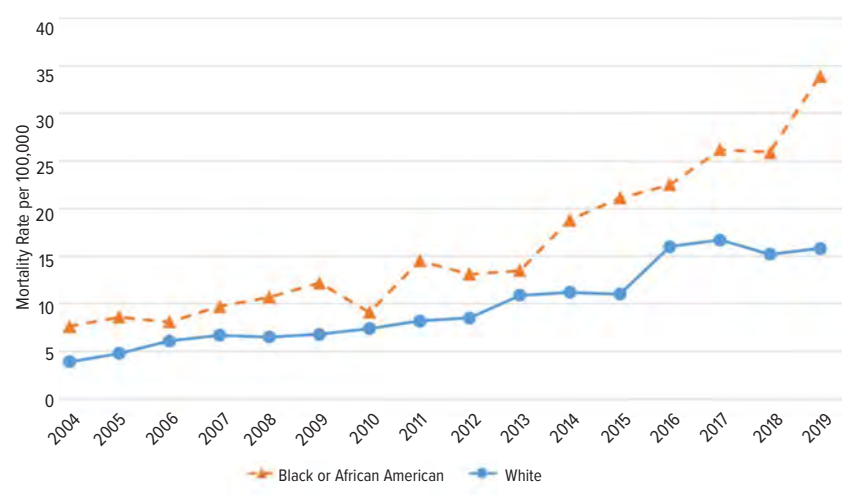
Data for this analysis was obtained from CDC WONDER for 2004-2019.[11] All ages, sexes, and races were included. Mortality related to opioid overdose was identified using ICD-10 (International Classification of Disease, Tenth Revision) codes based on the Substance Abuse and Mental Health Services Administration's (SAMHSA) Center for the Application of Prevention Technologies "Using International Classification of Diseases Codes to Assess Opioid-Related Overdose Deaths."[12]

Deaths were included in this study if they had both an underlying cause of mortality of accidental poisoning (X40-44), intentional self-poisoning (X60-64), assault (X85), or poisoning of undetermined intent (Y10-14), as well as an opioid-related contributing cause of overdose death (T40.0-40.4, T40.6). The exposures analyzed were age, race, sex, place (Wisconsin vs other US states), and year.

Descriptive statistics were calculated by CDC WONDER or in Microsoft Excel. Age-adjusted or age-specific mortality rates were calculated for each age, race, and sex subgroup, and bivariate analyses also were conducted. Subgroup analyses and age-adjustment were done in order to address potential confounding.

Figure 1. Opioid-Related Overdose Mortality Rates per 100,000 in Wisconsin by Race, 2004-2019



Yearly data for the American Indian Alaska Native population is not shown (unreliable due to small sample size). Data from CDC WONDER.[11]

RESULTS

Wisconsin Data

The age-adjusted mortality rate due to opioid overdose in Wisconsin has increased in recent years, from 4.0 per 100,000 in 2004 to 16.6 per 100,000 in 2019—an increase of 415%. The same trend was demonstrated for all age groups and races in the state, mirroring an overall increase in opioid overdose mortality in the US during 2004-2019.[11]

Black or African American and AI/AN Wisconsinites have had a consistently higher mortality rate due to opioid overdose during this timeframe. Both Black and White populations in Wisconsin have experienced a sharp increase in mortality rate in recent years, with a plateau or slight decrease from 2017 to 2018 (Figure 1). Data for AI/AN Wisconsinites by year were unreliable due to small sample size and are not shown.

The highest mortality rate in Wisconsin due to these causes was seen among AI/AN, followed by Black Wisconsinites. Mortality rates by sex, race, and age are described in the Table. Distribution of mortality rates among age groups differed by race. Among Black Wisconsinites, older age groups had higher mortality rates, whereas for White Wisconsinites, younger age groups had higher mortality rates (Figure 2). Among Black Wisconsinites, the highest mortality rate was among those ages 45-54, whereas among White Wisconsinites, the highest mortality rate was among those ages 25-34. With the exception of the 25-34 age group, the mortality rate for Black Wisconsinites exceeded that of White Wisconsinites for all age groups during the study period (Figure 2).

Table. Opioid Overdose Deaths, Mortality Rate per 100,000 per Year, and Relative Risk of Mortality in Wisconsin, 2004-2019

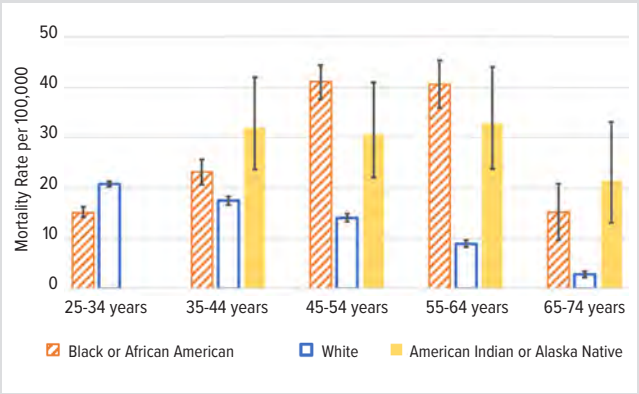
	# Deaths	Mortality Rate per 100,000 per Year (95% CI)	Relative Risk (95% CI)
Sex			
Women	3077	6.9 (6.6-7.1)	Ref
Men	5673	12.7 (12.4-13)	1.8 (1.8-1.9)
Race			
White	7636	9.7 (9.4-9.9)	Ref
Black/African American	907	16.6 (15.5-17.7)	1.7 (1.6-1.8)
American Indian/Alaska Native	181	17.7 (15.1-20.3)	1.8 (1.6-2.1)
Asian/Pacific Islander	26	1.0 (0.7-1.6)	0.1 (0.07-0.16)
Age group			
15-24 years	876	6.9 (6.5-7.4)	7.2 (5.7-9.3)
25-34 years	2258	19.7 (18.9-20.5)	20.5 (15.8-27)
35-44 years	2067	17.6 (16.8-18.4)	18.3 (14.2-24)
45-54 years	2046	15.6 (14.9-16.2)	16.2 (12.5-21.2)
55-64 years	1176	10.3 (9.7-10.8)	10.7 (8.3-13.9)
65-74 years	234	3.3 (2.8-3.7)	3.4 (2.8-4.0)
75-84 years	41	0.96 (0.7-1.3)	Ref

Abbreviation: Ref, reference.
Data are from CDC Wonder.[11] Sex and race mortality rates are age-adjusted.

Comparison to Other US States

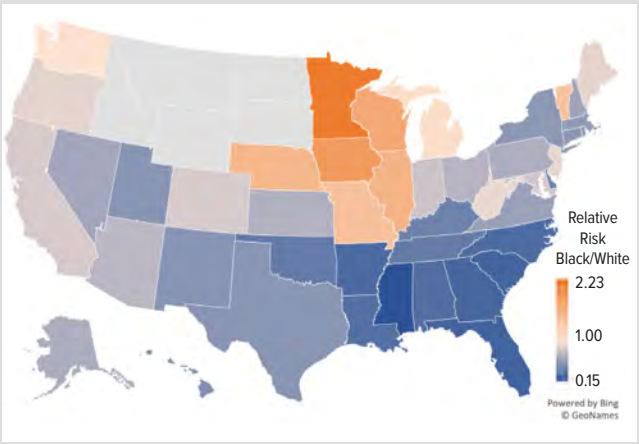
The relative risk (RR) of mortality for Black Americans compared to White Americans by state during the years 2004-2019 is shown in Figure 3. Wisconsin and other upper Midwest states (shown

Figure 2. Mortality Rate per 100,000 by Age Group and Race in Wisconsin, 2004-2019



Data are for all years of the time period combined. Data for the American Indian/Alaska Native 25-34 year age group is not shown (unreliable due to small sample size). Data from CDC WONDER.[11]

Figure 3. Relative Risk (RR) of Mortality by Opioids or Other Drugs by Race for Black/African American Populations vs White Populations, 2004-2019



Orange states had a higher RR for Black residents vs White residents, whereas blue states had a lower RR among Black residents vs White residents. States with unreliable or suppressed mortality data by race are shown in light gray. Data from CDC WONDER.[11]

in orange) differ from the remainder of the country in that the relative risk of mortality for the Black population exceeds that of the White population. The relative risk of mortality was lowest for Black residents compared to White residents in Mississippi (RR 0.15). In contrast, the relative risk for Black residents compared to White residents was highest in Minnesota (RR 2.2). In Wisconsin, the relative risk of death due to opioid overdose is 1.7 times higher for Black residents than for White residents.

DISCUSSION

Relevance

Overall, mortality due to opioid overdose increased in Wisconsin from 2004 through 2019, with the sharpest increase in the years following 2014. This rise parallels a national trend in opioid-related mortality and has been attributed to the increase in prescription opioid use and increased availability of synthetic opioids.[2]

Mortality by opioid overdose affects different age groups, racial groups, and sexes at different rates. Our findings are consistent with previous analyses of poisoning mortality rates in the US during 1999-2006.[13] In particular, the opioid overdose mortality rates are consistently higher for Black and AI/AN Wisconsinites than White Wisconsinites.

This analysis also reveals a different distribution of age-specific mortality rates between Wisconsinites of different races. During the study period, the mortality rate for White Wisconsinites was highest among younger age groups, whereas for Black Wisconsinites the mortality rate due to opioid overdose peaks in the 45-54 age group (Figure 2). This is consistent with recent work by Hoopsick et al,[8] in which national opioid overdose mortality rates among middle-aged adults were analyzed by type of opioid involved and by race. This study demonstrated the highest increase in opioid overdose mortality among middle-aged Black Americans, with a different distribution of opioid type, indicating possible alternative "trajectories" of opioid use among different racial groups.

Overall, these data are indicative of systemic inequities faced by minority racial groups in Wisconsin and underscore the need to evaluate the experiences of these populations in the state. For example, the disproportionate criminalization of drug use for communities of color[14] may contribute to lower rates of treatment in these populations and higher rates of overdose postincarceration.[15] These data urge further investigation regarding overdose deaths and patterns of opioid use in Wisconsin. The authors further echo the call by James and Jordan[16] for culturally appropriate outreach and of Hoopsick et al[8] for widespread criminal justice reform.

Limitations

This study is not without limitations. Mortality data are limited by errors in death certificates, including inaccurate reporting of cause of death and misclassification of sex, race, or ethnicity, the latter being particularly salient for AI/AN populations.[17] In addition, this analysis provides an overview of mortality related to opioids but does not include information on the type of drug related to each death. Furthermore, we conducted our analysis by race, an approach that is inherently limited, as the categories themselves are socially constructed and serve as imperfect proxies for diverse experiences of racism.[18] These data are presented with the intention of illuminating an inequity, with the acknowledgement that further work is required to evaluate and mitigate root causes.

In addition, yearly data for age-adjusted mortality rates in Wisconsin are only available for the Black and White populations due to small sample sizes in other races. Significant inequities also exist in AI/AN populations, both nationally and within the state,[19] but disparities over the selected time period were not observed in our analysis, which may point to limitations of the available data.

Future Directions

Mortality data is key in informing policy and strategies to slow the opioid epidemic. In particular, our analysis indicates racial disparities in opioid-related deaths in Wisconsin, underscoring inequities faced by Black and AI/AN populations in the state. Further analysis should be done to identify the precise substances involved, the geographic distribution of deaths, and the underlying causes of the disparities and different age distributions within racial groups seen here. Close monitoring of mortality data is important to inform ongoing efforts to mitigate the opioid crisis.

Acknowledgement: The authors would like to extend their sincere thanks to Patrick Remington, MD, MPH, University of Wisconsin School of Medicine and Public Health, for his guidance and instruction during their public health studies, during which the present work began.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Student Leadership Development Initiative: Benefits of a Unique Medical Student Organization

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ABSTRACT

Background: The Student Leadership Development Initiative was founded at the Medical College of Wisconsin to unite local physician leaders with Medical College of Wisconsin students to develop leadership skills and prepare for careers expanding beyond clinical practice.

Methods: An anonymous survey was distributed to 246 current and past Student Leadership Development Initiative participants, probing confidence in leadership skills, professional goals, and the perceived importance of leadership training. Feedback interviews were also conducted.

Results: Respondents reported improvement in areas such as compassion, leadership, and development of career goals. The perceived benefit for developing professional goals and compassion are positively related ($P<0.01$) to the number of sessions attended.

Discussion: Survey results highlight the importance of leadership training in medical education and suggest an integration strategy for a successful leadership training platform.

INTRODUCTION

Leadership and professionalism are undeniably valuable concepts to incorporate in medical education and are deemed important for addressing challenges in our health care system, particularly when physicians are required to step into leadership roles beyond the scope of traditional medical training.[1] When and how to introduce leadership education and training remains unresolved. Experts encourage the incorporation of leadership education as early as undergraduate medical education and longitudinally through medical training, yet this is a challenge as educational requirements are already extensive.[1,2] Additionally, there are no established standards, competencies, or program outlines and very little guidance regarding ideal content, delivery methods, or timing for leadership training.[1,3]

Despite the challenges of incorporating leadership training into medical school curricula, faculty and students still recognize its importance.[3] One systematic review of 26 studies discovered that medical students believe strongly in the importance of learning leadership and management skills.[1,4] Similarly, another study reported that over 90% of medical student respondents believed that training in medical leadership and management are important to their future roles as physicians.[1,5] More than 70% of these respondents expressed a desire for more training in their curriculum.[1,5]

To bridge the gap in leadership education and fulfill medical students' need and desire for leadership training at the Medical College of Wisconsin (MCW), the Student Leadership Development Initiative (SLDI) was founded as a student organization in 2016.[6] SLDI works to unite local exemplary physician leaders with MCW medical students who wish to develop their leadership skills and prepare for careers expanding beyond clinical practice. Although the group is open to all students, due to M3 and M4 clinical responsibilities, most participants are typically M1 and M2 students. SLDI members are invited to monthly sessions in which 15 to 20 students converse with physician leaders in an open discussion setting, as this has been shown to be an effective method for leadership training.[7] There is no formal curriculum or itinerary for sessions, and the conversations with the leaders can evolve organically.

The aim of this brief report was to determine how a student-run leadership initiative affected participants' self-reported knowledge and confidence in 5 key areas and to understand the perceived importance of leadership training to medical education.

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Table 1. Respondent Demographics, Past Leadership Role, and Student Leadership Development Initiative Sessions Attended (N=41)

Variables	Total N (column %)
Education year	
M1	4 (10%)
M2	11 (27%)
M3	10 (24%)
M4	6 (15%)
PhD in MD/PhD program	2 (5%)
PGY1	8 (19%)
PGY2	0 (0%)
PGY3	0 (0%)
Past participation in leadership role	
No	7 (17%)
Yes	34 (83%)
Number of SLDI sessions attended	
1	7 (17%)
2-3	15 (37%)
4-6	9 (22%)
7 or more	10 (24%)

M1 = 1st year medical student; PGY1 = post-graduate year 1; SLDI, Student Leadership Development Initiative.

METHODS

The MCW Institutional Review Board approved the study protocol. We utilized a 1-time retrospective cross-sectional, anonymous survey and interviews to determine the attitudes of current and former SLDI participants regarding SLDI sessions.

The survey was distributed via email to all current and past SLDI members with active MCW email accounts using REDCap electronic data capture tools hosted at MCW. It included demographic information, number of SLDI sessions attended, and subjective ratings on the importance of leadership skills in comparison to clinical knowledge. Using a Likert scale, the respondent was asked a total of 5 questions regarding the impact of SLDI on certain aspects of medical school training. REDCap software allowed for anonymous completion of the survey, and MCW Information Concealment Engine encryption tools to secure the data.

Fisher exact tests were conducted to determine whether the survey response to each area of benefit was dependent on the number of sessions attended by the respondent. We used Bonferroni correction for multiple testing and set $0.05/5 = 0.01$ as the significance cutoff.

In addition, 2 SLDI co-presidents conducted feedback interviews with 10 to 15 current SLDI members to elicit opinions on leadership in a medical school curriculum and the impact of SLDI. The interviews consisted of both standard questions and time for informal feedback.

RESULTS

Survey

Surveys were distributed to 246 past and present SLDI members. There were 41 responses (17%), with the majority (81%) currently in medical school (Table 1). Several respondents have or had a leadership role while in medical school (83%). About a quarter of respondents had participated in 7 or more SLDI sessions, while 17% had attended only 1 (Table 2).

Table 2. Benefits of Student Leadership Development Initiative (N = 41)

SLDI helped me:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Improve leadership skills	0	2 (5%)	5 (12%)	21 (51%)	13 (32%)
Build confidence	0	1 (2%)	11 (27%)	19 (46%)	10 (25%)
Develop professional goals	0	1 (2%)	4 (10%)	18 (44%)	18 (44%)
Increase compassion	0	0	6 (14%)	20 (49%)	15 (37%)
Value wellness	0	0	8 (19%)	15 (37%)	18 (44%)

Abbreviation: SLDI, Student Leadership Development Initiative.

Table 3. Number (%) of Students Agreeing or Strongly Agreeing That the Student Leadership Development Initiative Was Beneficial Based on Number of Sessions Attended (N = 41)

SLDI helped me:	Attended 1 Session	Attended 2–3 Sessions	Attended 4–6 Sessions	Attended ≥7 Sessions	*P* value
Improve leadership skills	6 (14%)	9 (22%)	9 (22%)	10 (25%)	0.02
Build confidence	5 (12%)	7 (17%)	7 (17%)	10 (25%)	0.02
Develop professional goals	7 (17%)	10 (25%)	9 (22%)	10 (25%)	0.02
Increase compassion	7 (17%)	9 (22%)	9 (22%)	10 (25%)	0.01
Value wellness	6 (14%)	11 (27%)	6 (14%)	10 (25%)	0.23

Abbreviation: SLDI, Student Leadership Development Initiative.
P values based on Fisher exact tests and Bonferroni correction for multiple testing, significance level of 0.01.

A high percentage of respondents reported that SLDI helped them develop professional goals and build confidence in leading a team (88% and 71%, respectively). Results show that SLDI facilitated respondents' abilities to value wellness as physicians, to be more compassionate and caring physicians, and to learn specific ways to improve leadership skills. (The frequency of responses to key questions are detailed in Table 2.)

Our survey analyzed the correlation between the number of sessions attended and the level of benefit to SLDI participants in all 5 areas. We found that the perceived benefit for becoming a more compassionate and caring physician leader was the only category significantly associated with the number of sessions attended (Table 3). While the other categories did not demonstrate an increased benefit dependent on how many SLDI sessions participants attended, responses were still overwhelmingly positive in all categories.

A majority of respondents (63%) reported that leadership education is of "similar importance" relative to clinical knowledge and skills, while 17% indicated clinical knowledge and skills are "more important" and 20% said they are "less important."

Interviews

Participants reported that the primary goal of a medical school curriculum should be "to produce competent physicians for the community that the school is based in" and those who are "not just good at science" but are "empathetic leaders" as well. When asked about required sessions as part of a curriculum, 1 interviewee said, "[requirements] are good when they serve an actual purpose, they can't be in a lecture format, they need to be more interactive." Another student said, "I like that it is a smaller, intimate setting for meetings. [This is] important for the interaction with the invited leaders." The overwhelming majority of interviewees indicated that SLDI has had a beneficial effect on their leadership education.

SLDI offers a direct connection to potential mentors. "It was more difficult than expected to find a solid mentor [in medical school]," said 1 student interviewed. "Coming from a family of no physicians, I honestly had very minimal information on what medical school was like or insider tips on extra involvement or finding a mentor. SLDI has helped me achieve that."

DISCUSSION

Our results indicate that SLDI participants found benefit in attending leadership sessions. This is shown by the overwhelmingly positive responses, as at least 71% of respondents selected "agree" or "strongly agree" for all of the survey questions. Since 88% of respondents agreed or strongly agreed that SLDI helped in developing professional goals and career paths, it is evident that the SLDI platform has been successful. Our results are similar to other studies, including one that also utilized surveys and showed that participants in a medical leadership and management training program had an overwhelmingly positive response and found the program interesting, useful, and relevant to their careers.[8]

These results are encouraging for the utility of SLDI as a way to disseminate important nonclinical information to medical students. Furthermore, because participants believe they are cultivating these skills without having to attend multiple sessions, this format could be used as an informal way to include leadership education in a medical school curriculum. Though this study demonstrates the benefits of our SLDI platform on leadership education of our students, there are still barriers to integrating SLDI into a medical school curriculum. Each session is unique and what students take away—aside from the 5 categories we studied—can be highly personal and dependent on the physician leader guests. We are still developing a concrete educational program and uncovering methods for longitudinal integration of our platform into medical school curricula.

Our study has limitations. The nature of retrospective surveys means that there is the possibility for recall bias. Furthermore, our study lacks a control population, which would include students who did not participate in SLDI sessions. This selection bias may skew our results to show that SLDI is providing benefit to students who are interested in attending our sessions. We recognize students who attend SLDI sessions are intrinsically motivated to learn leadership skills and may not reflect the entire student population. Additionally, our survey response rate is lower than most reported values.[8] We suspect this reflects the low proportion of students on our email listserv (246 emails) who consistently participate in sessions and are most likely to respond to the survey. Students can add their emails to the listserv, typically after signing up during the annual MCW Student Organization Fair, without having attended a session.

Determining best practices for leadership training has been challenging; however, we have shown that SLDI is beneficial to participants' medical education.[9] This study provides insight for leaders in medical education as they seek to implement additional aspects of medical training beyond clinical skills.[10] We have shown that small group discussions are effective for dissemination of skills and knowledge important for leaders and, in relatively few sessions, students reported that they developed leadership skills, outlined professional goals, gained confidence in leading a team, and expanded their compassion and care.

Acknowledgements: This study was supported by the Medical College of Wisconsin Institute for Health and Equity where Dr Meurer serves as director and Ms He is a biostatistician. At the time this paper was written, Drs Meurer and Hueston codirected the MCW Health System Management and Policy pathway in which Dr Linehan and Dr Chartier were enrolled.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Evidence of Early Household Transmission of SARS-CoV-2 Involving a School-Aged Child

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ABSTRACT

Introduction: Little is known about the role of school-aged children and household transmission at the start of the SARS-CoV-2 pandemic. To evaluate for SARS-CoV-2 in school-aged children and assess household transmission, we performed reverse transcription polymerase chain reaction on 670 archived specimens that were collected between September 1, 2019 and June 30, 2020 as part of a community-based study.

Case Presentation: A single SARS-CoV-2 case was detected in an 11-year-old girl on March 18, 2020, resulting in very low prevalence (0.15% [95% CI, 0.03–0.84]) in this population. This case was associated with SARS-CoV-2 detection in all other household members. Symptoms were reported as mild to moderate. Whole genome sequencing supported household transmission of near-identical viruses within the 19B clade.

Discussion: This case represents the earliest known household cluster of SARS-CoV2 in Wisconsin.

Conclusion: This case suggests that household transmission associated with school-aged children may have contributed to wide seeding across populations.

INTRODUCTION

The first laboratory detection of SARS-CoV-2 in Wisconsin was in a specimen collected on January 29, 2020, from a traveler returning to Madison (Dane County) from China.[1] By March 13, 2020, 334 adult and 2 pediatric cases had been reported to the Wisconsin Department of Health Services (Figure 1).

Although household transmission of SARS-CoV-2 was documented during April 2020 – September 2020 in Wisconsin,[2] early dynamics of SARS-CoV-2 transmission are unknown. We tested 670 archived specimens from school-aged children participating in a community-based influenza study (ORegon CHild Absenteeism due to Respiratory Disease Study [ORCHARDS], Oregon School District, Dane County), collected prior to and during the initial phase of the pandemic, to assess early transmission of SARS-CoV-2 in Wisconsin.

METHODS

ORCHARDS has enrolled students in kindergarten through 12th grade for specimen and data collection at home since January 2015.[3] Parents of a child with an acute respiratory infection call the study telephone line to enroll; eligibility requires ≥ 2 symptoms (fever, cough, coryza, nasal congestion, sore throat) with onset ≤ 7 days. Families may participate in a transmission study requiring symptom recording and self-collected anterior nasal specimens on day 0 (day of study packet drop-off) and 7 days later (day 7). Families participating in ORCHARDS receive a $50 gift card. Self-collected specimens for ORCHARDS have high reliability.[4] This study was reviewed and approved by the University of Wisconsin Health Sciences Institutional Review Board.

All ORCHARDS specimens were assessed initially at the Wisconsin State Laboratory of Hygiene (WSLH) for influenza and other respiratory viruses via reverse transcription polymerase chain reaction (RT-PCR) multiplex testing,[5,6] but not SARS-CoV-2 due to limited testing and supply constraints at the time

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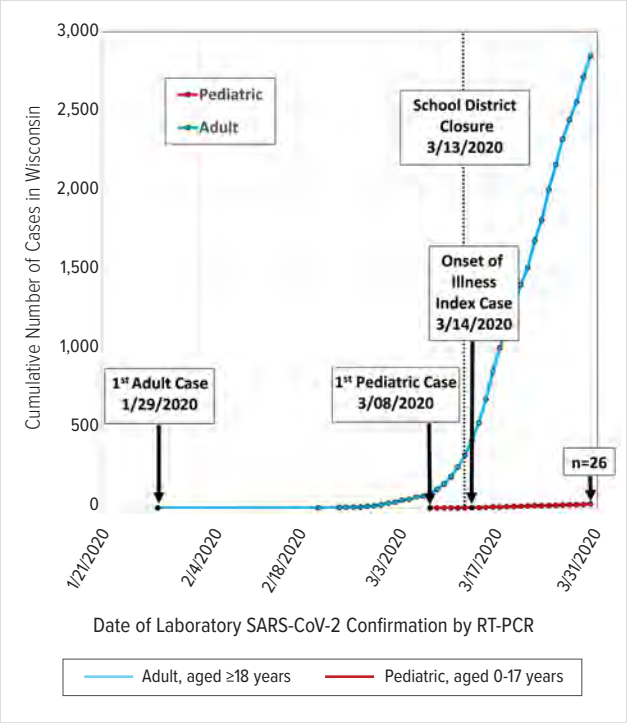
Figure 1. Cumulative Number of Laboratory-Confirmed Adult and Pediatric SARS-CoV-2 Cases Reported to the Wisconsin Department of Health Services, January Through March 2020



Dates of the first adult and pediatric cases, along with the day of symptom onset for the ORegon CHild Absenteeism due to Respiratory Disease Study (ORCHARDS) index case are shown. Cases confirmed by reverse transcription polymerase chain reaction (RT-PCR). The dotted line indicates timing of the Oregon School District closure. Case count data (2,850 cumulative adult cases and 26 pediatric cases by March 31, 2020) were provided by Wisconsin Department of Health Services.[1]

Table. Number of Specimens Collected and Specimens Positive for SARS-CoV-2 Per Study Period Between September 1, 2019, and June 30, 2020, From Students Participating in the ORegon CHild Absenteeism due to Respiratory Disease Study (ORCHARDS), Oregon School District, Dane County, Wisconsin

Specimen Collection Period	No. of Specimens Available	No. positive for SARS-CoV-2 (%)
September 2019	38	0 (0)
October 2019	38	0 (0)
November 2019	27	0 (0)
December 2019	63	0 (0)
January 2020	191	0 (0)
February 2020	237	0 (0)
Early-March 2020[a]	57	0 (0)
Late-March 2020[a]	18	1 (5.6)
April 2020	2	0 (0)
May 2020	2	0 (0)
June 2020	2	0 (0)
Total: September–June	**670**	**1 (0.15)**

[a]Early-March (until March 13, 2020) includes specimens collected following the standard ORCHARDS protocol and before school closure; late-March includes specimens collect after March 13, 2020 when Oregon School District schools were closed and the ORCHARDS protocol was modified.

of collection. Aliquots of specimens were archived and frozen at −70°C at the WSLH. Archived specimens collected from students between September 1, 2019 and June 30, 2020 were tested for SARS-CoV-2 using RT-PCR,[7] with all testing completed on February 27, 2021. Whole genome sequencing was performed at the WSLH using the Illumina MiSeq platform.[8,9] Sequences were compared to 11 contemporaneous Wisconsin SARS-CoV-2 specimens.

RESULTS

One of 670 ORCHARDS specimens (0.15% [95% CI, 0.03–0.84]) was positive for SARS-CoV-2; this specimen was collected on March 18, 2020 (Table). Details of this child and the related household cluster are reported below.

Case Presentation – Child

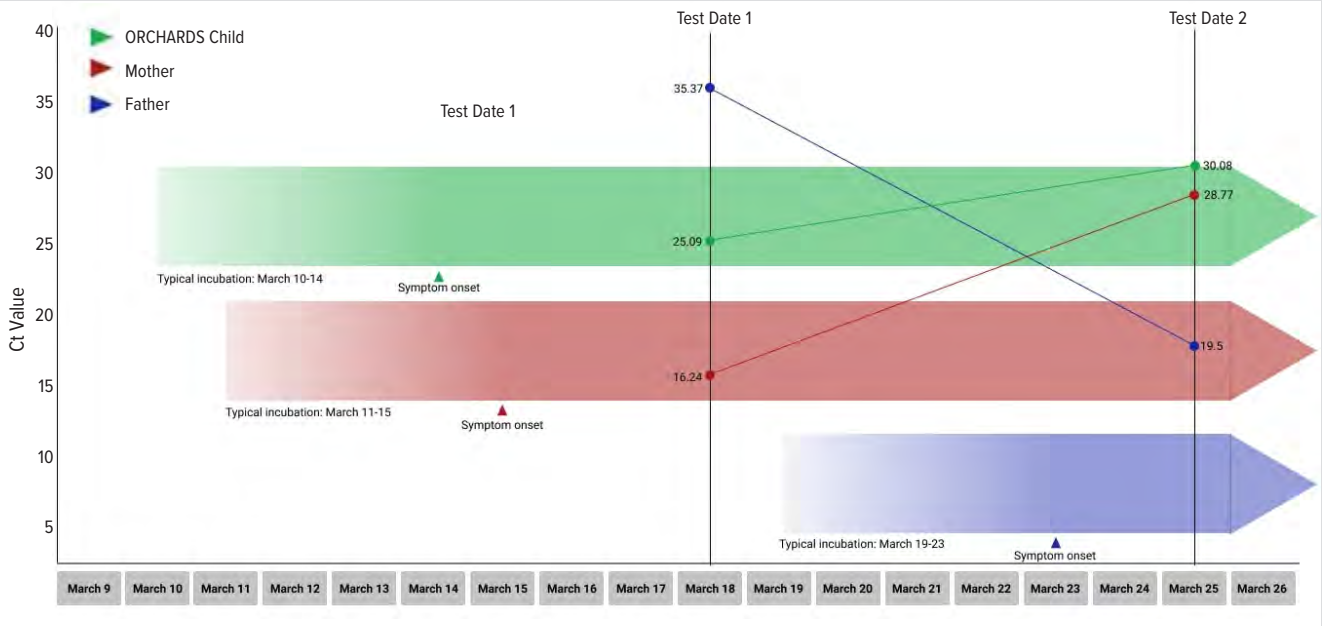
On March 17, 2020, the mother contacted ORCHARDS to report an influenza-like illness in her 11-year-old daughter. She was the only child in the household; the family reported no travel in the week prior to her illness onset on March 14, the day after the closure of her intermediate school (grades 5–6). Research staff provided a home study kit on March 18 (day 0). A moderate influenza-like illness with fever, cough, nasal discharge, fatigue, and headache was documented on day 0. By day 7 (March 25), her overall illness was rated as mild, with continuation of fever, cough, nasal discharge, fatigue, and nasal congestion. No medical visits occurred for this illness.

Case Presentation – Household Contacts

The 46-year-old mother reported onset of a moderate influenza-like illness on March 15 with symptoms of fever, chills, cough, fatigue, headache, and nasal congestion documented on day 0 (March 18). She did not seek medical care but missed 1 day of her work providing in-home daycare services. By day 7, her overall illness was rated as mild with continued cough, fatigue, headache, and nasal congestion. The 50-year-old father did not report any symptoms on day 0 (March 18). He then developed a mild illness with symptoms of fever, chills, nasal discharge, and muscle aches on March 23. He did not miss any time from his work outside the home and did not seek any medical care for this illness.

Following the modified ORCHARDS protocol, all household members self-collected anterior nasal specimens from both nostrils on days 0 and 7. The day 0 specimen from the ORCHARDS child was tested immediately after receipt and found to be negative for influenza and 14 additional respiratory viruses, not including SARS-CoV-2.[5,6] All other specimens were tested immediately for influenza and were negative. After detection of SARS-CoV-2 in the archived day 0 specimen of the ORCHARDS child, however, the remaining household specimens (days 0 and 7) were then tested for SARS-CoV-2 at the WSLH using the TaqPath RT-PCR.

Figure 2. Time Course of SARS-CoV-2 Transmission Among Members of a Household in Wisconsin, March 2020



Abbreviation: ORCHARDS, ORegon CHild Absenteeism due to Respiratory Disease Study; Ct, cycle threshold.

Onset of symptoms for each household member is shown, along with the SARS-CoV-2 Ct values from reverse transcription polymerase chain reaction testing. Note that the manufacturer only provides instructions for interpreting Ct values as positive or negative for SARS-CoV-2 in a specimen. The hypothesized incubation period is provided for everyone.[10]

The GISAID accession numbers for these household members are EPI_ISL_803306, EPI_ISL_803327, EPI_ISL_803307, EPI_ISL_803638. The GISAID accession numbers of Wisconsin contemporaneous samples are 578531, 578455, 578445, 578454, 421325, 578380, 421328, 421329, 421324, 421331, and 417514.

The days 0 and 7 specimens collected from each of the 3 household members were positive for SARS-CoV-2 (Figure 2). Specimens collected from the child and mother demonstrated increasing cycle threshold (Ct) values from day 0 to day 7, suggestive of decreasing viral loads.[10] The Ct value in RT-PCR is defined as the number of amplification cycles required for a signal to cross the threshold of detection. Specimens collected from the father demonstrated declining Ct values, suggestive of increasing viral load.

Whole genome sequencing performed by the WSLH on all specimens was not successful for 2 specimens (father day 0; child day 7) with Ct values > 30. Sequences for the remaining 4 specimens were aligned using Nextalign, visualized using Nextclade, and found to be near-identical (differing at 2 sites: nucleotide 942 in Spike and nucleotide 26.211 in ORF3a) and clustered with the 19B clade (Pango A.4 lineage).[11-13]

DISCUSSION

Low level of detection of SARS-CoV-2 in school-aged children is not surprising given the timeframe of specimen collection relative to low levels of this virus in Wisconsin,[1] eligibility criteria requiring acute respiratory infection, and closure of schools in the Oregon School District on March 13, 2020, and across the state no later than March 18, 2020. The sampling frame of ORCHARDS likely enhanced identification of uncommon events due to the longitudinal nature of this study, community recognition and trust, and the provision of an incentive for participation.

To our knowledge, this is the earliest detected household cluster of SARS-CoV2 in Wisconsin. Based upon onset, course of illness, and Ct values, the initial case was either the child or the mother. The child's exposures outside the home included public school classmates and friends. The mother's exposures outside of household members included the preschool children for whom she provided in-home care. The declining Ct values in the father likely represent within-home transmission from either his daughter or his wife.

Upon visual inspection of the Wisconsin-specific Nextstrain phylogentic tree (https://nextstrain.org/community/gagekmoreno/Wisconsin-SARS-CoV-2/ncov/wisconsin/2021-1-8), we found that 11 contemporaneous Wisconsin SARS-CoV-2 specimens were identical or near-identical to those of the family, consistent with limited local spread following a single introduction of a clade 19B virus. Given the known epidemiologic interactions among the family members, this cluster likely represents a single introduction followed by spread in the household. However, exposure through a shared outside source cannot be ruled out.

Furthermore, this cluster illustrates the potential role of unrecognized SARS-CoV-2 cases during the early pandemic in transmission outside of the home. The index child remained at home beginning March 14 because schools were closed in response to

the pandemic. However, the mother, after taking a day off from work, resumed providing childcare to preschool children. The father—reporting only a mild illness despite a relatively low Ct value on day 7—continued to work outside of the home. We cannot determine whether there was onward spread from these individuals.

Finally, this cluster report underscores the importance of community-based surveillance programs and the banking of specimens for future evaluation. In this instance, a nationwide shortage of testing reagents precluded immediate testing. Had early results been available, they may have informed public health agencies on the frequency of mild COVID-19 infection and the high risk for household transmission. A handful of similar programs scatted across the state could provide real-time situation awareness of trends in respiratory pathogens.

CONCLUSIONS

In the early phases of the SARS-CoV-2 pandemic, unrecognized household transmission associated with school-aged children may have contributed to wide seeding across populations. Identification of this early household transmission cluster underscores the value of longitudinal, community-based, laboratory-supported surveillance that can be repurposed for public health response following emergence of a novel pathogen. Similar to the Seattle Flu Study,[14] we used specimens collected for a study of influenza and other respiratory viruses to examine early prevalence and transmission of SARS-CoV-2 in a low-risk population in Wisconsin. Hence, preestablished, community-based longitudinal research and surveillance platforms can act as a window on early transmission dynamics of newly emergent pathogens.

Acknowledgments: We are indebted to the families of the Oregon School District for participation in ORCHARDS and the district's administration and staff for their ongoing support. We thank Anna Kocharian, MS, with the Wisconsin Department of Health Services for providing SARS-CoV-2 cases data for Wisconsin.

Financial Disclosures: Dr Temte reports a conflict of interest in that he received in-kind research support from Quidel Corporation for the ORCHARDS study. The other authors have no conflicts of interest to disclose relevant to this article. Quidel Corporation did not direct or exert any influence over this manuscript.

Funding/Support: This study has been supported by the Centers for Disease Control and Prevention through cooperative agreement # 5U01CK000542-02-00. Dr Temte received the award.

Role of Funder/Sponsor: Centers for Disease Control and Prevention project officer (AU) assisted with study design, interpretation of data, writing of this report, and in the decision to submit the paper for publication. The findings and conclusions in this study are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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The Risks of Reflexive Refilling

Olivia R. McCarty, MD; Margaret Pertzborn, PharmD; Paul A. Bergl, MD

ABSTRACT

Introduction: The electronic health record and electronic prescribing have transformed the practice of medicine. Both have led to improved efficacy and safety in medication management. However, dangers may arise when electronic prescription requests are filled by default and when electronic health record medication lists are presumed accurate. In this case, our patient underwent 2 days of inpatient evaluation before a thorough medication reconciliation revealed that his symptoms had likely resulted from a medication that had been refilled reflexively.

Case Presentation: A 69-year-old man presented with worsening weakness, weight loss, decreased appetite, and nonbloody diarrhea. Imaging revealed a large right pleural effusion and a nonspecific colitis. Lab workup revealed significant bicytopenia, hypogammaglobulinemia, and hypolipidemia. Initial evaluation and diagnoses were focused toward causes of malnutrition and malabsorption. However, on hospital day 2, a pharmacist discovered that the patient had been taking long-term oral linezolid for unclear reasons. With cessation of linezolid, the patient's myriad symptoms resolved and all lab values progressively normalized.

Discussion: The side effects of linezolid have been well documented and include reversible myelosuppression and gastrointestinal symptoms. However, medication reconciliation was imperative in diagnosing and treating our patient. Further, reflexive refilling of this patient's medication likely explains why he was taking linezolid for such a long period of time, as other forms of automation bias are known to introduce errors in electronic prescribing.

Conclusion: This case calls attention to the importance of medication reconciliation, the danger of overreliance on electronic health record medication lists, and the pitfalls in not maintaining vigilance with electronic prescribing. It also highlights the necessity of patient and caregiver education regarding their medications.

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INTRODUCTION

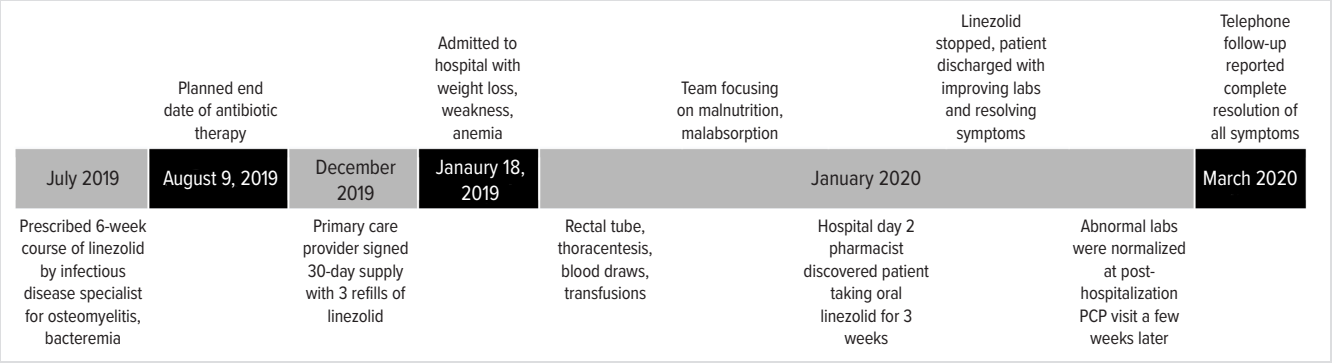
The electronic health record (EHR) and electronic prescribing (e-prescribing) have transformed the practice of medicine. Both have led to improved efficacy and safety in medication management. However, dangers may arise when electronic prescription requests are filled by default and when EHR medication lists are presumed accurate.

We report the case of a patient who underwent 2 days of inpatient evaluation before a thorough medication reconciliation revealed that his symptoms had likely resulted from a medication that had been refilled reflexively.

CASE PRESENTATION

A 69-year-old man with hypertension, diabetes mellitus, and previous below-the-knee amputation presented to the emergency department (ED) for worsening weakness, hair loss, decreased appetite, and watery, nonbloody diarrhea. His symptoms began insidiously and developed over several weeks. His weakness was characterized by difficulty in wheelchair transfers and several falls. He had no fevers but had lost 25 pounds since his last recorded weight 3 months earlier. The remainder of his review of systems was negative. His vital signs were normal, and his physical examination was notable only for pallor and alopecia. In the ED, he had a hemoglobin of 5.0 g/dL and a platelet count of 72×10^6/uL compared to values of 8.7 g/dL and 246 x 10^6/uL, respectively, 5 months earlier. Additionally, computed tomography (CT) of the abdomen revealed a large right pleural effusion

Figure. Timeline of Linezolid Treatment



and nonspecific colitis. He received 2 units of packed red cells and was admitted to the medicine ward for further management and evaluation. Workup of his bicytopenia revealed normal iron stores but profound reticulocytopenia (0.05 10^6/uL). He underwent thoracentesis, which revealed transudative fluid. His diarrhea was negative for common viruses, bacteria, and parasites. His albumin was 3.6 g/dL, total protein was 5.5 g/dL with hypogammaglobulinemia, and his low-density lipoprotein cholesterol (LDL-C) was less than 4 g/dL. Thus, our team began to focus evaluation toward malnutrition and malabsorption.

While the admitting physicians performed a cursory medication reconciliation based on the patient's most recent electronic medication list, on hospital day 2, an inpatient pharmacist performed a more thorough review of the patient's outpatient medications. The pharmacist used multiple data sources, including the patient's recollection, his wife's report of medications physically in their possession at home, a prescription adjudication database with dispensations, and both the local EHR and linked EHRs in other health care organizations. Upon completion of this thorough reconciliation, the pharmacist discovered that the patient had been taking oral linezolid for 3 weeks. Although linezolid had not appeared on any of the patient's electronic medication lists, we verified the prescription had been electronically signed by his primary care provider (PCP) for a 30-day supply with 3 refills. A timeline of the patient's linezolid prescriptions and symptoms can be viewed in the Figure. Neither the patient nor his wife could provide a reason for the prescription, and we found no clinician documentation justifying this refill. The patient's PCP was contacted via telephone in an attempt to clarify the prescription. Unfortunately, the PCP did not recall why the antibiotic was restarted.

In reviewing the EHR, we discovered that the patient had received a 6-week course of linezolid 6 months prior for osteomyelitis and Staphylococcus aureus bacteremia. As we could find no rationale for the current prescription, we surmised that an errant electronic refill was generated by his pharmacy and inattentively refilled in his PCP's office.

With cessation of linezolid, the patient's reticulocyte count and platelet count quickly normalized. In a post-hospitalization primary care visit, his hemoglobin had risen to 10.7 mg/dL, his LDL-C was 30 mg/dL, and his diarrhea had subsided. In a telephone follow-up 3 months later, he reported complete resolution of all his symptoms. Approximately 9 months after hospitalization, his hemoglobin had completely normalized and his weight had returned to his previous baseline.

DISCUSSION

Linezolid is an antibacterial agent with broad-spectrum activity against gram-positive organisms. Its side effects include reversible myelosuppression. While thrombocytopenia is more common, anemia may also complicate long-term linezolid use.[1] Linezolid exhibits its therapeutic effects by inhibiting protein synthesis via blockade of the bacterial ribosome 50S subunit. However, this activity may affect human mitochondrial protein synthesis and thus may contribute to broader mitochondrial toxicity across multiple tissue types.[2] Given these wide-ranging effects, we speculate that the patient's bicytopenia, alopecia, hypolipoproteinemia, and presumed malabsorptive diarrhea all related to prolonged linezolid toxicity.

This case calls attention to the importance of medication reconciliation and the perils of over-reliance on EHR-based medication lists and e-prescribing. The primary goals of electronic medication lists and e-prescribing are to improve the quality, clarity, and safety of medication prescriptions. E-prescribing has led to fewer adverse drug events and errors, and it has improved the efficiency of the prescribing process.[3] Further, it saves administrative costs and increases patient adherence.[3] While e-prescribing has improved overall medication safety, errors may still occur if electronic medication lists are not routinely reconciled[4] or if EHR warnings are ignored due to alert fatigue.[3]

The advent of e-prescribing gave rise to clinical decision support (CDS) systems that alert prescribers to potential errors. However, while helpful, e-prescribing and associated CDS are prone to inaccuracies. For example, automation bias may occur when clinicians excessively rely on CDS; this bias is formally

defined as "the tendency to use automated cues [such as CDS alerts] as a heuristic replacement for vigilant information seeking and processing."[5] In one observational study, researchers examined how automation bias affected e-prescribing in simulated clinical scenarios and found that overreliance on CDS can lead clinicians to make both omission errors (ie, failing to notice mistakes unless notified by CDS software) and commission errors (ie, rotely complying with incorrect CDS suggestions). Specifically, when CDS provided incorrect information—either by failing to alert or creating a "false alarm" alert—prescribing errors increased by 86.6%.

Alert fatigue is a related byproduct of CDS and is described as a "mental state that is the result of too many alerts consuming time and mental energy."[6] In a review of CDS alerts, safety alerts were overridden in 49% to 96% of cases, with irrelevance and repeated information most often cited as reasons for overriding.[6] Other studies have shown that prescribers often disagree with CDS alerts, especially when the patient was already taking the medication or in the absence of a true contraindication.[5] Finally, another study that examined CDS alert fatigue found that clinicians were less likely to accept best practice reminders when the number of reminders and frequency of repeated reminders were higher.[7] Although we lack direct proof, we speculate that the ease and efficiency of e-prescribing, along with the known risk factors of automation bias and alert fatigue, may have contributed to reflexively refilling linezolid for our patient.[5-7]

While the goal of electronic medication lists is to improve safety and efficiency, they are often incorrect and outdated. Unfortunately, these inaccuracies are common, with a 2015 systematic review finding that from 20% to 87% (median 60%) of discharged patients had errors in their EHR medication lists. The most common medication list discrepancies are simply medication omissions. Importantly, this systematic review also found a correlation between the number of medication discrepancies and the total number of medications a patient was prescribed.[8]

Thus, authorities in medication safety have emphasized medication reconciliation—particularly at points of transition in care—as a solution to the wide reach of medication-related harm.[9-11] The World Health Organization (WHO) defines medication reconciliation as a formal process in which health care professionals and patients together ensure medication list accuracy at all care interfaces.[9] Steps in the medication reconciliation process, as outlined by the WHO, include (1) obtaining the best possible medication history, (2) confirming history accuracy, (3) reconciling the history with currently prescribed medications, and (4) supplying accurate information about the medications.[10] Further, the Joint Commission listed medication reconciliation as a national patient safety goal for 2020 and outlined a process that builds upon WHO recommendations. This process also includes defining the medication (including name, dose, route, frequency, and purpose), comparing the patient's medications to the medications that are ordered, and explaining to patients how to manage their medications.[11] The MATCH toolkit (Medications at Transitions and Clinical Handoffs) is a useful resource for practical implementation of medication reconciliation best practices.[12] Had our clinical pharmacist not manually reconciled the EHR medication list through meticulous tracking of medication dispensing data, we would have pursued a costly and unnecessary evaluation for malabsorption and malnutrition. Moreover, failure to discover and discontinue the patient's linezolid prescription could have led to recurrent symptoms after hospitalization when the patient resumed his home prescriptions.

Ostensibly, if frequent medication reconciliation by a clinical pharmacist were feasible in the outpatient setting, our patient may have been spared from hospitalization entirely. In one hospital-based multicenter quality improvement initiative, interventions that led to decreased rates of medication discrepancies included providing clear definitions of clinical roles and responsibilities in medication reconciliation and hiring dedicated staff (usually pharmacists) to perform medication reconciliation at discharge.[13] In fact, the literature largely supports pharmacist-led medication reconciliation as a safety mechanism. A systematic review found that adverse drug event-related hospital revisits and hospital readmissions were reduced after implementation of pharmacist-led medication reconciliation interventions at transitions of care.[14] In a separate review, pharmacist-led reconciliation interventions decreased the number of medication discrepancies and adverse drug events.[15]

This case also highlights the imperative to educate patients and caregivers on their medications. Patients' understanding of medication instructions and indications, empowerment, and self-efficacy with medication management all correlate with improved compliance.[16] By extension, such engagement should predictably reduce medication errors. Further, several studies and guidelines have highlighted the importance of patient and caregiver education regarding their medications when performing effective medication reconciliation.[11,15] While our patient's wife maintained his medication list, we discovered that both she and he had poor understanding of the medications' indications. Perhaps hospitalization could have been avoided if they had a clear understanding of why linezolid—an antibiotic that had been used to treat a systemic infection previously—was being represcribed. The case also calls attention to the broader issue of patient health literacy. Low health literacy is associated with poor health outcomes, including the abilities to correctly take medications and interpret medication labels.[17] Interventions to improve health literacy include using plain and nonmedical language in verbal and written communications, using visual aids and models, empowering patients to participate and manage their care, and providing support systems when necessary.[17]

Beginning in 2021, pharmacists in Wisconsin are no longer required to counsel patients on refilled prescriptions so long as the patient has taken the drug previously, the therapy has not changed,

the patient does not request counsel, and the pharmacist does not deem it necessary.[18] While this may decrease workload for pharmacists, it may prove detrimental to patient safety and well-being. Certainly, our patient would have benefited from an earlier intervention and counseling from a pharmacist regarding his linezolid refill. However, since this case occurred in early 2020, he presumably did receive some counsel regarding the refill, which again highlights the importance of patient health literacy and medication reconciliation at multiple transitions of care. Ultimately it must be a combined effort on the part of physicians, pharmacists, and patients to ensure that medications are prescribed, managed, and taken safely and appropriately.

CONCLUSION

This case calls attention to the importance of medication reconciliation, the danger of overreliance on electronic health record medication lists, and the pitfalls in not maintaining vigilance with electronic prescribing. It also highlights the necessity of patient and caregiver education regarding their medications.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Pausing During the Pandemic: Addressing Cognitive Biases in Providers' Medical Decision-Making During the COVID-19 Era

Sarah Yale, MD; Jacqueline Lee, MD; Natalya Beneschott, MD; Amanda Rogers, MD

ABSTRACT

Introduction: The COVID-19 pandemic has not only exacerbated traditional cognitive biases but also created new cognitive biases specific to the pandemic that contribute to diagnostic errors. Cases of suspected multisystem inflammatory syndrome in children (MIS-C)—one of the more clinically significant manifestations of COVID-19 in children—need to be reported and reviewed by clinicians as they have varied presentations and lack definitive confirmatory testing, presenting challenges to effective diagnosis.

Case Presentation: We present 3 cases of pediatric patients initially diagnosed with COVID-19/MIS-C who were ultimately found to have alternative diagnoses.

Discussion: For each case, we describe conventional and COVID-19-related cognitive biases to enhance awareness of their role in diagnostics and promote strategies to support diagnostic accuracy and timeliness.

Conclusion: With rapidly changing knowledge about COVID-19 and MIS-C, providers must remain diligent to counteract heuristic thinking and provide timely and accurate diagnostic evaluations.

INTRODUCTION

COVID-19 has transformed the health care field in myriad ways, one being a growing risk of cognitive biases contributing to diagnostic errors. Prior to the pandemic, diagnostic errors were estimated to occur at a rate of 10% to 15%.[1] COVID-19 has led to the rapid influx of evolving information, frequent modifications to workflows,[2] and physical and psychological strain on providers,[3] which can increase the risk of heuristic thinking.[4-6] In addition, a new typology of diagnostic errors has emerged specific to the impact of COVID-19, which clinicians must be aware of to help mitigate these barriers to optimal care.[7]

Pediatrics is uniquely vulnerable to several cognitive biases (systematic pattern of deviation from rationality in judgment) in the setting of COVID-19. There is pervasive public awareness of COVID-19 despite a relatively low severity of disease burden in pediatrics. Children often have mild cases, nonspecific findings,[8] and a high rate of asymptomatic carriage,[9] which can lead to diagnostic challenges. Additionally, multisystem inflammatory syndrome in children (MIS-C)—one of the more clinically significant manifestations of COVID-19 in children—has varied presentations and lacks definitive confirmatory testing, presenting challenges to effective diagnosis.[10]

We present 3 cases of pediatric patients initially diagnosed with COVID-19/MIS-C who were ultimately found to have alternative diagnoses. For each case, we describe conventional and COVID-19-related cognitive biases to enhance awareness of their role in diagnostics and promote strategies to support diagnostic accuracy and timeliness.

CASE 1

A 2-year-old girl presented with 2 weeks of anorexia, emesis, and abdominal discomfort. She had no fever or diarrhea. Initial evaluation included normal electrolytes, inflammatory markers, and abdominal radiograph. Her lipase was 2 to 3 times the upper limit of normal (800 U/L). Abdominal ultrasound revealed mild gallbladder wall inflammation and no pancreatic changes. Her SARS-CoV-2 nucleic acid amplification test (NAAT) was positive. She was hospitalized for dehydration suspected to be secondary to pancreatitis and COVID-19-related gastrointestinal (GI) symp-

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toms. Subsequent review of her clinical timeline noted that her GI symptoms preceded her COVID-19 diagnosis, and additional family history noted paternal celiac disease and maternal Graves' disease. Further workup included elevated tissue transglutaminase (>128 units/mL) and positive anti-endomyoseal IgA. Her abdominal pain, anorexia, elevated lipase, and gallbladder wall inflammation were ultimately attributable to duodenitis secondary to celiac disease. She was discharged home with a celiac-appropriate diet with subsequent resolution of her symptoms.

Discussion

This case demonstrates ***confirmation bias***, when providers look for and accept only evidence that confirms a diagnostic impression, rejecting contradictory evidence.[11] Confirmation bias is closely related to availability bias, where providers tend to think of examples that come to mind more readily than the actual case frequency. Despite the patient's lack of fever, diarrhea, or respiratory symptoms, her abdominal pain and vomiting were referenced as GI manifestations of COVID-19. Similarly, despite normal pancreatic imaging, the elevated lipase and abdominal pain were attributed to acute pancreatitis. Elements supporting the suspected diagnosis were interpreted as confirmatory, while contradictory data was classified initially as an atypical presentation.

This case also highlights a specific type of error related to COVID-19 labeled as ***unintended***.[4] This is a missed or delayed diagnosis because of fewer direct provider-patient interactions, including increased use of telemedicine and personal protective equipment conservation efforts that may lead to challenges taking histories and performing exams. The patient presented early in the pandemic when infection prevention processes were in development. It is possible COVID-19-related changes in patient placement, reduced room entries, and limited experience with telehealth affected the speed at which key features were identified, including that her GI symptoms preceded her COVID-19 infection and her family history of autoimmune diseases, which were vital to reaching her ultimate diagnosis.

CASE 2

A 14-year-old female presented with 1 day of altered mental status; 3 days of fever, cough, dyspnea, vomiting, and diarrhea; 5 days of neck and throat pain; and a known COVID-19 exposure 1 month prior. She was febrile, hypotensive, and tachycardic. Blood cultures were obtained, and she was given empiric antibiotics. Workup was notable for thrombocytopenia (platelets 54 K/uL) and elevated procalcitonin (228.47 ng/mL), C-reactive protein (CRP) (23.1 mg/dL), D-dimer (4.05 mg/L), ferritin (370 ng/mL), and NT-proBNP (1,737 pg/mL). Monospot test and SARS-CoV-2 NAAT and IgG were negative. Gram stain showed gram-negative bacilli on 2 cultures. Based on her fever curve, markers of inflammation, and COVID-19 exposure, the patients was diagnosed with MIS-C and started on enoxaparin, intravenous immunoglobulin (IVIG), and steroids. After MIS-C treatment was initiated, her blood cultures subsequently grew *Fusobacterium necrophorum* and an ultrasound revealed an internal jugular vein occlusive thrombus, leading to the diagnosis of Lemierre's syndrome.

Discussion

This case represents ***diagnostic momentum,*** perpetuating a diagnostic label over time despite the label being incomplete or inaccurate, as well as premature closure where the clinician fails to consider alternative diagnoses after an initial diagnostic label is made.[11] The patient initially was labeled with MIS-C given her fevers, respiratory and GI symptoms, and degree of inflammation. This was perpetuated despite developments pointing in a different direction, including negative SARS-CoV2 NAAT and IgG testing and a positive gram stain on 2 cultures. It was not until the organism considered pathognomonic for Lemierre's syndrome was identified that the initial diagnostic label was replaced.

The case also highlights how the cognitive bias of ***anchoring*** can be amplified in the COVID-19 era. In anchoring, clinically significant non-COVID-19 diagnoses may be missed or delayed because symptoms are attributed to COVID-19. It can be challenging for clinicians to interpret new information objectively once the assumption has been made that COVID-19 is the culprit, and data are interpreted "anchored" to this original viewpoint. In this case, the 2 positive gram stains were initially assumed to be a contaminant. It was interpreted under the assumption that COVID-19 was the underlying process.

CASE 3

A 13-year-old female presented with 4 days of abdominal pain, vomiting, anorexia, dysuria, and fever. Her exam was notable for right upper quadrant tenderness and cracked lips. SARS-CoV-2 NAAT was negative, IgG was positive, and she reported a COVID-19 contact 1 month prior. Labs were notable for elevated white blood cell (WBC) count (14.6 K/uL), CRP (18.4 mg/dL), D-dimer (2.47 ug/mL), fibrinogen (982 mg/dL), and procalcitonin (2.49 ng/mL). Urinalysis showed 20-50 WBCs. Based on her fevers and labs, she initially was labeled as MIS-C and treated with IVIG. The following morning, her urine culture grew >100,000 CFU/mL of *Escherichia coli*. She was ultimately diagnosed with pyelonephritis and treated with appropriate antibiotics.

Discussion

This case demonstrates ***availability bias***,[12] the tendency to more easily recall things that were seen recently or are common or memorable. The patient presented in a timeframe of multiple MIS-C cases, which can raise the clinical suspicion and reflects a ***diagnostic recall bias***. Despite the incidence of pyelonephritis being significantly higher than MIS-C, the ubiquitous nature of information and evolving guidelines regarding MIS-C in pediatrics may lead to prematurely labeling patients with this readily available diagnosis.

The case also highlights the emerging COVID-19-related diagnostic error, ***secondary***,[7] in which a second diagnosis was initially missed due to a positive SARS-CoV-2 test. The patient's presentation initially was attributed to MIS-C, in large part due to the

Box. Diagnostic Timeout

1. Name the clinical concern or diagnostic dilemma
2. Remove diagnostic labels and instead list out signs and symptoms (ie, remove COVID-19/MIS-C)
3. Do we currently have a leading diagnosis? If so…
   - What clinical data cannot be explained with the provisional diagnosis?
   - What are the "can't miss" or "worst case scenario" diagnoses?
4. Broaden the differential using an anatomic (or age-based if pediatric patient) approach
5. Decide on next steps:
   - Obtain further history and repeat physical exam
   - Review labs and actual images (not just the reports)
   - Discuss with other team members (consultants, nurses) and family
   - Obtain further labs and imaging (using pre and posttest probability)

positive IgG, which was ultimately an incidental finding. This led to a delay in identifying the secondary clinically relevant diagnosis of pyelonephritis. This type of error may be especially prominent within pediatrics, where many COVID-19 cases are asymptomatic[9] and caught on routine surveillance testing during admission for secondary unrelated diagnoses.

MITIGATING ERROR

Providers have a crucial role in counteracting heuristic thinking and replacing it with analytical, thoughtful processing[13] in the appropriate clinical settings; yet this needs to be balanced with competing factors, such as patient acuity, efficiency, and resource management. The pandemic has highlighted that although providers are successful adapters in complex situations, these adaptations sometimes fail.

An important step in mitigating cognitive biases is increased awareness of their existence and impact on diagnostic processes. Learning about biases and actively reflecting on prior cases where biases may have been at play can be invaluable in counteracting their role in future cases. The Joint Commission recommends discussion of clinical cases that illustrate biases, such as the examples above, in order to raise awareness as to how they occur.[14]

Another simple, efficient tool to consider in addressing cognitive biases is pausing for a "diagnostic timeout." The timeout is not meant to simply create a longer differential but, instead, with diverse input from team members, can help promote analytic scrutiny and implement cognitive forcing strategies.[1] A stepwise approach to the timeout (Box) can remove diagnostic labels, review leading diagnoses, broaden differentials, and decide on next steps. Including interprofessional representation can be invaluable to ensure all perspectives are included. It is important to note that heuristic thinking is an essential part of clinician practice and that the evidence to support timeouts is limited, but it can be an valuable tool to consider in select clinical situations.

Other error mitigation strategies to consider include promoting the use of a systematic approach to common problems, acknowledgement of how the patient makes the clinician feel, and admitting one's own mistakes.[15]

CONCLUSIONS

These cases highlight how COVID-19 has further complicated the contributory role that cognitive biases play in diagnostic errors in pediatrics, exacerbating traditional cognitive biases and leading to new errors related to the pandemic. With rapidly changing knowledge and many unknowns about COVID-19/MIS-C in pediatrics, providers must remain diligent to counteract heuristic thinking and provide timely and accurate diagnostic evaluations. Open discussion of cases is an important step in raising awareness of these biases and learning from past errors. In addition, diagnostic timeouts can serve as a structured format to reflect on diagnostic reasoning and counteract future errors.

Acknowledgments: Michelle Mourad, MD, for innovation and support of adaptation and use of the diagnostic timeout in the pediatric inpatient setting.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Austrian Syndrome – A Rare Clinical Triad

Lauren E. Watchmaker, BA; Dana Ley, MD; Bartho Caponi, MD

ABSTRACT

Austrian syndrome is the clinical triad of endocarditis, meningitis, and pneumonia secondary to *Streptococcus pneumoniae*. It is an uncommon but serious illness that requires clinical suspicion in an at-risk population in order to guide further workup and treatment. Here we present a case of a Wisconsin resident who illustrates the severity of the disease and how certain elements of this triad may be delayed in clinical presentation.

INTRODUCTION

Streptococcus pneumoniae may cause bacteremia in both immunocompetent and immunocompromised individuals. It is the most commonly isolated organism in bacterial meningitis, otitis media, pneumonia, and sinusitis.[1,2] Although the incidence of pneumococcal disease has declined following the introduction of pneumococcal vaccines, *S pneumoniae* remains the most commonly cultured organism in bacterial pneumonias (38%) in hospitalized patients.[3] Vaccinated patients who are immunocompromised have increased risk of disease and may develop disease secondary to serotypes not covered by the vaccines.[4] Disseminated disease can result in the clinical triad of pneumococcal endocarditis, meningitis, and pneumonia – also known as Austrian syndrome.

In 1957, Robert Austrian described a series of 8 patients who developed the clinical triad that now bears his name.[5] Since then, additional single case reports and small series have added to our knowledge of this rare syndrome.[6-9] Most reports describe pneumonia as the initial illness, followed by multisystem involvement.[10,11]

Unfamiliarity with this syndrome frequently leads to a delay in diagnosis, with an average time from symptom onset to diagnosis of 5 days.[9] Clinical suspicion, especially in immunocompromised individuals, provides the opportunity for earlier treatment. The diagnosis of Austrian syndrome also may modify dosage, duration, and choice of antibiotics. Here we present a case report of a patient in Wisconsin diagnosed with Austrian syndrome and discuss its diagnosis and treatment.

CASE PRESENTATION

In January 2020, a 58-year-old man with untreated chronic hepatitis C and polysubstance use disorder including intranasal heroin, alcohol (4-5 oz/day), and tobacco presented to an outside emergency department in respiratory distress. He was in his usual state of health until 2 weeks prior when he began to develop progressive fevers up to 39.5° C, chills, nausea, and vomiting. He became short of breath and, upon presentation to the hospital, had a blood pressure of 85/49 and an O_2 saturation of 82% on room air.

He was treated initially with broad-spectrum antibiotics, which included vancomycin, ceftriaxone, and piperacillin-tazobactam; fluids, vasopressors, and bilevel positive airway pressure (BiPAP). Chest imaging showed multifocal left-sided pneumonia (Figure). His acute hypoxic respiratory failure progressed rapidly, leading to intubation and transfer to our institution. His white blood cell count was 5.3; however, his immature granulocyte count was elevated to 170 (normal range 0-50/μL). His albumin was low at 1.4

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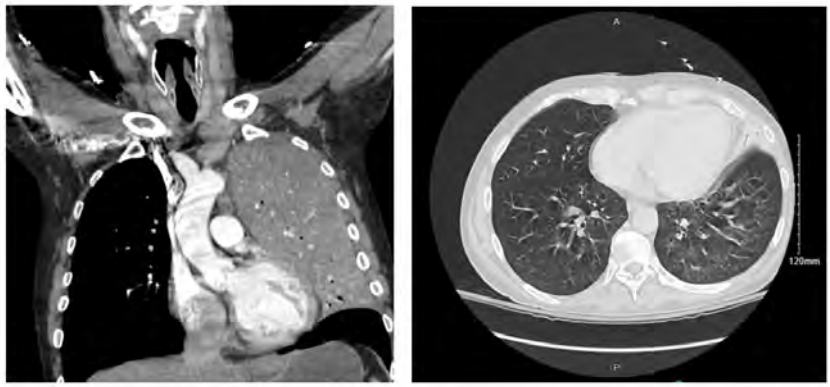
g/dL, and his aspartate aminotransferase (AST) was elevated at 240 U/L. His brain natriuretic peptide was normal, and influenza polymerase chain reaction (PCR) was negative.

The patient remained hypotensive requiring vasopressors. On hospital day 2, his initial blood cultures and sputum cultures grew *S pneumoniae* sensitive to ceftriaxone. Given bacteremia and persistent, recurrent fevers, there was concern for pneumococcal meningitis. A lumbar puncture was performed and showed 3,200 nucleated cells, low glucose, and elevated protein; and a gram stain of the cerebrospinal fluid identified gram positive cocci in pairs. Additional bacteremia workup included an echocardiogram later on admission day 2 that demonstrated a decreased ejection fraction and severe aortic regurgitation but no vegetations.

Figure. Chest Imaging at Initial Presentation



Coronal (left) and transverse (right) view of patient's computed tomography angiography (CTA) chest showing diffuse left upper lobe consolidation with inflammatory nodules.

His antibiotics were narrowed to 2 grams of intravenous ceftriaxone every 12 hours. Dexamethasone was not initiated as he had already been on antibiotics for multiple days. His condition improved, and he was extubated on admission day 8. On admission day 18, he reported decreased hearing, along with tinnitus. Audiology and otolaryngology were consulted, and workup included head magnetic resonance imaging and temporal bone computed tomographic scan to exclude tumor and anatomic inner ear pathology. The etiology of his hearing loss was presumed secondary to pneumococcal meningitis. A follow-up echocardiogram on day 23 demonstrated an 8 mm x 2 mm vegetation on the mitral valve, in addition to the aortic regurgitation. With the presence of pneumococcal pneumonia, meningitis, and endocarditis, the patient was diagnosed with Austrian syndrome. With continued clinical improvement, he was transferred to a skilled nursing facility where he completed a 4-week course of ceftriaxone and subsequently returned home. His tinnitus resolved and hearing improved to the point where he did not require hearing aids or implants. Follow-up echocardiograms demonstrated persistent regurgitation from valvular damage, which led to eventual aortic and mitral valve replacement.

DISCUSSION

S pneumoniae is a common human pathogen. Although the incidence of pneumococcal disease has declined since the introduction of pneumococcal vaccines, an increase in disease caused by pneumococcal serotypes not included in the vaccines has been observed.[4] Our patient was vaccinated with pneumococcal polysaccharide vaccine (PPSV-23) 2 years prior to presentation. We suspect that his illness was caused by his relatively immunocompromised host state from chronic, untreated hepatitis C and polysubstance abuse, although it may also have been caused by a strain not covered by PPSV-23.

In the critically ill patient with pneumococcal pneumonia and/or bacteremia, Austrian syndrome should remain in the differential, as it guides the need for additional workup for cardiac and central nervous system (CNS) involvement. In our patient, the suspicion of Austrian syndrome led to early echocardiogram and lumbar puncture. This is important because if meningitis is confirmed, CNS dosing would need to be instituted.[12] The presence of endocarditis would warrant 4 weeks of treatment rather than the 1 to 2 weeks used to treat pneumonia, bacteremia, or meningitis.[13]

Initially, the clinical triad of pneumococcal endocarditis, meningitis, and pneumonia may be difficult to confirm, as in our case. Notably, early intubation and sedation can obscure potential neurologic symptoms, and echocardiographic evidence of a vegetation may be delayed.[13] In our case, an initial transthoracic followed by transesophageal echocardiogram showed aortic regurgitation but failed to show a valvular vegetation. Given our suspicion of Austrian syndrome and the possibility that an early echocardiogram can miss a vegetation,[13] these negative studies were followed up with repeat studies at 4 weeks. The follow-up study demonstrated a vegetation.

Austrian syndrome should also remain in the differential due to risk for longstanding neurologic damage. Our patient developed sensorineural hearing loss absent treatment with ototoxic drugs, which may have been secondary to his meningitis. Empiric corticosteroids may have mitigated this outcome;[14] however, the success of corticosteroids is associated with their initiation prior to or at the time of initial antibiotic administration.[15] Our patient was on day 2 of antibiotics prior to the diagnosis of meningitis, therefore corticosteroids were not administered.

In addition, diagnosis of pneumococcal endocarditis alerts the clinician to the possibility of longstanding valvular dysfunction.[16]

Our patient demonstrated persistent regurgitation and compromise of cardiac function, which eventually necessitated aortic and mitral valve replacement.

Austrian syndrome is more common in individuals with alcohol dependence, splenectomy, and preexisting heart disease.[6,7,17,18] In the patient with pneumococcal pneumonia, early detection of additional organ involvement through lumbar puncture and echocardiography may shorten the delay in diagnosis that is typical of Austrian syndrome. An ongoing index of suspicion is critical in the absence of confirmation. Our patient and previous reports have highlighted the delayed appearance of cardiac manifestations.[6] Until culture-positive growth and susceptibility have been determined, invasive pneumococcal disease should be treated with combination antibiotic therapy (eg, vancomycin for meningitic coverage and a third-generation cephalosporin) rather than monotherapy.[19]

CONCLUSION

The triad of endocarditis, meningitis, and pneumonia secondary to *S pneumoniae* is an uncommon syndrome and requires a high index of suspicion and recognition of an at-risk population. This case of Austrian syndrome in a Wisconsin resident highlights the typical presentation, clinical course, complications, and treatment of this serious illness. In addition, it highlights the importance of entertaining this diagnosis to guide further workup, antibiotic selection, and treatment duration.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Verbal Amnesia Secondary to Unilateral Infarct of the Mediodorsal Thalamic Nucleus

Haley Pysick, MD; Donn Dexter, MD; Christopher Lindsay, MD

ABSTRACT

Introduction: The mediodorsal nucleus is a subcomponent of the thalamus hypothesized to have a role in memory pathways. Given the limited number of reported cases and associated images, its clinical significance has not yet been fully elucidated.

Case Presentation: We report the case of a 53-year-old man who presented with verbal amnesia, including deficits of both recall and recognition. High-resolution magnetic resonance imaging demonstrated a well-defined infarct contained within the mediodorsal nucleus.

Discussion: Current literature reports a range of conclusions regarding the extent to which the mediodorsal nucleus is involved in memory pathways. Several case series have attempted to localize infarcts by combining neuropsychology testing with imaging but were constrained by dated imaging modalities often dispersed with impurities.

Conclusion: Our case demonstrates that isolated lesions of the mediodorsal nucleus can lead to deficits in both recall and recognition and that high-resolution magnetic resonance imaging is necessary when a thalamic infarct is suspected.

INTRODUCTION

The thalamus is a component of the diencephalon involved in information processing, memory, attention, and executive function.[1] The mediodorsal nucleus (MD)—a subcomponent of the thalamus—is largely attributed to limbic function.[1] Despite numerous investigations, the precise roles and mechanisms of the MD remain controversial. A particularly debated topic is the extent to which the MD is associated with memory consolidation. Previously, the long-term declarative memory center of the brain had been solely associated with the medial temporal lobe.[1] It is now understood that various components of the medial diencephalon, including the MD, also have contributions to memory processing and storage.[1] While studies have consistently revealed an association between verbal deficits and the MD, there remains controversy as to the extent these deficits are related to interference in recall and/or recognition. We present a rare case of verbal amnesia following a unilateral infarct of the MD accompanied by high-resolution magnetic resonance imaging (MRI) to support its localization.

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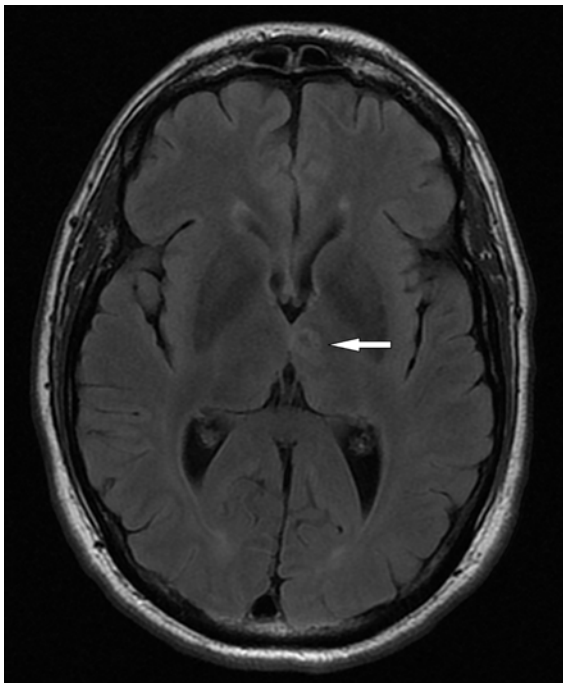
CASE PRESENTATION

An otherwise healthy 53-year-old right-handed man presented in memory clinic 1 year after experiencing acute onset dizziness and retrograde memory loss, with specific complaints of forgetting names of loved ones and getting lost while driving his regular routes. MRI revealed a chronic lacunar infarct in the left MD, which was compared to a normal MRI from 10 years prior. He was administered the Repeatable Battery for Assessment of Neuropsychological Status (RBANS) and scored in the 21st percentile. Nearly all of his scores were within normal limits except delayed memory, which showed highly selective impairment on verbal memory consolidation, including a severe deficit of both delayed recall and recognition. These results were consistent on repeat testing 1 year later, indicating the deficits are likely permanent.

DISCUSSION

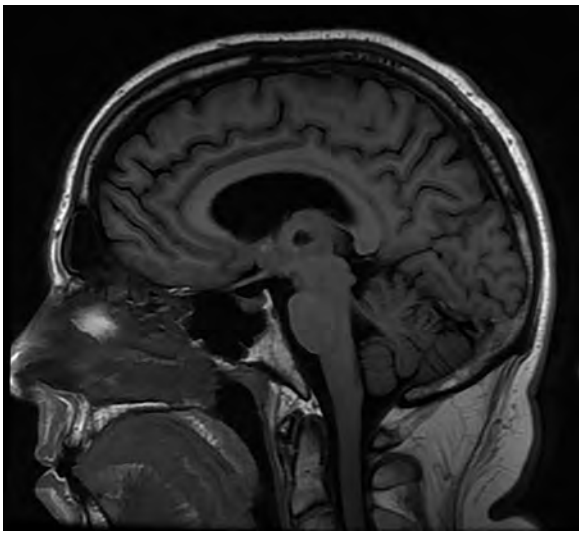
The MD contributes to numerous neural processes but continues to elude researchers in terms of its exact role in memory process ing and storage. In 1999, Aggleton and Brown classically associ-

Figure 1. Axial FLAIR Image



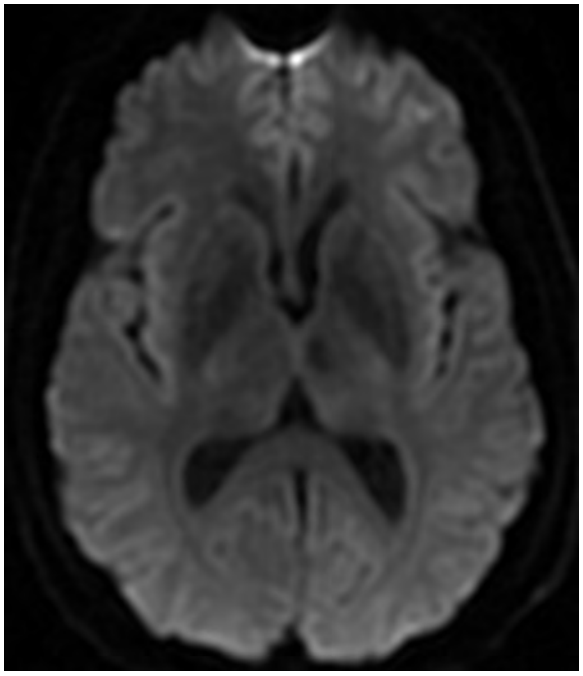
Abbreviation: FLAIR, fluid-attenuated inversion recovery.
Hyperintense signal change and gliosis, predominantly at the periphery of the infarct in the left mediodorsal thalamus, and relative low signal centrally. A classic appearance of a chronic infarction on FLAIR imaging.

Figure 2. Sagittal T1-Weighted Magnetic Resonance Imaging Scan



Encephalomalacia and volume loss of the left mediodorsal thalamus post-infarction.

Figure 3. Axial Diffusion Image



Area of low signal in the left thalamus, typical of chronic infarction. No abnormal diffusion signal to suggest acute infarction.

ated the MD with recognition—but not necessarily recall—in the perirhinal-MD system.[2] In 2011, they revised this model to include both recognition and recall, either directly or indirectly, via the MD's connection with the prefrontal cortex.[3] Other studies have proposed that the MD does not necessarily have an isolated role in the retention of previously learned material but, rather, knowledge acquisition.[4] It has even been suggested that memory impairments from lesions to the MD are due only to disruptions in executive processing, such as attention deficits, rather than primary memory storage or retrieval interference.[5] Animal studies have validated that the MD does have a role in memory processing but—similar to human studies—they have demonstrated a wide array of conclusions in terms of deficits reported secondary to MD lesions.[1]

An imperative component of diagnosing thalamic lesions clinically is utilizing high-resolution imaging. Previous case series have sought to demonstrate localization of thalamic infarcts by combining neuropsychology testing with magnetic resonance imaging.[6] However, many of these cases are now decades old and limited by organic and artificial imaging interference. The MRI scans in this patient's case provide pristine images with well-defined borders of the infarct within the MD and virtually no structural or vascular abnormalities elsewhere (Figures 1-3).

Pertinent neuropsychology findings include the patient's inability to recall words following a delay in word list discrimination testing, as well as recognition memory testing that was marginally better than chance-level performance. The clinical picture of highly specific recall and recognition deficits combined with the precise MRI findings lend support to Aggleton

and Brown's revised model and contradict several others. Given the limited research in this area, we hope this case provides perspective for future studies investigating the role of the MD in memory pathways.

CONCLUSION

Our case provides a unique addition to current medical knowledge due to the clarity of the high-resolution imaging, specificity of neuropsychology testing, and presentation in a relatively younger patient with an otherwise normal MRI. This case supports that the MD has a specific role in working memory consolidation and that, in isolation, lesions of this nucleus can be linked to selective verbal amnesia of both recall and recognition. It also reinforces the clinical importance of high-resolution MRI scans to detect infarcts when neurological deficits are suspected.

Funding/Support: None declared.

Financial Disclosures: None declared.

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Joseph E. Kerschner, MD

Making Human and Social Differences Our Source of Strength

Joseph E. Kerschner, MD

According to author Simon Sinek in *The Infinite Game*, leaders who embrace an infinite mindset – where there are no winners or losers, but only "ahead" and "behind" – build stronger, more innovative, and more inspiring organizations. Many industries, including health care and academic institutions, are embracing this "infinite game." Their people trust each other and their leaders, and have the resilience to thrive in an ever-changing world while their competitors fall by the wayside.[1]

Sinek lays down five essential practices necessary for leaders to have an infinite mindset, including advancing a "Just Cause." As he notes, "a Just Cause is linked to our WHY, our noble purpose for being. Our WHY comes from our past – it is our origin story and it is who we are. Our Just Cause is our WHY projected into the future. It describes a future state in which our WHY has been realized. It is a forward-looking statement that is so inspiring and compelling that people are willing to sacrifice to see that vision advanced."[2]

The "Just Cause" of the Medical College of Wisconsin (MCW) is to improve health for all. We envision a healthier world that is just, equitable, and thriving for everyone – a world where social and human differences are drivers of health and well-being, not barriers. And we are committed to the intentional actions it will take to achieve this vision.

To achieve our vision, we are making our human and social differences a source of strength. Social identities are the result of constructs shaped by social norms. There are many dimensions of difference,but diversity scholars suggest key dimensions of human and social difference,[4] called the "Big 8," present persisting challenges and opportunities to organizations. The dimensions found among MCW's people and stakeholders include race/ethnicity, gender/gender identity, sexual orientation, geographic origin/nationality, mental/physical (dis)ability status, religion, age, and role and functional/military background.

We envision a healthier world that is just, equitable, and thriving for everyone – a world where social and human differences are drivers of health and well-being, not barriers. And we are committed to the intentional actions it will take to achieve this vision.

As leaders, we have committed ourselves to gender equity, to be an anti-racist institution, and to build inclusion across multiple dimensions of difference. We are acting to advance economic equity, which is a critical driver of the social determinants of health, by further establishing ourselves as an anchor institution through the ThriveOn Collaboration[3] (a joint vision for a Milwaukee that is equitable, healthy, and thriving for all), implementing a supplier diversity strategy and taking a critical look at our recruiting and hiring practices to ensure that we are hiring talented Black, Indigenous, and people of color across all of our campuses. Further, we are committed to advancing policy changes that bring healthier communities and create improvements based on the political determinants of health.

Finding strength from the interaction of these critical differences provides the best opportunities to build a high-performing organization and contribute to a thriving society. Making our human differences a strength requires inclusion. Inclusion requires intentional, strategic action across multiple domains that MCW terms "Inclusive Excellence." Inclusive excellence provides the strategic framework for identifying and achieving the

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goals to ensure that MCW is a thriving institution in a thriving community across Wisconsin for decades to come.

For MCW, inclusive excellence begins within. At its foundation, people learn to engage constructively around differences and grow in their ability to adapt to change and embrace diversity in a complex environment. It advances when people can perform and be recognized as inclusive leaders at all levels. Inclusive excellence gives us the ability to attract, build, and retain a 21st-century knowledge force that reflects diverse identities, backgrounds, and abilities and recognizes people's potential. MCW's rooted position in our community allows us to invest in and partner with our community and other organizations as an anchor institution to catalyze access to the outstanding talent and strong community partnerships that cultivate a healthy and thriving community.

One such pillar in our vision for equity, diversity, and inclusion is MCW's Center for the Advancement of Women in Science and Medicine[5] (AWSM), built on the collective work of women and men to promote gender equity. The work of AWSM, and its linked Council for Women's Advocacy, has resulted in salary equity as a core institutional compliance competency and annual report; development of an institutional policy on full professional effort; backup care benefits; grants to examine gender in promotion and retention, tracking, support, and recognition of the development of women as full professors at MCW; and the creation of an Associate Dean for Women's Leadership in 2013.

Our vision is that MCW will be a destination for women leaders, cultivating an inclusive and vibrant culture that supports all genders to grow and thrive in the health sciences. Our mission is to advance the careers of women at MCW through data-informed strategic projects that enhance opportunity and improve workplace climate.

An additional highlight of the work through AWSM has been the IWill 1.0 and 2.0 Campaigns, which have created shared language, provided education and understanding and positive action through pledges of more than 1,400 staff, students, and faculty. Along with equity enhancements, MCW has made great strides in increasing the diversity of our incoming medical student class as we seek to train a 21st-century knowledge force that reflects diverse identities, backgrounds, and abilities and recognizes people's potential. For fall 2021, we matriculated 265 medical students at our three campuses (Milwaukee, Green Bay, and Central Wisconsin), 25% of whom (66 individuals) are from underrepresented in medicine (URiM) backgrounds, including Black/African American, Mexican, Native American, Hmong, Puerto Rican, and mixed race. This percentage is the result of intentional efforts through pipeline programs and a holistic admission process with diversity training for all involved in these efforts. Importantly, these numbers compare closely to the demographics for the communities that we serve. And given that MCW trains 50% of the physicians who currently practice medicine in Wisconsin, this bodes well for enhanced diversity of the Wisconsin workforce in years to come.

Our differences make us better, stronger, and more innovative in a complex world of disruptive change. We believe that MCW can raise the bar and close the gaps in health across our community by striving for inclusive excellence at MCW and within our communities.

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