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Peering Across the Portal: The Way We Live Now

Ann Freeman Cook, PhD and Jerome W Freeman, MD

In her famous 1986 essay “The Way We Live Now”,¹ Susan Sontag provides glimpses of an unnamed man, suffering the ravages of an unnamed disease. She reflects on the tumult of AIDS in the early 1980’s by emphasizing the pervasive ambiguity and uncertainty of that time. Then and now, ambiguity in illness care seems instinctively abhorrent to caregivers and patients alike. Yet, as all seasoned clinicians know, ambiguity is an inescapable aspect of clinical medicine. We are stuck with ambiguity and need to recognize, acknowledge and manage it.

A tolerance for ambiguity varies. Seasoned clinicians understand that ambiguity is an inescapable aspect of the “real world.” But a person who is less tolerant will be more likely perceive ambiguity as a *threat*.² The navigation of this dynamic does pose considerable challenge when preparing students to enter the ranks of healthcare providers. Students encounter situations that are novel, complex, and insoluble throughout their training.³ They face myriad challenges that modify their academic expectations, their clinical decision-making, the cultivation of patient/clinical relationships, and maintenance of their own wellbeing. And students face an evolving social context that may undermine their perceptions of healthcare. This contextual maelstrom includes society’s diverse beliefs and opinions, power differential/boundary issues, and public erosion of trust in healthcare providers. And of course, all students will confront challenges accompanying the ubiquitous presence of artificial intelligence (AI).

Once in practice, encounters with ambiguity and uncertainty continue. A reduced tolerance for ambiguity has serious implications for patient care. As Geller and colleagues note, a clinician with less tolerance may be more likely to avoid certain types of patients, such as substance abusers, the poor, and the underserved. They and other authors report a range of additional problems such as fears of making mistakes, increased test ordering, and discomfort with death and grief. A reduced tolerance for ambiguity has also been linked to physician distress and burnout,⁴ quality of life concerns including less life satisfaction,⁵ and reduced psychological wellbeing.⁶

There is a growing recognition of the need for students to

learn how to manage ambiguity during medical training. The Association of American Medical Colleges (AAMC) includes tolerance and adaptation to stressful and changing environments as key resiliency and adaptability competencies.³ There is less agreement, however, about how to achieve this goal. Empirical studies of medical students’ tolerances for ambiguity have been limited and models for innovative training for expanding tolerance have not been well defined or evaluated. Our expectation has been that as students move from their preclinical years to direct patient care, a heightened tolerance for ambiguity would ensue. However, research has shown that medical students’ tolerance for ambiguity decreased significantly during their clinical clerkship, with the mean score dropping from 59.7 to 43.8. This significant reduction supports the proposition that tolerance for ambiguity may decline during medical training.⁷

Students commencing medical school have a strong academic record, a robust work ethic, and generally high expectations for their own behavior. Medical students demonstrate higher perfectionism scores than arts students.⁷ These skills and aspirations are valuable and certainly bolster candidacy for a career in medicine. But they may also reduce tolerance for ambiguity. Any interventions designed to increase student tolerance should be thoughtful and sustained. As Patel notes, one-time “ambiguity” interventions such as including elements of uncertainty within simulation training or written assessments, may prompt students to experience feelings of discomfort or even distress.⁸ Such lessons can pose added difficulties for students who have previously had negative experiences related to uncertainty. Indeed, most medical students instinctively seek definitive answers and results.

Medical educators can face pushbacks when trying to help students cultivate a greater tolerance for ambiguity and accompanying uncertainty. Students may insist they want a model for their training that specifies the right answers when encountering difficult situations or is specifically aligned with the USMLE-style questions they encounter on exams. Students may characterize exercises in ambiguity as a waste of time and energy. They may resist being asked to reflect, rethink, or engage in dialogue. Some students decline to read

published articles provided by faculty if students perceive that such material may challenge their personal beliefs. Confident in the certainty and truth of their approaches, such students are wary of expanding their perspectives.

Any learning curve to expand students' tolerance of ambiguity must be intentional and longitudinal. Opportunities for reflection and consideration of varying perspectives should be created. It takes time and practice for students to learn how to reframe novel and uncertain scenarios in ways that can take the focus away from negative associations with uncertainty, and instead direct attention to ways in which uncertainty could be beneficial. Students gradually learn to question preconceptions and consider vastly different perspectives.⁹

At SSOM, the 4-year ethics curriculum is delivered via an online platform. Readings, case studies, and key questions offer students ways to ponder and evaluate ambiguous situations. Reflective written responses uploaded onto each course's structured discussion forum offer a way to engage in ongoing peer and faculty dialogue. Rather than identifying the "right" answer, emphasis in these courses is placed on analysis, assessment, and consideration of practical responses that might be possible. Embracing the challenges of ambiguity can be a kindness that students offer to themselves, and a kindness that students extend to patients. The pedagogical challenge is how best to provide students space for evolving insight and motivation.

As noted by Stephens et al., the reflective process (thinking, writing, re-evaluating) is, by itself, a critical intervention. Their research suggests that thoughtful reflections appear to influence students' perceptions about past uncertainties, as well as future uncertain scenarios.⁹ They further note

that reflective writing may be a "powerful tool" for students' professional development as they confront uncertainty. Their findings align with the work of Sarkar and Raphael who note that incorporating the insights of ethics and medical humanities help learners recognize illness as a narrative experience and normalize uncertainty as part of clinical reasoning.¹⁰

We live in socially turbulent times and clinicians must navigate uncertain terrain. Medical students benefit from reflection and reassessment. They should be provided opportunities to experience how ambiguity and uncertainty influence medical decision-making.

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Beyond the Stethoscope: Laennec's Other Discovery

Henry Travers, MD, FACP

To the Editor:

The tale of Laennec's discovery of the stethoscope in the July 2026 issue of *South Dakota Medicine* by Kremer and Vogt emphasizes the talent and ingenuity of an important physician in the history of our profession.¹ As Kremer and Vogt noted, Laennec's inquisitive mind contributed to "several medical discoveries" including descriptions of peritonitis, bronchiectasis, emphysema and pulmonary edema.

Laennec first reported the clinical applications of the stethoscope 1819 in *De l'Auscultation Médiate* published by Brosson and Chaudé in Paris.² Focusing on just the book's narrative of the stethoscope and its diagnostic use might lead one to miss a small, unrelated "discovery" buried there in a footnote. To his description of a patient, Jean Edme, a 47-year-old tall and moderately muscular man, Laennec added this about Edme's liver.³

This type of growth is also among those often grouped under the name "scirrhus." I believe it should be designated as "cirrhosis," on account of its color. Its development in the liver is one of the most common causes of ascites, and it is characterized by the fact that, as the cirrhotic changes progress, the liver tissue is absorbed—often disappearing entirely, as in this case—and that, in every instance, a cirrhotic liver loses volume rather than enlarging. This type of growth also develops in other organs and eventually softens, like all pathological formations. [Author's translation]

The condition Laennec portrayed had been previously described by Browne⁴ and Baillie⁵ in the 17th and 18th centuries, but neither had used the term cirrhosis. Laennec presented *cirrhosis* to medicine almost as an afterthought, but for some time thereafter (most popularly in the United States through William Osler's *The Principles and Practice of Medicine*) it was known as Laennec's cirrhosis.

Henry Travers, MD, FACP
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Elections and the SDSMA

Ben Meyerink, MD
President, South Dakota State Medical Association



It has been a historic year in South Dakota when it comes to our election cycle, and we have not even reached November yet. For the first time in our state's modern history, we had a gubernatorial primary runoff. If you are like me and a resident of Sioux Falls, you also had the opportunity to vote for a mayoral runoff. Three elections in two months certainly did not feel normal. In addition, many legislative seats across our state were closely contested leading to 16 incumbents losing their races. This is following 14 seats lost in 2024. The legislative body we work with in Pierre will certainly look very different this next session as will one of our Federal offices in Washington D.C.

One exciting development we had this year was one of our own members, Dr. Dawn Hill, running for our state legislature. While she did not win her primary, I want to commend her on a well run campaign. She is a talented person and physician and I hope we see her run again. As a physician, I understand how we are all limited on time away from our patients to serve in Pierre. However, it has been a number of years now since we had a physician in the legislature. Meanwhile, other healthcare professions have been able to get candidates involved and win seats in Pierre. While we do try to partner and support these non-physician legislators, it still would be far more beneficial for us to have physicians in legislative seats. The AMA and our SDSMA have excellent resources and training for anyone interested in running. Please contact us if you are even considering doing so.

The SDSMA PAC continues to be involved behind the scenes during election seasons as well. In fact, our board doubled their budget this cycle and gave over \$60,000 to candidates. 36 of the 49 candidates the PAC supported were successful in June. I know there are always many questions about how our PAC functions. We have an excellent board of physicians that work with our full-time staff to evaluate this. Typically they select incumbents who vote with our agenda over 70% of the time. In addition, they depend on firsthand references and information from you all. They also have board vacancies and are always looking for more people to not only give their

donations but also serve with them. Please contact our staff if interested.

With a shifting legislative body in Pierre, we are going to be more dependent than ever on all of you this legislative session. While our SDSMA board covers all sides of our state and testifies frequently and communicates with legislators often, we do not represent every single community or have connections to every single politician. Few things are more powerful than utilizing the stories, connections, and insights of all of you, our physician members. Not only do we seek to do this during the legislative session but as we monitor and act on political developments throughout our state all year long we want to partner and involve all of you. I will be visiting every district this fall with our CEO, Tammy Hatting, and would welcome you to connect with me at those dinners if you'd like to get more involved. I would also encourage you to reach out to our Director of Policy and Advocacy, Justin Ohleen, at any point if you have questions about any candidate or issue. We seek your involvement and welcome you to partner with us during these changing times and historic election cycles.



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Impact of Frailty on Outcomes After Transcatheter Edge-to-Edge Repair with MitraClip (from the National Inpatient Sample 2021–2022)

Dawood Shehzad, MD; Logan Johnke, MD; Muhammad Faisal Riaz, MD; Amr Moustafa, MD; Hammad Chaudhry, MD; and Dawlat Khan, MD

Abstract

Background: Frailty profoundly influences procedural outcomes in cardiovascular interventions. Although its effect is well established in transcatheter aortic valve replacement (TAVR), data remains limited for mitral transcatheter edge-to-edge repair (TEER). We evaluated the impact of frailty (defined by the Johns Hopkins Adjusted Clinical Groups Indicator) and the prevalence of associated comorbidities on in-hospital outcomes after TEER.

Methods: Adults (≥ 18 years) undergoing TEER were identified from the National Inpatient Sample (NIS) 2021–2022. Frailty was defined per the Adjusted Clinical Group (ACG) criteria, and patients were categorized as frail or non-frail. The primary endpoint was in-hospital mortality. The secondary endpoints included: length of stay (LOS), hospitalization costs, and comorbidities associated with mortality. Univariate and multivariable logistic and linear regressions adjusted for demographics and comorbidities were conducted where appropriate.

Results: Among 26,196 weighted TEER hospitalizations, 2,130 (8.13 %) met frailty criteria. Frailty was associated with four-fold higher odds of in-hospital mortality (OR 4.03, 95 % CI 2.97–5.44, $p < 0.001$). Independent predictors of mortality included end-stage renal disease (ESRD, OR 13.67), heart failure (OR 3.38), chronic liver disease (OR 2.60), and CKD stage 3–5 (OR 1.92). Obesity showed no association with mortality. Frail patients had longer LOS (10.9 vs 3.3 days, $p < 0.001$) and higher mean costs (\$377,688 vs \$230,650, $p < 0.001$).

Conclusions: Frailty is present in approximately 8 % of TEER patients and is strongly associated with increased mortality and resource utilization. Routine frailty screening may help optimize patient selection and post-procedural care.

Introduction

The MitraClip device has become a cornerstone therapy for patients with severe mitral regurgitation (MR) who are ineligible for surgery.^{1,2} Despite excellent procedural success, heterogeneity in outcomes reflects differences in baseline comorbidity burden, especially frailty - a multisystem syndrome characterized by reduced physiologic reserve and increased vulnerability to stressors.³ Frailty has been extensively studied in transcatheter aortic valve replacement (TAVR), where it predicts mortality independently of age or Society of Thoracic Surgeons (STS) risk score.^{4,7} The evidence for frailty evaluation in patients undergoing transcatheter edge-to-edge repair (TEER) for MR remains limited to small registries.⁸

TEER, similar to TAVR, is a minimally invasive procedure for treating mitral valve regurgitation, which is recognized as a safe alternative for patients at a high surgical risk.⁹ Catheter directed access is gained to the heart chambers through the femoral vein and MitraClip, a small metal clip covered in polyester, is inserted which brings the mitral valve flaps closer together to facilitate better closure when the heart beats.⁹

Given the increasing use of TEER in octogenarians and poly-morbid patients, understanding the impact of frailty on outcomes is critical for risk stratification and resource planning. We used the Healthcare Cost and Utilization Project (HCUP) NIS 2021–2022 to examine the association between frailty and in-hospital mortality, length of stay (LOS), and hospital costs associated with patients undergoing TEER in the U.S.¹⁰

Materials and Methods

We utilized data obtained from the 2021–2022 NIS for this study. The NIS is a publicly available inpatient healthcare database in the United States. It is part of the HCUP, sponsored by the Agency for Healthcare Research and Quality (AHRQ). It contains detailed data on hospital inpatient stays from U.S. community hospitals, including information on diagnoses, procedures, demographics, length of stay, costs, and discharge outcomes.¹⁰

The NIS uses a 20% stratified sample of all inpatient discharges, with discharges, not hospitals, as the sampling units. Stratification is based on hospital characteristics, including but not limited to region, teaching status, and bed size. Hospitals are not individually selected at random; instead, all eligible community hospitals that participate in the HCUP State Inpatient Databases are included in the sampling frame. From this broad pool, a stratified random sample of discharges is drawn to ensure national representativeness. Each sampled discharge is weighted to produce national estimates, making the NIS a valid and reliable resource for large-scale epidemiologic and health services research. Each record includes patient demographics, diagnoses, procedures, hospital characteristics, and outcomes.¹⁰

Hospitalizations were included if they contained ICD-10-PCS codes for TEER (02UG3JZ). Patients were excluded if they were less than 18 years of age, or had any concomitant valvular procedure. Weighted national estimates were calculated per HCUP guidelines.

Frailty was identified using the Johns Hopkins Adjusted Clinical Groups (ACG) frailty indicator, which has been validated for administrative datasets.¹¹ The indicator defines frailty if ≥ 1 of the following diagnoses is present:

1. Malnutrition (E40–E46)
2. Dementia (F01–F03, G30)
3. Severe vision impairment (H54)
4. Decubitus ulcer (L89)
5. Urinary incontinence (N39.3, N39.4)
6. Weight loss (R63.4)
7. Difficulty in walking (R26) or falls (W19)
8. Social support needs (Z60.2, Z63.4)

Patients meeting any of these criteria were classified as frail.¹²

Demographics (age, sex, race), baseline hospital characteristics, Charlson Comorbidity Index, Elixhauser

Comorbidity Index, end-stage renal disease, heart failure, chronic liver disease, chronic kidney disease, hypertension, atrial fibrillation/flutter, type 1 or 2 diabetes, chronic obstructive pulmonary disease, coronary artery disease, obesity and hyperlipidemia were recorded between the frail and non-frail groups.

Endpoints of the study were as follows:

- **Primary endpoint:** In-hospital mortality.
- **Secondary endpoints:** LOS and total hospitalization costs.

Survey weights and stratification variables provided by HCUP were applied to generate national estimates. Continuous variables were analyzed with weighted *t*-tests and reported as means $\pm$ SD. Categorical variables used χ^2 tests. Multivariable logistic regression modeled frailty and comorbidities as predictors of mortality. Linear regression analyzed LOS and costs. All tests were two-sided, with $p < 0.05$ as the significance threshold. Analyses were performed in Stata 18 BE.

Results

From 2021 to 2022, we identified 26,196 TEER hospitalizations nationwide. Among these, 2,130 (8.13%) patients met the Johns Hopkins ACG criteria for frailty. Frail patients were older (mean 81.6 ± 7.2 vs 74.8 ± 8.3 years, $p < 0.001$), more often female (57.2 % vs 45.8 %, $p < 0.001$), and more likely to have Medicare insurance (88.4 % vs 72.6 %). Geographic distribution was similar across hospital regions, though frailty was most prevalent in large, urban teaching centers (62 %).

Of the criteria used to define frailty, dementia, malnutrition, and decubitus were the most prevalent contributing factors to frailty in our patients.

The overall in-hospital mortality following TEER was 1.8%. However, mortality differed substantially by frailty status, occurring in 7.4% of frail patients compared with 1.2% of non-frail patients ($p < 0.001$). This absolute difference of more than 6 percentage points translated into approximately 4-fold higher adjusted odds of death among frail individuals (aOR 4.03, 95% CI 2.97–5.44, $p < 0.001$). The association remained robust across sensitivity models after adjusting separately for all NIS characteristics detailed in Table 1, as well as the Elixhauser and Charlson Comorbidity Indexes.

Independent mortality predictors included:

- ESRD (OR 13.67, 95 % CI 8.93–20.95, $p < 0.001$)

Table 1. NIS cohort characteristics.

Characteristic	Frail (n = 2,130)	Non-frail (n = 24,066)	p-value
Age $\geq$ 80 y	71.2 %	44.3 %	<0.001
Female sex	57.2 %	45.8 %	<0.001
Heart failure (any)	89.6 %	72.5 %	<0.001
CKD (Stages 3–5)	31.7 %	17.5 %	0.002
ESRD	8.9 %	1.8 %	<0.001
COPD	22.1 %	18.4 %	0.06
Chronic liver disease	9.5 %	4.2 %	0.01
Obesity	13.7 %	15.2 %	0.42

Table 2. Distribution of frailty defining characteristics.

Characteristics	Percentage (n = 2,130)
Dementia	41.3%
Malnutrition	32.9%
Decubitus ulcer	12.4%
Impaired vision	9.6%
Weight loss	5.4%
Difficulty ambulation	4.7%
Urinary incontinence	4.7%
Social support needs	0.5%

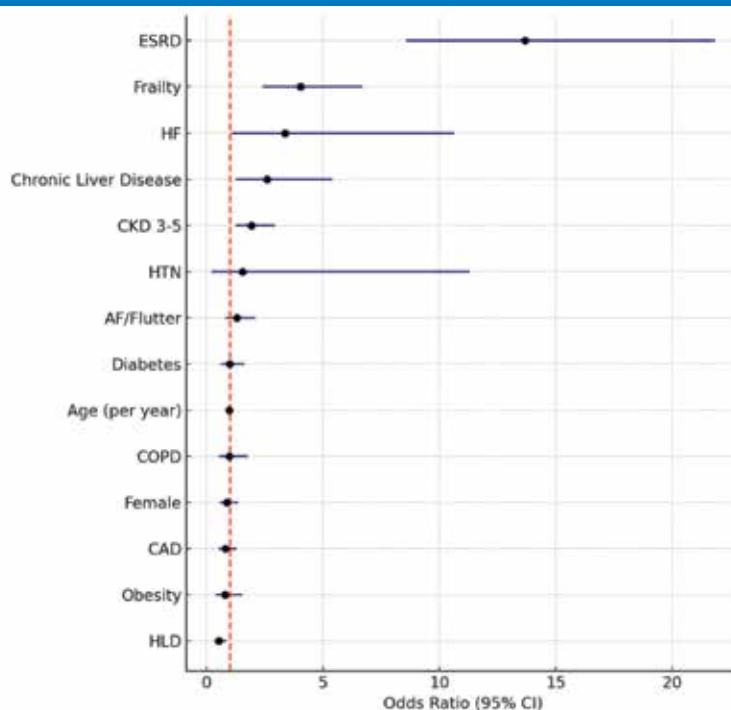
- Heart failure (OR 3.38, 95 % CI 2.12–5.38, $p < 0.001$)
- Chronic liver disease (OR 2.60, 95 % CI 1.41–4.78, $p = 0.002$)
- CKD Stage 3–5 (OR 1.92, 95 % CI 1.23–3.01, $p = 0.006$)
- Obesity was not associated with mortality (OR 1.07, 95 % CI 0.72–1.52, $p = 0.63$).

Hospital resource utilization differed markedly by frailty status. Mean LOS was more than threefold higher in frail compared with non-frail patients (10.9 ± 6.4 days vs 3.3 ± 2.7 days, $p < 0.001$). Total hospital charges were also significantly higher in frail patients ($\$377,688 \pm 84,321$ vs $\$230,650 \pm 56,802$, $p < 0.001$), corresponding to a 64% relative increase.

The association between frailty and in-hospital mortality remained consistent across key clinical subgroups. No significant interaction was observed between frailty and sex (interaction $p = 0.48$), age category (≥ 80 vs < 80 years, $p = 0.33$), or heart failure subtype (HFpEF vs HFrEF, $p = 0.40$), indicating that the excess mortality risk associated with frailty was uniform across these strata.

Among frail patients, the highest mortality occurred in those with concomitant end-stage renal disease (ESRD), where in-hospital mortality reached 14.2%. In contrast, frail patients without renal disease experienced a markedly lower mortality rate of 3.9%. This gradient highlights the compounding

Figure 1. Forest plot of independent predictors of mortality.



Horizontal Forest layout: black dots = aORs (ESRD 13.67; Frailty 4.03; HF 3.38; Chronic liver disease 2.60; CKD 1.92; Obesity 1.07); blue solid line = 95 % CIs; red dashed line = OR 1.0.

effect of renal dysfunction on adverse outcomes in the frail TEER population.

Discussion

This large, nationally representative analysis demonstrates that frailty is a strong and independent predictor of adverse in-hospital outcomes in the TEER population. Frail patients

experienced nearly fourfold higher risk of in-hospital mortality and significantly greater resource utilization, with longer hospital stays and substantially higher total costs compared with non-frail counterparts.

Using this large nationally representative dataset, our findings extend prior registry findings and provide robust population-level validation of frailty as a prognostic marker in structural mitral interventions.

The in-hospital mortality reported for transcatheter aortic valve replacement in frail patients is not as well documented as the 30-day and 1-year mortality.^{4,7} It appears that the risk associated with frailty in TEER is higher than in the TAVR population. TEER patients typically have chronic volume overload, severe mitral regurgitation, leading to left ventricular dilation, elevated left atrial pressures, pulmonary hypertension, and some degree of right ventricular dysfunction.

Frailty reflects diminished physiological reserve across multiple organ systems, extending beyond chronological age or isolated comorbidities. The pathophysiologic hallmarks of frailty, such as sarcopenia, chronic systemic inflammation, impaired mobility, and neurocognitive decline, collectively reduce resilience to the procedural and hemodynamic stress imposed by transcatheter edge-to-edge repair (TEER). Frail patients likely have limited cardiac reserve, making them less able to tolerate abrupt preload and afterload shifts that occur during and post mitral valve repair.

The excess resource utilization among frail patients likely reflects prolonged recovery, greater rehabilitation needs, and higher complication rates. Routine frailty screening using simple bedside tools or validated claims-based indices such as the ACG measure should become a standard component of pre-TEER evaluation. Identifying frail patients early enables more informed procedural selection, tailored peri-procedural planning, and realistic expectations during shared decision-making. Proactive strategies such as early mobilization, nutritional support, and multidisciplinary management may help mitigate the adverse impact of frailty on recovery and cost.

Prospective studies are needed to test whether targeted “prehabilitation” programs focusing on nutrition, strength, and functional conditioning can improve outcomes in the frail population.

Limitations

This study has several limitations inherent to its retrospective,

administrative design. NIS lacks granular clinical data on TEER procedural details, such as the number of clips deployed, procedural complications, or procedural success, which may influence outcomes. Frailty diagnoses were identified from discharge codes, and the temporal relationship to TEER cannot be confirmed, thus raising the possibility of reverse causation if frailty-related codes were added post-procedure.

Hospital procedural volume is unavailable; therefore, outcomes may differ between high and low-volume centers. The study period (2021–2022) coincided with the COVID-19 pandemic, which could have affected the length of stay, discharge planning, and recovery patterns. Additionally, while heart failure was included as a covariate, its near-universal presence precluded assessment of disease severity. Future studies should quantify the relationship between increasing frailty burden and mortality to better characterize the dose-response effect of frailty on TEER outcomes.

Conclusions

Frailty, as defined by the Johns Hopkins ACG criteria, was present in approximately 8% of patients undergoing TEER and was independently associated with a four-fold increase in in-hospital mortality, prolonged hospitalization, and higher costs. These findings highlight frailty as a critical determinant of both clinical and economic outcomes following TEER. Incorporating routine frailty screening into pre-procedural assessment and post-procedural care planning may improve risk stratification, guide patient selection, and optimize resource utilization. Future work should explore interventions to reduce frailty burden and assess how increased frailty severity influences long-term outcomes.

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Disseminated *Coccidioides posadasii* Infection in Pregnancy Complicated by Central Nervous System Disease: A Case Report and Review

Fahd J. Nazir, MS IV; Syed Sami N. Zafar Ahmed, MS IV; Zahed Barak, MS IV; Krishna Suresh, MBBS; Neil K. Bansal, MD; and Jawad Nazir, MD

Abstract

Coccidioidomycosis is typically a self-limited pulmonary infection but may cause severe disseminated disease in pregnancy. Central nervous system involvement is the most serious manifestation and can be diagnostically challenging due to nonspecific symptoms. We report a case of disseminated *Coccidioides posadasii* infection in a pregnant patient presenting with persistent headache subsequently complicated with coccidioidal meningitis and hydrocephalus requiring neurosurgical intervention. This case highlights the importance of maintaining suspicion for endemic fungal infections in pregnant patients with unexplained neurologic symptoms and emphasizes the need for early, multidisciplinary management to prevent significant morbidity and mortality for both the mother and the fetus.

Introduction

Coccidioidomycosis is a fungal infection caused by *Coccidioides immitis* or *Coccidioides posadasii*. Infection most commonly presents as a primary pulmonary illness with symptoms including cough, fever, chills, and fatigue. While most cases are self-limited, a subset of patients develop disseminated disease. Central nervous system (CNS) involvement represents the most severe complication and is associated with significant morbidity and mortality. Pregnancy is a recognized risk factor for severe and disseminated infection, particularly in the later stages of gestation. We present a case of disseminated *Coccidioides posadasii* infection in a pregnant patient with concurrent pulmonary and neurological involvement.

Case Presentation

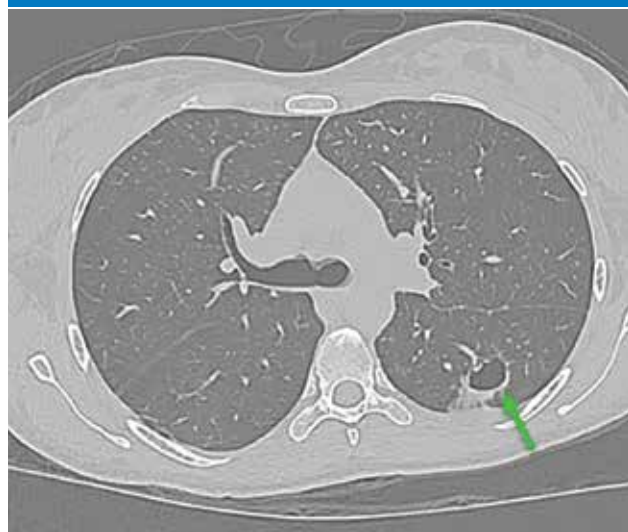
A 33-year-old woman, G3P2, at 27 weeks' gestation, was transferred to a tertiary care hospital for evaluation of one month of progressively severe headaches associated with intermittent fevers. She had multiple prior emergency department visits earlier in the month with transient improvement following corticosteroids, antibiotics for presumed sinusitis, and symptomatic treatment. Initial imaging, including CT and CT Angiography head and neck at an outside facility were unremarkable. On admission, the patient was afebrile and hemodynamically stable but continued to report severe, persistent headaches. Neurologic examination was unremarkable for focal sensorimotor

deficits. Initial laboratory evaluation was notable for marked peripheral eosinophilia, with an absolute eosinophil count of $1.8 \times 10^9/L$ (18%) (normal: $<0.5 \times 10^9$; 0-6%)

MRI of the brain demonstrated multifocal acute infarctions involving the right lentiform nucleus, bilateral hypothalami, left posterior hippocampus and thalamus, left temporal lobe, and right parietal-occipital region. Neurology evaluation favored an infectious or inflammatory vasculitic process rather than primary thromboembolic disease. Lumbar puncture revealed markedly elevated opening pressure (37 cm H₂O), and cerebrospinal fluid (CSF) findings were significant for neutrophilic pleocytosis (57 nucleated cells with 59% polymorphonuclear leukocytes), low CSF glucose (27 mg/dL), and elevated protein (162 mg/dL). CSF Gram stain, India ink, meningitis PCR panel, and initial cultures were negative.

CT chest without contrast identified a 2.5-cm thin-walled cavitary lesion in the superior segment of the left lower lobe with surrounding reticulonodular changes (Figure 1). Further history revealed recent travel to Mexico approximately three months prior to presentation. Given the combination of CSF abnormalities and pulmonary cavitation in the setting of pregnancy, differential diagnoses included tuberculosis and disseminated fungal infection. Empiric therapy was initiated while results were pending. Liposomal amphotericin B was started, to cover possible disseminated fungal infection.

Figure 1. CT chest without contrast. Axial views of CT imaging showing thin-walled cavitary lesion in the left lower lobe, raising concern for infectious etiology.



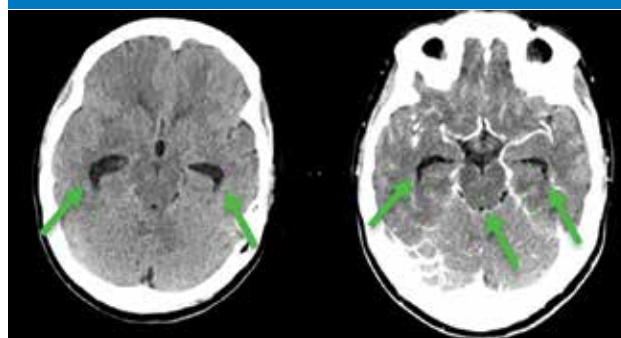
Anti-tuberculous therapy with isoniazid, rifampin, and ethambutol was initiated, while pyrazinamide was withheld due to pregnancy. In addition, broad-spectrum antimicrobial coverage with meropenem was added to address possible bacterial meningitis, including *Listeria monocytogenes* in the setting of her penicillin allergy.

During hospitalization, the patient developed acute mild hypothermia with a rectal temperature of 93°F and worsening mental status. Repeat CT head demonstrated progressive ventriculomegaly with transependymal CSF flow, consistent with developing hydrocephalus and rising intracranial pressure (Figure 2). Neurosurgery was consulted, and an external ventricular drain (EVD) was placed for CSF diversion. Despite the EVD, the patient developed worsening symptoms and hydrocephalus. As a result, a definitive right-sided frontal ventriculopleural shunt placement was performed.

Karius testing subsequently returned positive for *Coccidioides posadasii*. Serologic testing demonstrated elevated serum *Coccidioides* IgG and IgM with a complement fixation titer of 1:128, and CSF testing resulted with *Coccidioides* IgG 9.1, IgM 2.3, and a complement fixation titer of 1:16. CSF fungal cultures later grew *Coccidioides posadasii*, confirming disseminated coccidioidomycosis with CNS and pulmonary involvement.

Empiric anti-tuberculous therapy and amphotericin B were discontinued, and high-dose fluconazole (800mg) daily was initiated with plans for potentially lifelong therapy given the

Figure 2. CT head. Axial non-contrast CT head demonstrating interval enlargement of the temporal horns compatible with new onset hydrocephalus (Left). Comparison is made to contrast enhanced CT head from three days prior (Right).



disseminated infection. In addition, a course of Ivermectin therapy was completed due to positive *Strongyloides* antibody in the setting of unknown exposure timeline. Following shunt placement and targeted antifungal therapy, the patient's mental status and headaches improved. She remained under multidisciplinary care and subsequently developed preterm labor characterized by progressive uterine contractions and cervical change from 1 cm to 3 cm despite tocolytic therapy with nifedipine. Following consultation with maternal-fetal medicine, delivery was recommended, and the patient underwent cesarean section per patient preference at 31 weeks' gestation. She was discharged in stable condition with plans for outpatient infectious disease follow-up.

Discussion

Coccidioidomycosis is caused by two genetically distinct species, *Coccidioides immitis* and *Coccidioides posadasii*, which differ in geographic distribution but cause clinically similar disease. *C. immitis* is largely confined to California's Central Valley and parts of Washington State, whereas *C. posadasii* predominates throughout the southwestern United States, northern Mexico, and regions of Central and South America.¹ These dimorphic fungi thrive in arid environments characterized by low precipitation and alkaline soil, with infection occurring through inhalation of airborne arthroconidia. Although traditionally associated with endemic regions, increasing population mobility and travel have expanded exposure risk beyond these areas.² While dissemination occurs in only approximately 1% of infections in immunocompetent hosts, this risk is substantially higher among certain populations, including individuals with impaired cell-mediated immunity, those receiving immunosuppressive therapies, and pregnant patients.³

Pregnancy is a well-established risk factor for severe and disseminated coccidioidomycosis, with the highest risk occurring during the third trimester and early postpartum period. This increased susceptibility reflects physiologic immunologic adaptation, as advancing gestation is associated with reduced cell-mediated immune responses necessary for containment of *Coccidioides*, facilitating increased fungal burden and extrapulmonary dissemination.^{4,6} Historically associated with poor maternal outcomes, disseminated disease in pregnancy now appears substantially mitigated with early diagnosis and appropriate antifungal therapy with no clear increase in rates of preterm delivery or fetal loss when infection is promptly treated.^{4,5}

CNS involvement by *Coccidioides* is often difficult to recognize early because initial manifestations are frequently subtle and lack focal neurologic findings. Pregnancy further complicates recognition, as common gestational symptoms may obscure symptoms of progressive infection. Headache is a common presenting feature of coccidioidal meningitis; however, its diagnostic significance lies in persistence, progression, and association with other neurologic or systemic symptoms rather than isolated occurrence.³ Additional features may include cognitive changes, fever, or gastrointestinal symptoms, while classic signs of meningeal irritation are frequently absent.⁷ Clinical evaluation should therefore prioritize persistent or worsening neurologic symptoms when considering CSF examination.^{3,8}

CSF findings in coccidioidal meningitis reflect a chronic inflammatory process and often include markedly elevated opening pressure, which has important implications for management.^{3,9} Typical abnormalities include elevated protein concentrations, substantially reduced glucose levels, and a variable leukocyte count with lymphocyte predominance.³ Although uncommon, the presence of eosinophils in the CSF may provide supportive diagnostic context when interpreted alongside other clinical, laboratory, and imaging findings.¹⁰

Because no single diagnostic test demonstrates adequate sensitivity, evaluation of suspected coccidioidal meningitis requires a multimodal approach. Diagnostic accuracy is therefore improved by combining serologic, antigen-based, and molecular assays, interpreted in conjunction with clinical presentation and CSF findings. In addition, contrast-enhanced MRI plays an important role not only in diagnosis but also in the assessment of disease progression and complications.¹¹

Hydrocephalus is a frequent and clinically significant complication of CNS coccidioidomycosis and may be present at diagnosis or emerge later in the disease course. Chronic inflammation involving the basal meninges disrupts CSF resorption, leading to progressive ventricular enlargement that is often refractory to antifungal therapy alone. Fibrotic changes within the subarachnoid space most commonly result in communicating hydrocephalus. Recognition of hydrocephalus can be challenging, as symptoms such as headache and cognitive changes overlap substantially with initial symptoms of meningitis. Clinical deterioration may therefore reflect either progression of meningeal disease or the development of elevated intracranial pressure, underscoring the importance of serial neurologic assessment and repeat neuroimaging when symptoms worsen.³

Management is guided by neurologic status on presentation. Patients without signs of increased intracranial pressure may be managed conservatively with continued antifungal therapy and interval imaging, whereas those with neurologic symptoms require prompt neurosurgical evaluation. Current expert guidance indicates that while temporary CSF diversion may be used for initial stabilization, long-term ventricular shunting is frequently required, even in the setting of active infection, due to the morbidity associated with sustained intracranial pressure elevation.³

Coccidioidal meningitis requires prolonged, and often lifelong, antifungal therapy due to a high risk of relapse.⁵ Current clinical guidelines recommend triazole antifungals as first-line therapy, with fluconazole preferred at doses of 800–1,200 mg daily or itraconazole 400–600 mg daily as an effective alternative in nonpregnant patients.¹² Lower doses of fluconazole are associated with increased relapse rates and are generally inadequate for treatment of CNS disease.

Management during pregnancy requires careful consideration because azole antifungals are associated with teratogenic risk, particularly during the first trimester. As a result, amphotericin B is the preferred treatment for invasive and CNS fungal infections during early pregnancy despite its limited CSF penetration, owing to its established maternal–fetal safety profile. When coccidioidal meningitis is diagnosed after the first trimester, therapy should be started with an azole antifungal such as fluconazole or itraconazole, balancing maternal benefit with fetal risk.^{7,13,14}

Neonatal considerations are also important in cases of maternal coccidioidomycosis. Serologic testing is not recommended during the first three months of life and

should be interpreted cautiously throughout the first year due to passive maternal antibody transfer. In infants with suspected infection, empiric fluconazole therapy at 6–12 mg/kg daily is recommended until the diagnosis is excluded. Breastfeeding is generally discouraged for mothers receiving azole antifungals other than fluconazole.³

Conclusion

Disseminated coccidioidomycosis with CNS involvement should be considered in pregnant patients with persistent headache, pertinent CSF abnormalities, and compatible exposure history. Early recognition and multidisciplinary management are essential to prevent severe neurologic complications and optimize maternal and neonatal outcomes.

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SDSMA MEMBER SPOTLIGHT



Ben Meyerink, MD

Specialty: Family Medicine

SDSMA leadership position: President

Practice location: Avera Medical Group Family Medicine 69th & Cliff, Sioux Falls

Faculty position: Director of Career Advising and Student Success, University of South Dakota Sanford School of Medicine

Member since: 2014 — Student Member; 2021 — Actively Practicing Physician Member

WHY I CHOSE MY SPECIALTY

Primarily, I was inspired by my hometown doctor, Jerome Bentz, MD, growing up to pursue primary care. What drove me to stay on that path was seeing the longitudinal relationships with patients family physicians develop and the tremendous impact that primary care can have not only on individual preventative health but medicine and communities as a whole.

WHY I'M A MEMBER OF THE SDSMA

My involvement began very early in medical school and I was quickly surrounded by excellent mentors who have guided me to where I am now. While politics and political advocacy can be frustrating, the SDSMA is the best voice for physicians in our state to work with our legislature and other entities to advocate for the patients of South Dakota and improve health-care and the practice of medicine.

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Walk a Mile in Someone Else's Shoes: An Experiential Approach to Cultivating Compassion in Future Physicians in a Pre-Post Intervention Study

Phebie Rossi MS IV; and Michelle Schimelpfenig, DO

Abstract

This study examined whether experiential role-play could enhance empathy and compassion in medical students by simulating the experiences of underserved populations. Fourteen third-year students at the University of South Dakota Sanford School of Medicine (USD SSOM) participated in scenarios involving homelessness, intimate partner violence, and undocumented status. Pre- and post-intervention surveys measured students' understanding of community barriers, confidence in accessing local resources, and perceived empathy. Results showed significant improvements in knowledge and confidence related to social determinants of health, though self-reported empathy did not change significantly. Despite this, students rated the experience as highly effective in fostering compassion and preparing them for empathetic clinical care.

Introduction

In recent years, concepts of “empathy” and “compassion” have become increasingly prominent in discussions surrounding healthcare. However, these terms often lack consistent definitions and are interpreted in various ways across medical contexts. For the purposes of this project, it was essential to adopt a clear and operational definition of empathy. In a clinical setting, empathy is defined as “a predominantly cognitive attribute that involves an understanding of the pain and suffering of the patient, combined with a capacity to communicate this understanding, and an intention to help.”¹ An added step is to define compassion and what it means in the healthcare setting. There is a social movement currently that argues compassion is not a noun, but rather a verb.² To have compassion is to use the cognitive understanding of pain and suffering to guide actions to decrease said pain and suffering. This understanding illustrates that empathy is a critical competency in medicine, supported with findings that physicians who demonstrate strong empathetic skills have better clinical outcomes, reduced patient anxiety, and increased patient satisfaction compared to their less empathetic counterparts.³

To further underscore the significance of empathy in medical education, a growing body of literature has identified a concerning trend of “empathy erosion” as students advance through their training. In one longitudinal study,

researchers administered the Jefferson Scale of Empathy to medical students beginning at orientation and annually thereafter. While empathy levels remained stable during the preclinical years, a statistically significant decline was observed beginning in the third year, coinciding with the onset of clinical rotations, and continued into the fourth year, regardless of gender or specialty interest.⁴ Similarly, a separate study highlighted the cumulative impact of time pressures, emotional fatigue, and the scarcity of empathetic role models in the clinical environment as key contributors to this decline.⁵ Both indicated further investigation is needed on protective factors to prevent this erosion.

Building upon this framework, this study seeks to explore methods for cultivating empathy in medical students by facilitating meaningful engagement with vulnerable populations. Central to the project's design is the well-known adage: “walk a mile in someone else's shoes.” This metaphor guided the development of experiential learning through role-play, enabling students to immerse themselves, within safe and ethical boundaries, in the lived realities of marginalized individuals. Role-play has been shown to be an effective teaching strategy in healthcare education. It was demonstrated that such simulations foster empathy by bridging personal experience with the perspectives of others.³ Rather than assume another's identity, students were tasked with embodying a hypothetical scenario to better

understand the structural and interpersonal barriers faced by these groups. Medical students engaged with three distinct groups commonly underserved in healthcare: individuals experiencing homelessness, victims of intimate partner violence, and undocumented, uninsured immigrants.

Overall, this project aimed to deepen medical students' understanding of patient experiences beyond the clinical setting, address implicit biases, and strengthen their capacity for empathetic, patient-centered care. Through structured role-play and community immersion, students gained critical insights into the social determinants of health that influence patient behaviors and outcomes. Additionally, exposure to community resources enhanced students' awareness of support systems available to patients, equipping them to more effectively integrate this knowledge into their clinical practice.

Methods

Prior to initiating the study, the project was reviewed by the Institutional Review Board (IRB) and it was determined that the study posed minimal risk to participants. Fourteen USD SSOM students (7 male, 7 female), all of whom had successfully completed the USMLE Step 1 examination and were undergoing orientation for their clinical rotations in February 2025, volunteered to participate. On the final day of orientation, students were introduced to the project, assigned to small groups, and provided a packet containing their role-play scenario, public transportation tickets, a map of the area, and essential contact information for the staff available on site.

Each packet contained a clinical vignette giving students background on who they would be for the day. The three patients were: an unhoused man, a survivor of domestic abuse, and an undocumented citizen. All three patients had the same primary needs of a meal, shelter, medical care, and a piece of medical equipment. Students were also provided paper maps of the buses in Sioux Falls and tickets for their groups to utilize the buses for free. Each group was tasked with meeting their needs between 8 AM and noon utilizing the materials given.

Before undertaking the role-play activity, participants completed an anonymous, pre-intervention survey consisting of 10 items: two demographic questions and eight items designed to assess their baseline understanding of community resources and their perceived empathy toward underserved populations using a 7-point Likert scale. Upon returning to the designated meeting location following the

completion of their assigned tasks, students completed a post-intervention survey containing the same eight core items, one additional question on the intervention's effectiveness, and an additional seven optional reflective questions. The survey utilized can be found in Appendix A at sdsma.org. Students then underwent a debriefing session with faculty. No data was formally collected from this session.

Survey data was analyzed using paired samples *t*-tests to evaluate changes in responses before and after the intervention. To control for multiple comparisons and reduce the false discovery rate, the Benjamini-Hochberg (BH) procedure was applied as a post-hoc correction.

Results

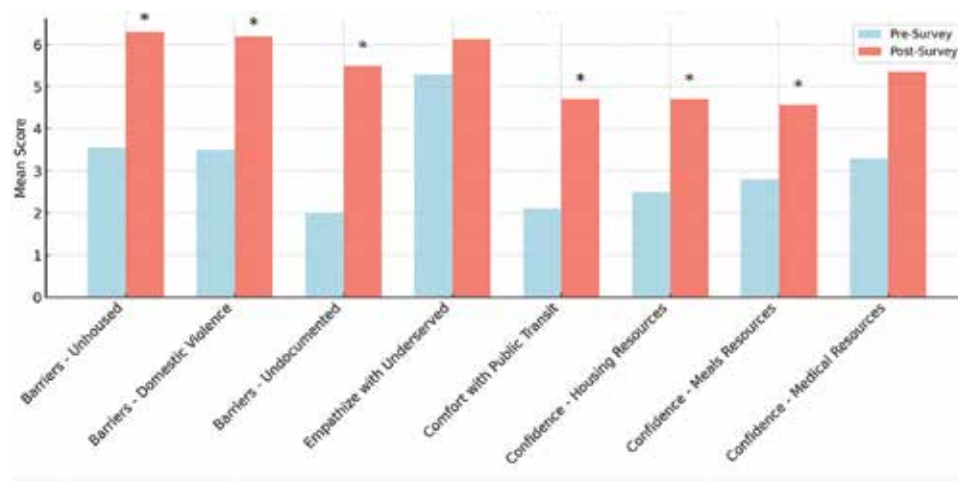
A total of 10 medical students completed the pre-intervention survey and 14 students completed the post-intervention survey. The analysis focused on evaluating changes in student knowledge of community resources and self-perceived empathy following the role-play intervention.

Paired samples *t*-tests revealed statistically significant improvements across multiple domains. Participants demonstrated a significantly greater understanding of the barriers faced by unhoused individuals ($t = -8.693$, $p < .001$, BH = .00625), survivors of domestic violence ($t = -3.873$, $p = .030$, BH = .03), and undocumented individuals ($t = -5.196$, $p = .035$, BH = .04375). Confidence in accessing community resources also increased significantly post-intervention. Notable gains were observed in students' confidence in providing reduced-price housing ($t = -6.862$, $p < .001$, BH = .001), medical care ($t = -4.630$, $p = .001$, BH = .001), and meal resources ($t = -3.857$, $p = .004$, BH = .004). Comfort using public transit also improved significantly ($t = -5.212$, $p < .001$, BH = .001) (Figure 1).

All statistically significant comparisons remained significant after applying the Benjamini-Hochberg procedure for multiple comparisons correction, confirming the robustness of these findings. The only item that did not reach statistical significance was self-reported ability to empathize with individuals from underserved populations ($t = -1.765$, $p = .111$, BH = .111), suggesting a more complex relationship between experiential learning and perceived empathy.

To assess the overall perceived impact of the experience, students responded to a post-intervention question: "How effective was this experience in helping you gain compassion and empathy for your future patients?" Responses were rated on a 7-point Likert scale, with a mean score of 6.43 (SD

Figure 1. Pre vs post survey mean scores by question (post-hoc significant differences marked *)



= 0.85), indicating a high level of perceived effectiveness (Figure 2).

These findings suggest that the intervention significantly increased students' knowledge of barriers faced by vulnerable populations and their confidence in navigating local support resources. Although there was no statistically significant increase in self-reported empathy scores, students perceived the experience as highly valuable in fostering compassion and empathy toward their future patients.

Discussion

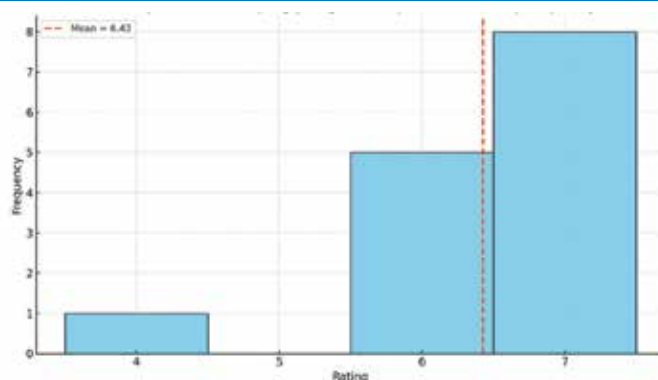
This study set out to explore the impact of immersive role-play experiences on medical students' understanding of underserved populations and their perceived capacity for empathy and compassionate care. The intervention yielded compelling results, particularly in enhancing students' cognitive understanding of social barriers and confidence in engaging with community resources, key components of our

working definition of clinical empathy.

Consistent with prior research emphasizing the effectiveness of experiential learning in healthcare education, our findings suggest that brief, focused interventions can meaningfully improve students' awareness of the structural determinants of health. Students reported significantly greater understanding of the challenges faced by individuals experiencing homelessness, intimate partner violence, and undocumented status. These findings underscore the potential of role-play scenarios to move beyond abstract instruction and foster a more grounded, empathetic perspective.

One of the most promising outcomes was the statistically significant improvement in students' confidence in navigating and offering community-based support services. These results are notable because they speak not only to enhanced knowledge, but also to students' readiness to translate empathy into action, aligning with the conceptual distinction

Figure 2. How effective was this experience in helping you gain compassion and empathy for your future patients?



between empathy (understanding) and compassion (doing) emphasized in both social discourse and educational reform movements. In this sense, the intervention appears to have strengthened not only the students' perceptual lenses, but also their functional capacity to respond to patients' needs.

Despite these gains, it is important to note that the intervention did not result in a statistically significant increase in self-reported empathy scores. While this may appear contradictory, it likely reflects the complex and multidimensional nature of empathy. One possible explanation is that students, after engaging in a challenging and emotionally immersive experience, developed a deeper and more nuanced understanding of empathy, prompting a reassessment of their previous self-perceptions. In other words, increased insight may have led to greater humility in self-assessment. Additionally, because participation in the project was voluntary, it is likely that students who opted in already valued empathy and entered the experience with relatively high baseline scores. This ceiling effect may have limited the observable upward movement on the Likert scale. This nuance is further supported by students' high ratings of the intervention's effectiveness in helping them "gain compassion and empathy" for future clinical encounters. The strong subjective endorsement of the program suggests that even in the absence of measurable shifts in affective empathy, the experience had a profound personal and professional impact.

There are several limitations to consider. The small sample size limits generalizability, and the imbalance in pre- and post-survey completion may introduce bias. Additionally, the study assessed immediate changes in perception, leaving open the question of long-term retention and behavioral impact. Future research should consider longitudinal designs, incorporate objective assessments of empathetic behavior, and explore how repeated or extended exposures influence both empathy development and patient outcomes.

Overall, this project contributes to a growing evidence base that calls for more integrative, experiential models in medical education. By prioritizing not just what students know, but how they relate to others, we take important steps toward cultivating clinicians who can both understand suffering and act meaningfully to alleviate it.

Conclusion

This pilot study demonstrates that structured, experiential role-play interventions can meaningfully enhance medical students' understanding of the lived experiences of

underserved populations and increase their confidence in utilizing community health resources. While no significant change was detected in self-reported empathy scores, students overwhelmingly perceived the experience as effective in fostering compassion and deepening their appreciation for the social determinants of health.

The findings suggest that empathy-building in medical education may benefit from a multimodal approach that integrates cognitive understanding, behavioral action, and reflective practice. Given the small sample size and short duration of the intervention, future studies with larger cohorts and longitudinal follow-up are warranted to explore the durability of these gains and their potential influence on long-term clinical behavior.

By engaging students in meaningful, immersive learning, this project contributes to the growing movement to center empathy and compassion as core competencies in medical training and patient care.

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Acute Acalculous Cholecystitis as a Rare Manifestation of Thyroid Storm: A Case Report

Ellie Gubbrud, MS IV; Mackenzie Gustafson, MS IV; Will Brown, MS IV; and Sherlon Sinclair, MD

Abstract

Background: Acute acalculous cholecystitis (AAC) is an uncommon, but potentially life-threatening inflammation of the gallbladder without gallstones. While typically seen in critically ill patients, its association with thyroid storm is exceedingly rare.

Case Presentation: We report a 28-year-old male with a history of Hashimoto's thyroiditis and Graves' disease, nonadherent to methimazole, who presented with dizziness, palpitations, epigastric pain, and nausea. Examination revealed tachycardia, hypertension, and atrial fibrillation with rapid ventricular response. Laboratory evaluation showed severe thyrotoxicosis (Free T4 5.63 ng/dL, Total T3 527 ng/dL, TSH <0.01 μ IU/mL) and mildly elevated liver function tests. Abdominal imaging demonstrated gallbladder wall thickening without cholelithiasis, consistent with AAC. The patient was managed conservatively with antithyroid therapy, beta-blocker, IV fluids, and antibiotics. He experienced significant symptomatic improvement, and follow-up confirmed resolution of abdominal symptoms.

Discussion: This case report highlights AAC as a rare, but clinically relevant complication of thyroid storm. Early recognition, appropriate imaging and management of underlying hyperthyroidism can allow successful non-operative treatment in patients. Clinicians should maintain a high index of suspicion for AAC in patients presenting with abdominal pain and severe thyrotoxicosis.

Conclusion: Further research is needed to clarify the pathophysiological link between thyrotoxicosis and AAC as well as development of nonoperative management guidelines.

Introduction

Acute acalculous cholecystitis (AAC) is a well-documented but relatively uncommon condition characterized by gallbladder inflammation in the absence of gallstones or biliary sludge. Among all instances of acute cholecystitis, AAC is estimated to account for 3-14% of all cases.^{1,3} Prompt diagnosis and treatment of AAC is essential; compared to acute calculous cholecystitis, AAC carries significantly greater morbidity and mortality, due to higher risks of developing severe complications such as gallbladder gangrene, empyema, perforation, and sepsis.³⁻⁷

AAC has historically been described as a disease process of critically ill patients, with trauma, sepsis, and prolonged total parenteral nutrition frequently identified as comorbidities.^{1,4} However, while thyroid storm is a critical illness with a well-described pathophysiology and standard of care,⁸ reports linking AAC to thyrotoxicosis are scarce. A 2021 case report linked thyrotoxicosis to AAC, suggesting that severe hyperthyroid states may contribute to gallbladder dysfunction

in rare instances, but further literature investigating this connection is needed.⁹

We present a case of AAC in a 28-year-old male diagnosed with thyroid storm and atrial fibrillation with rapid ventricular response (RVR), successfully managed through non-operative intervention.

Case Presentation

A 28-year-old male with a history of hypertension and atrial fibrillation presented to the emergency department reporting 24 hours of intermittent, 5-10 minutes-long episodes of sweateness, dizziness, and a sensation of impending syncope. Each episode was preceded by severe, cramping epigastric pain, nausea, and vomiting, which subsided completely as the other symptoms resolved. He denied fevers, shortness of breath, alcohol consumption, or use of any street drugs. He endorsed chronic tobacco and marijuana use.

He reported a history of "thyroid problems." Review of his medical records revealed diagnosis 12 years prior

of concurrent Hashimoto's thyroiditis and Graves' disease following admission for hypokalemic paralysis. Endocrinology at that time treated him with methimazole, tapered off over 2 years with clinical improvement. Seven months prior to his current presentation, he again was hospitalized with hypokalemic paralysis, was found to be in a thyrotoxic state, and was re-started on methimazole. He admitted nonadherence with his methimazole since his most recent admission and had been experiencing palpitations at home for months. He had been reluctant to follow with endocrinology due to their recommendations for ablation/thyroidectomy. He was reluctant to undergo surgery and concerned about his uninsured status.

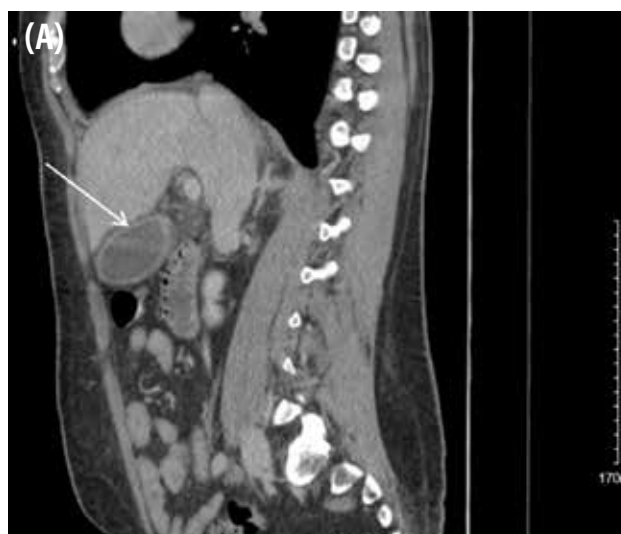
Physical examination showed tachycardia at 145 BPM, severe hypertension at 170/101 mmHg, temperature of 98.4 F, respiratory rate of 17/min and oxygen saturation of 99% on room air. A rapid and irregular rhythm was noted on his initial telemetry; subsequent EKG was performed which confirmed atrial fibrillation with RVR at a rate of 133 BPM, with findings suggestive of a prior anterior infarct and borderline ST depression in the anterolateral leads. Heart sounds were loud, rapid and irregular, with visible precordial palpitations. Abdomen was soft and non-distended with hypoactive bowel sounds and epigastric tenderness. No right upper quadrant tenderness, Murphy's sign, visualized proptosis or lower extremity edema were noted.

Due to his epigastric pain, computed tomography (CT) of the abdomen and pelvis was performed which revealed gallbladder wall thickening without radiopaque cholelithiasis and periportal edema (Figure 1A, 1B). A long segment of distended small bowel (3.5 cm) with internal fecalization suggested a developing small bowel obstruction or reactive sentinel loop. Subsequent gallbladder ultrasound confirmed wall thickening and pericholecystic fluid without sonographic Murphy's sign (Figure 1C). Liver findings were concerning for hepatitis and/or enteritis, so were correlated with LFTs which showed a total bilirubin of 2.4 mg/dL, an alkaline phosphatase of 216 U/L, and normal AST/ALT.

The patient was admitted to the medical floor for A-Fib with RVR and CT findings suggestive of acalculous cholecystitis. Free thyroxine (FT4) was found to be at 5.63 ng/dL, total triiodothyronine (TT3) at 527 ng/dL, thyroid stimulating hormone (TSH) < 0.010 uIU/mL. General labs were notable for an unremarkable white count at 5.3 K/uL with minimal left shift at 75.2% neutrophils, mildly decreased Hgb at 13.6 g/dL, lactate of 2.1 mmol/L, glucose 146 mg/dL, potassium 3.6 mmol/L and magnesium 1.7 mg/dL. Urine drug screen

Figure 1. Multimodality imaging of the right upper quadrant.

(A) Sagittal and (B) axial contrast-enhanced CT views demonstrating a distended gallbladder with diffuse wall thickening and pericholecystic fluid (arrows), characteristic of acalculous cholecystitis. No radiopaque cholelithiasis is identified within the gallbladder lumen.



(C) Longitudinal transabdominal ultrasound confirms the presence of gallbladder wall edema and the absence of cholelithiasis or sludge. Note the heterogenous liver parenchyma and periportal edema (star) visible on both modalities.



was positive for THC. Lipase, UA were unremarkable.

His Burch-Wartofsky Point scale score was 45 (>25 supports the diagnosis of thyroid storm, with ≥ 45 highly suggestive of thyroid storm). He was subsequently managed as a case of thyroid storm with concurrent acute acalculous cholecystitis, and atrial fibrillation with RVR. His AAC was addressed with IV antibiotics (aztreonam, vancomycin, metronidazole), IV fluids, morphine, Zofran, and Compazine PRN for symptomatic relief. His heart rate improved with two, 10 mg boluses of diltiazem. Lisinopril 20 mg was restarted for his hypertension. Potassium and magnesium were repleted to goals of 4 mmol/L and 2 mg/dL, respectively. Lactate improved overnight to 1.0 mmol/L. He was started on propranolol 40 mg and re-started on methimazole 15 mg BID and reported significant improvement with medical management. A surgical consult was obtained which recommended antibiotic treatment and management of his initial thyroid storm to be followed by re-assessment later. A cardiology consult was also obtained with similar recommendations.

The patient left against medical advice after 1 day of treatment, planning outpatient follow-up once he confirmed insurance coverage. He was continued on the propranolol, methimazole and lisinopril upon discharge and advised to follow-up with his primary care physician. He had visit 1 week later. At that visit, he reported adherence to his discharge medications and resolution of his abdominal symptoms. Vitals were stable at BP 135/74, pulse 95, and temperature 98.6 F. At his endocrinology visit 5 weeks after discharge, free T4 was 4.69, with his vitals again stable at BP 124/72, pulse 85. He reported continued complete resolution of his abdominal symptoms and plans for future thyroidectomy or ablation.

Discussion

Hepatic biochemical dysfunction and untreated hyperthyroidism are a well-known comorbidity.¹⁰ A 2021 systematic review and meta-analysis found that 55-60% of patients with untreated hyperthyroidism had at least one abnormal liver function test, with as many as 44% of patients having an elevated alkaline phosphatase and 12% having an elevated bilirubin;¹¹ methimazole itself has also been reported as a precipitant of cholestasis and subsequent cholecystitis,¹²⁻¹³ although the intracanalicular cholestasis with mild periportal inflammation noted on liver biopsy in reported cases is an acute and exceedingly rare presentation.¹⁴

Abdominal pain is known to be a presenting feature of

thyrotoxicosis; reported etiologies range from gastroparesis or hepatocellular damage to an acute abdomen.¹⁵⁻¹⁶ The primary challenge of AAC diagnosis is when there is a lower index of clinical suspicion despite presentation with its classic features. The diagnosis of AAC is based on a combination of both clinical suspicion and radiologic findings; typical imaging features include gallbladder wall thickening, pericholecystic fluid, and a distended gallbladder without gallstones.¹⁷⁻¹⁹ A 1989 study concluded that early recognition of AAC through imaging in high-risk trauma patients can enable timely surgery and reduce mortality, with more recent updates recommending both CT and ultrasonography as highly sensitive and specific diagnostic methods in clinically suspected AAC.¹⁷⁻¹⁹

Management of AAC includes stabilization of the critically ill patient with antibiotics and IV fluids, obtaining diagnostic imaging, source control, and determining the ideal operative treatment. Although there are no current guidelines, definitive management of AAC is widely considered to be cholecystectomy. Percutaneous cholecystostomy has also been used as a non-operative alternative, although evidence regarding its efficacy in comparison to cholecystectomy is mixed.²⁰⁻²² A newer, promising management option has also emerged recently, in which a lumen-apposing fully covered metal stent is placed endoscopically through the GI tract into the gallbladder to achieve decompression, but this is a relatively newer technique and the pool of evidence is limited.²³

Discussion regarding outcomes of symptomatic management and antibiotics alone is much less common. A comparative study found that 30.3% of AAC patients were treated successfully with antibiotics alone, but this was limited by small sample size ($n = 27$);²³ another retrospective analysis indicated it may be safe to avoid interval cholecystectomy in AAC patients unable to undergo surgery who recovered with antibiotics alone, with similar limiting caveats.²⁴

In our patient's case, prompt recognition and medical management of his acalculous cholecystitis in addition to his comorbid thyroid storm and atrial fibrillation with RVR allowed for marked improvement over the course of admission and the avoidance of surgery. Further studies are required to investigate which patients may benefit from management of acalculous cholecystitis with resolution of their underlying condition and antibiotics alone.

Conclusions

This case highlights a rare but clinically relevant association

between thyroid storm and acute acalculous cholecystitis (AAC), suggesting that severe hyperthyroid states may contribute to gallbladder disease in settings outside of the ICU. Prompt recognition of AAC and thyroid storm allowed for successful medical management without surgical intervention, reinforcing the importance of early diagnosis and conservative treatment in select cases. Clinicians should maintain a high index of suspicion for AAC in patients presenting with abdominal pain and hyperthyroidism, particularly in the setting of abnormal liver function tests and systemic signs of inflammation. Further research is needed to better define the pathophysiological link and to establish guidelines for the non-operative management of AAC in patients with reversible underlying conditions.

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Review of Feasibility and Impact of Point-of-Care Ultrasound Use in Rural Guatemala Outreach Clinics

Rebecca Hofer, MS IV; Tiffany Knecht, MS IV; Maureen Hurley, MD; Leah Naasz, MD; and Daniel Megard, MD

Abstract

Background: Despite advances in medical technology, diagnostic gaps persist in low-resource settings. Point-of-care ultrasound (POCUS) is a portable, accessible tool that can expedite diagnosis, guide treatment, and improve clinical outcomes. However, few studies quantify its real-world impact, specifically in low-resource settings. This study seeks to evaluate how POCUS influences clinical diagnosis and treatment decisions in areas with limited radiologic support, as well as highlight cases where its use influenced patient management.

Methods: POCUS use during five days of a primary care outreach clinic in five rural Guatemalan communities was documented. A POCUS-certified physician conducted abdominal, pelvic, renal, and thyroid scans with participating medical students. Verbal consent was obtained via certified translators and all images were deidentified. Data on pre-imaging suspicion and post-imaging diagnosis were documented, and diagnoses were categorized as confirmed, ruled out, or changed.

Results: Of 219 patients seen, a total of 27 ultrasounds were performed. The most frequent type of scan was pelvic (n=12, 44.4%), followed by abdominal (n=11, 40.7%). Fourteen scans (51.9%) confirmed the suspected diagnosis, 10 (37.0%) ruled out structural abnormalities (i.e. leiomyomas, bladder abnormalities), and 3 (11.1%) changed diagnosis.

Conclusion: POCUS use demonstrated practical utility that can allow physicians to offer definitive diagnoses and treatment options in communities with limited radiology support. This readily accessible imaging modality demonstrated usefulness in the diagnosis of conditions like hyperthyroidism, cholelithiasis, and numerous gynecologic conditions. Its utilization in primary care outreach clinics offers a method to enhance diagnostic accuracy and should be further explored.

Introduction

The use of point-of-care ultrasound (POCUS) in rural and under-resourced areas has been explored as a method to streamline diagnoses these areas.¹ Previous studies have demonstrated POCUS changing management in up to 50% of the cases it was utilized in, and other studies found its use can decrease unnecessary referrals.^{2,4} The potential of POCUS carries potential as a primary care force-multiplier, yet few studies explore its tangible impact on patients in primary care outreach clinics.

The Lake Atitlán region in southwestern Guatemala finds its primary economy in tourism, rural agriculture, and livestock.⁵ With many of the local population living on approximately \$3 USD per day, access to healthcare is one of many socioeconomic disparities faced by the population.⁶

The region contains nine private hospitals, four public

clinics, and three public hospitals with varying services.⁶ Surgical services were most frequently noted, offered at 92% of hospitals, and 82% have a surgeon on staff. In contrast, radiological services are only accessible at 58% of hospitals, and only 33% of hospitals have a radiologist on staff.⁶ Availability of point of care ultrasound and electrocardiogram machines are reportedly variable between hospitals and almost nonexistent within clinics, though hospital status as private or public did not affect access.⁶ This gap regarding radiological and surgical care creates a high demand for the diagnostic imaging necessary to provide surgical intervention with certainty.

In this context, POCUS can help meet the demand for imaging, provide increased diagnostic confidence to support or alter clinical suspicions, and exclude structural abnormalities, offering reassurance to patients. This study

seeks to offer evidence regarding the impact of POCUS in limited-resource setting by exploring its role in diagnosis, treatment, and referral during a medical mission trip in rural Guatemala.

Methods

Data was gathered during five days of a primary care outreach clinic held in five communities surrounding Lake Atitlán in southwestern Guatemala. The trip consisted of 20 medical students and four attending physicians specializing in internal medicine, family medicine, pediatrics, and obstetrics/gynecology (OBGYN). Each clinic was conducted in collaboration with a local nonprofit mission and utilized local community health workers and certified translators employed by the mission. Data was collected in an electronic medical record (EMR) and relayed to the local hospital in San Lucas Tolimán. The integration of local personnel and resources promoted long term sustainability of treatments and medications distributed.

A Butterfly iQ ultrasound device connected to a tablet was utilized for all scans. Deidentified images were collected with verbal consent from patients through certified translators. A POCUS-certified attending assisted with all scans and directed students to collect images as appropriate. Data on scans was collected at the end of each day, including initial clinical suspicion, scan performed, and final diagnosis. All resulting specialty referrals were processed through the local health system.

This study was reviewed and deemed exempt by the University of South Dakota's Institutional Review Board due to the retrospective, deidentified nature of the study.

Results

Quantitative Results

A total of 27 ultrasound scans were performed out of the 219 patients seen (utilization rate of 12.3%). The most frequent indications were gynecologic (n=12, 44.4%) and abdominal (n=11, 40.7%). All clinical suspicions/complaints, scans performed, and

outcomes are demonstrated in Table 1.

Gynecologic complaints included dysmenorrhea/menorrhagia as the most frequent complaint (n=7, 25.9%), followed by irregular menstrual cycles (n=3, 11.1%). Of the dysmenorrhea/menorrhagia patients, recorded diagnoses included adenomyosis (n=2), uterine leiomyomas (n=2), and menopausal symptoms (n=1). Two patients met sonographic and clinical criteria consistent with polycystic ovarian syndrome.

Suspected gallbladder disease was the most frequent indication for abdominal imaging, accounting for 10 scans. Positive findings for cholelithiasis were present in four scans, while gallbladder sludge was found in one scan.

POCUS was used to confirm 14 clinical suspicions (51.9%) and used to exclude structural abnormalities in 10 cases

Table 1. Ultrasounds performed based on clinical suspicion, results of test, and final diagnoses. Separated by ultrasound type.

Clinical picture/suspicion:	Total:	Ultrasound result:	Diagnosis:	# Performed:
Pelvic:	12			
Dysmenorrhea and menorrhagia		Positive	Adenomyosis	2
Suspected PCOS		Positive	PCOS	3
Suspected PCOS		Positive	Ovarian cyst	1
Infertility		Negative	No diagnosis made	1
Dysmenorrhea and menorrhagia		Positive	Uterine leiomyoma	2
Dysmenorrhea and menorrhagia		Negative	No diagnosis made	1
Dysmenorrhea and menorrhagia		Negative	Menopause	1
Primary Amenorrhea		Negative	Hormonal imbalance	1
Abdominal	11			
Gallbladder disease		Positive	Gallstones	4
Gallbladder disease		Positive	Gallbladder sludge	1
Gallbladder disease		Negative	Gastritis	4
Abdominal pain		Negative	Myofascial pain syndrome	1
Inguinal hernia		Positive	Inguinal hernia	1
Renal & bladder:	2			
Gallbladder disease		Positive	Kidney stones	1
Interstitial cystitis		Negative	Interstitial cystitis	1
Thyroid:	1			
Hyperthyroidism		Positive	Hyperthyroidism	1
Other:	2			
Nodule		Negative	Cyst	1

(37.0%). Three scans resulted in a changed diagnosis (11.1%) (Figure 1). Changed diagnoses included suspected gallbladder disease to renal calculi, suspected polycystic ovarian syndrome to single ovarian cyst, and suspected cholelithiasis to gastritis.

Illustrative Cases

Two illustrative cases of POCUS use are presented below, describing clinical presentation, ultrasound findings, and subsequent management.

First, POCUS was performed in a 44-year-old female presenting with chief complaints of anxiety, palpitations, and weight loss. The patient also reported a history of increased sleep disturbances and daily diarrhea for approximately one year. Upon physical exam, the patient was noted to be tachycardic and have palpable enlargement of the thyroid gland consistent with a goiter, as shown in Figure 2.

POCUS examination of the thyroid revealed heterogeneous parenchyma with increased echogenic septations or fibrosis (Figure 3). The patient was prescribed a beta blocker for management of palpitations and referred to endocrinology.

Another case included a 44-year-old-female presenting with persistent vaginal bleeding for 4 months. She also reported experiencing fatigue, dizziness, and abdominal pain. Prior trials of progesterone therapy provided no symptomatic relief. Physical examination showed conjunctival pallor and abdominal tenderness. A transabdominal ultrasound demonstrated an irregular, enlarged, heterogeneous uterus with hypoechoic areas in the uterine wall, as shown in Figure 4, prompting diagnosis of multiple uterine leiomyomas.

Figure 1. Stacked bar chart demonstrating impact of ultrasound on final diagnoses on primary differential.

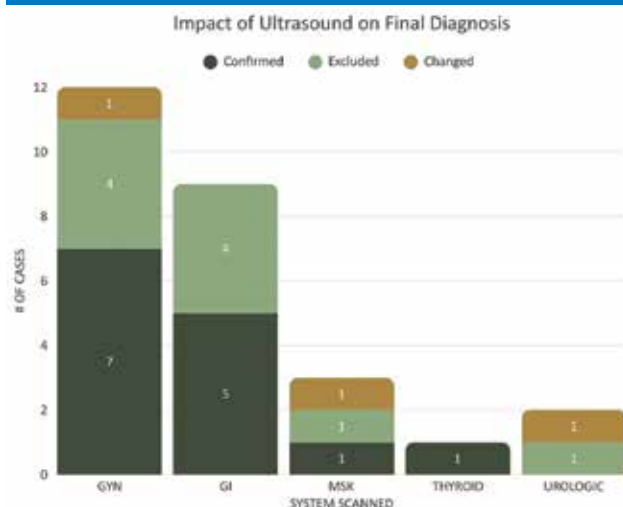


Figure 2. Photo of goiter on patient with clinical hyperthyroidism.



Figure 3. Ultrasound findings show heterogeneous, hyperechoic thyroid parenchyma (shown by the arrows) suspicious for hyperthyroidism.

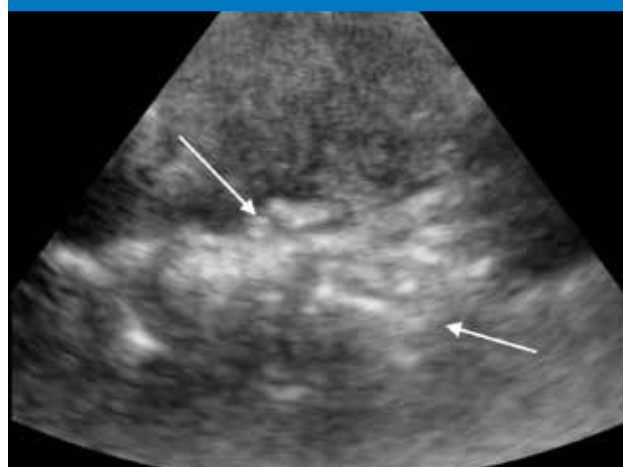
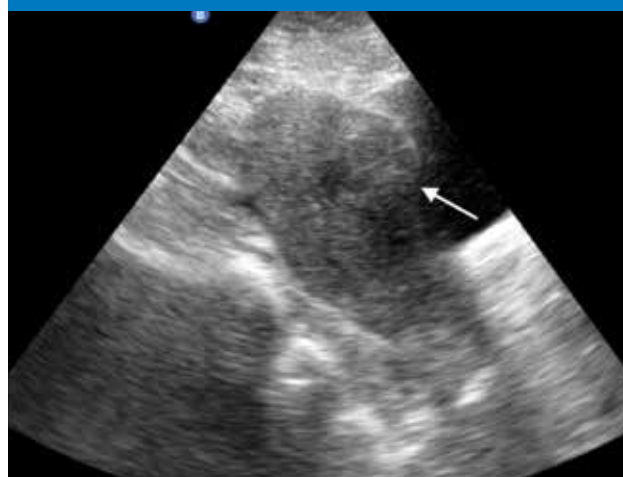


Figure 4. Ultrasound showing sagittal view of the uterus, demonstrating an irregularly shaped, enlarged uterus with an area of heterogenous, hyper and hypo-echogenicity (indicated by arrow) indicating a leiomyoma.



Due to the patient's symptomatic manifestations and failed prior progesterone therapy, immediate referral was made for gynecologic surgical intervention.

Discussion

This study demonstrates POCUS use in rural and resource-limited communities as both feasible and useful. During five days of clinic, ultrasound scans were demonstrated to be frequently concordant with clinical suspicions and provided reassurance by sonographically excluding diagnoses such as tumors or structural abnormalities.

The nature of the clinic and services offered likely impacted the scans performed. We saw no emergent or trauma-related cases, likely due to our status as primary care clinics rather than emergency services.^{7,8} One prior study explored the impact of POCUS on diagnosis in primary care clinics, including whether the scan confirmed, changed, or excluded diagnoses. It found that POCUS used altered medical management in more than 50% of scanned patients.⁶ Comparatively, scans in this study altered approximately 11.1% (n=3) of diagnoses, indicating a much lower “changed” diagnosis rate. Differences in these rates could be due to type of scan performed, clinic location, or other confounding factors. Additionally, definitions of “changed management” varied by study, with one study including excluded diagnoses as “changed management”² and another including any confirmed or excluded pathologies.⁴

An impactful result of POCUS use is management of referrals. With the limited radiological support available in the Lake Atitlán region, extensive travel may preclude diagnostic imaging necessary for referral and treatment.⁶ By providing preliminary imaging via POCUS in outreach clinics, physicians can offer patients diagnostic clarification and assist in excluding other pathologies. In this way, POCUS can support shared decision making and prioritize referrals, ensuring that limited resources spent on travel and medical expenses is done so in an effective and meaningful way.

Regarding technology used, the Butterfly iQ (\$2,699–\$3,899) and required compatible mobile device (Figure 5) represent additional costs, which may limit use in resource-constrained programs.⁹ Use also required the expertise of a POCUS-trained physician for operation and interpretation. Newer Butterfly models can charge from 10% to 90% in 90 minutes via cable or wireless pad, though nightly charging is recommended.¹⁰ Our temporary clinic sites had access to electrical outlets, but charging infrastructure may vary by outreach setting.

Figure 5. A photo of the Butterfly iQ ultrasound machine utilized by the group.



The illustrative cases demonstrate how POCUS supports clinical suspicions and prompts necessary referral through immediate imaging at clinic sites. In these cases, patients reported limited socioeconomic support, and with coordination with the local mission and community healthcare coordinators, they were able to receive necessary interventions such as surgical consult and medications. Additionally, numerous patients reported increased peace of mind post-imaging, demonstrating progress towards more equitable and holistic care.

Limitations

This study has limitations, including small sample size, short duration, and limited follow-up data on outcomes. Patients were selected for POCUS imaging when clinically indicated, leading to a possible selection bias of likely impactful cases. Additionally, diagnosis and image acquisition was dependent upon our POCUS-certified physician's interpretation and could vary between examiners. Our team had no ability to verify field diagnoses due to lack of gold-standard imaging access or other diagnostic modalities. Lastly, a limited range of conditions were noted due to the outreach's status as a primary care clinic, likely limiting acute or emergent conditions necessitating a higher level of care.

Future Research

Future studies should seek to confirm sonographic findings with gold-standard radiologic imaging to assess accuracy of in-field diagnoses and treatments. Additionally, POCUS should be considered in tandem with other innovative new technologies, such as point-of-care hemoglobin A1c% machines. Consideration for sustainability in these communities should continue to be explored, and partnership with the local mission should seek to expand

local community healthcare programs.

Conclusions

Overall, POCUS provided a feasible, adjunctive measure in rural outreach clinics to increase diagnostic confidence and expedite referral processes in communities with limited radiologic support. Future research should expand this study to verify findings in alternative communities and clinical settings.

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Extra-intestinal Manifestations of Salmonella in Immunocompetent Pediatric Patients: A Case Series

Kirsten May, MD; Kyla Jarvis, MS IV; Ted Van Alstyne, MS IV; and Peter Paul C. Lim, MD

Abstract

Introduction: This case series discusses five cases of invasive Nontyphoidal Salmonella (iNTS) infections. These presentations are atypical in healthy children without immunodeficiency or hemoglobinopathy.

Methods: We present five cases of iNTS in otherwise healthy children that were not previously known to have established risk factors. An abridged literature review of iNTS was performed.

Results: The patients in this case series were older than previously documented reports of iNTS with a mean age of 12.4 years. Each patient was immunocompetent aside from hypogammaglobulinemia in case 5. These cases had variable presentations ranging from bacteremia, septic arthritis, abscesses, pyelonephritis, transaminitis and meningismus. Additionally, our patients had hospital durations with an average of 4.8 days.

Conclusion: While iNTS most commonly affects pediatric patients less than 5 years of age with hemoglobinopathy or immunodeficiency, this is not always the case. Thus, a high index of suspicion is needed for iNTS: Blood cultures should be collected and focal infections ruled out. Additionally, patients should receive an immunologic and hematologic workup.

Introduction/Background

Nontyphoidal Salmonella (NTS) is a Gram-negative bacillus mostly regarded as a food-borne pathogen in contaminated products such as undercooked chicken, eggs and raw milk.¹ Worldwide, NTS is a major cause of diarrhea with an estimated incidence of 93.8 million cases and 155 thousand deaths each year.² In the U.S., conservative estimates from a report in 2019 suggest 1.28 million cases, 12,500 hospitalizations and 238 deaths in one year.³ Gastroenteritis is the most common presentation with diarrhea, fever, nausea, vomiting, and abdominal cramping.⁴ Bacteremia and extraintestinal infections can be serious complications of NTS gastroenteritis. Additionally, invasive NTS (iNTS) may present without a known focus of infection.⁵

Globally, Sub-Saharan countries have a higher prevalence of iNTS.⁶ This is due to certain NTS serovars and sequence types that are endemic (*Salmonella enterica* serovars Typhimurium sequence type (ST) 313, Enteritidis ST 11, Dublin, and Isangi).⁷⁻¹⁰ Several serotypes are linked with iNTS including Choleraesuis, Dublin, Enteritidis, Typhimurium, Bovismorbificans, Arizona, and Gallinarum—with Enteritidis and Typhimurium being the most common overall and the most common cause of invasive infection.^{11,12} Some

manifestations of iNTS include bacteremia, endocarditis, mycotic aneurysm, visceral abscesses, osteomyelitis, and meningitis.¹² Risk factors for iNTS include age less than 12 months or greater than 50 years, atherosclerosis, prosthetic heart valves, immunocompromised status, hemoglobinopathies such as sickle cell disease, reticuloendothelial system disorders such as cirrhosis or chronic granulomatous disease, and severe malarial anemia and malnutrition.¹³⁻¹⁶ It is, however, important to note that iNTS infection can occur in individuals without known risk factors and a sentinel invasive infection may facilitate work up of an occult co-morbidity. With the severity of illness associated with iNTS, risk factors are an important clinical consideration as complicated courses of infection often result in this patient population. In this case series, we present five cases of iNTS in children that were either previously healthy without risk factors and/or had complicated disease presentations.

Case 1 - L.A.

The patient is a previously healthy 17-year-old male who presented to the emergency department (ED) following an 8-day history of right sided lower back pain, muscle weakness, numbness, dysuria, hematuria, a 20-pound

weight loss over the last couple of months, and severe night sweats. He was in urgent care 2 days prior when his pain was preventing him from standing, sitting, or sleeping. He had found some relief with chiropractics, hot tub therapy, and hydromorphone-acetaminophen but his pain did not respond to injected ketorolac, meloxicam, tamsulosin, prednisone, or cyclobenzaprine that were prescribed in previous medical visits. Previous labs and imaging (CBC, CMP, ESR, x-ray, and MRI) disclosed no clear abnormalities aside from neutrophil differential being high at 75.2% (normal 40-60%) with a white count of 6.3K/uL (normal 4.5-11K/uL), total protein was elevated at 8.2g/dL (normal 6.3-7.7), total bilirubin was slightly elevated at 0.9mg/dL (normal 0.2-0.8mg/dL), BUN/creatinine ratio was elevated at 21.4 (normal 10.0-20.0), CRP was elevated at 18.7 (normal <0.5mg/dL) and ESR was normal at 6 (range is 0-15 mm/Hr).

Following multiple clinic, urgent care, and ER visits, a urine culture grew *Salmonella spp.* and a CT abdomen pelvis showed an iliopsoas abscess as well as pyelonephritis (Figure 1). He was sent home on nitrofurantoin at his initial visit but he required eventual admission to the pediatric hospital 2 days later when positive blood cultures grew *Salmonella spp.* He was treated with IV ceftriaxone and metronidazole for *Salmonella* bacteremia, potential septic arthritis, pyelonephritis, and right iliopsoas abscess. He was discharged on IM ceftriaxone following a 3-day hospital stay. However, he was found to have asymptomatic eosinophilia at a follow-up appointment and was switched to oral amoxicillin, completing a total course of 6 weeks of therapy with clinical improvement.

The patient did not have any predisposing factors such as hemoglobinopathies for *Salmonella* septic arthritis or bacteremia. He did have pet reptiles (2 snakes, 1 turtle, 1 bearded dragon, 1 tortoise, and 1 gecko) that he handled regularly and was thought to have been the source of his infection. In addition, he has several healed tattoos and piercings. An extensive workup was planned for him to rule out occult co-morbidity leading to his extensive iNTS but he was unfortunately lost to follow up.

Case 2 - A.L.

The patient is a 9-year-old male who presented to his primary care physician with a 2-day history of right ankle pain and swelling along with new-onset hypertension, tachycardia, and fever. Two weeks prior to this he had an upper respiratory infection with low-grade fevers, nasal congestion, and cough. Labs at this visit disclosed a normal CBC, Na of 133mEq/L (normal 135-145mEq/L), ESR of >130mm/hr (normal <15mm/hr), and CRP of 1.4mg/dL (normal

<1.0mg/dL). Ankle x-ray showed swelling around his ankle joint but no other acute findings (Figures 2 and 3). His primary care provider sent him to the ED, where a joint

Figure 1. Iliopsoas abscess on CT abdomen pelvis.



Figure 2. Right ankle AP view.



Figure 3. Right ankle lateral view.



aspiration revealed cloudy fluid with elevated nucleated cell count but no organisms on Gram stain. Following a consult with orthopedics, he was admitted to the hospital for a joint washout and empiric cefazolin while waiting for synovial fluid culture results.

Synovial fluid cultures showed *Salmonella spp*, and blood cultures were negative, so he was switched to ceftriaxone based on microbiology from surgical culture. He was sent home on oral amoxicillin and completed 6 weeks of therapy with clinical improvement.

The patient had no known identified risk factors such as hemoglobinopathies. His father works for a local pork processing plant. Following antibiotic therapy, the patient had pending immune workup, but he was lost to follow-up.

Case 3 – A.A.

The patient is a 5-year-old male who presented to the ED with a 6-day history of diffuse abdominal pain, fevers, nausea, vomiting, sore throat, and newly decreased appetite. He had visited both the ED and the pediatric clinic prior to this presentation but was not feeling better despite ibuprofen, Tylenol, and Zofran treatment. His previous visits disclosed tachycardia (HR 130s), peak temperature of 102°F, and pain with palpation in the epigastric, periumbilical, and suprapubic regions with no rebound tenderness or guarding. Previous CBC, urinalysis, rapid strep test, and lipase showed no clear etiology, but there were ketones in his urine. This was likely due to dehydration and lack of nutrition. Since his symptoms were continuing to worsen, he was admitted to the hospital for failure to thrive.

Blood cultures on admission showed Gram-negative bacteria. Empiric therapy of ceftriaxone and metronidazole was started until cultures showed *Salmonella spp*, which prompted discontinuation of metronidazole while waiting for susceptibility. Following 3 days in the hospital, he was discharged on oral amoxicillin and took a total of 10 days with clinical improvement.

The patient was doing well on outpatient follow-up. NTS infection was reported to the South Dakota Department of Health. The patient had some potential links to exposures through common demographic risk factors including: a local pork processing plant, recent farm fresh egg consumption, and family origins in Ethiopia. However, no hemoglobinopathies were identified on his peripheral blood smears in the hospital. Further work up was planned for him to determine potential predisposing health risk factors to

NTS bacteremia but he unfortunately was lost to follow up following completion of his antibiotic therapy.

Case 4 – D.J.

A previously healthy 15-year-old male of Ethiopian descent presented to his pediatrician 3 days prior to hospital admission with nonbloody diarrhea, vomiting, and diffuse abdominal discomfort. He was sent home on ondansetron due to presumed viral gastroenteritis. The following day, he visited urgent care with continued symptoms and a fever of 103°F but was again sent home on supportive therapy. He presented to the ED the next morning with new-onset dizziness, weakness, chills, aches, cough, and a sore throat. He had taken acetaminophen and ibuprofen prior to arrival. He was febrile (103.2°F) and tachycardic (121 bpm) with a blood pressure of 138/77. Blood count and metabolic panel revealed WBC 4.2k (normal 3.8-10.4k), platelets 102 (normal 139-320 $10^3/uL$), and slightly elevated ALT and AST of 96 and 56 U/L, respectively (normal 8-45 U/L ALT, 15-41 U/L AST). Blood cultures were drawn out of concern for sepsis with the patient's high fever and persistent tachycardia. In the ED, fever reduced to 99.8 °F and heart rate decreased into the 90's. The patient received a bolus of 1 liter of normal saline. With the normal WBC, normal lactate level, and minimally elevated LFTs, viral illness was the top differential diagnosis per ED discretion, and a mutual decision was made between provider and parents for discharge and outpatient follow-up on Monday with repeat LFT levels. The patient was called back to the ED the next day and admitted to inpatient pediatrics when blood cultures grew *Salmonella spp*. IV ceftriaxone was initiated for bacteremia with compensated mild sepsis.

The patient remained hospitalized for 6 days in total. His symptoms initially worsened to include headache but began to subside with fever breaking by day 4. Daily labs demonstrated persistence of his leukopenia (lowest 3.9), mild anemia (lowest 12.6; normal 13.3-16.9 g/dL), thrombocytopenia (lowest 41), and worsening transaminitis (highest 234 ALT, 174 AST U/L) throughout the stay which were attributed to transient marrow suppression and liver hypoperfusion, respectively, with possible contribution from parenteral nutrition which was started on days 5 and 6 due to diminished oral intake. Repeat blood cultures were all eventually negative. CSF studies and peripheral blood smear were unremarkable. The patient demonstrated clinical stability by day 6 and was discharged on 14 days of oral amoxicillin with clinical improvement.

His potential risk factors were identified and included

swimming in a lake two weeks prior, his mother's occupation at a local pork processing plant, and family origins in Ethiopia. At infectious disease follow-up one week later, the patient felt well and reported complete resolution of fevers, abdominal pain, anorexia, and diarrhea. He was still leukopenic (3.9K) but had an otherwise unremarkable CBC. Transaminitis had resolved (38, 35). State laboratory salmonella serotyping revealed type B NTS. Two months later, a limited immune workup was performed with no findings. By the most recent follow-up—4 months after admission—leukopenia had finally resolved. The patient has reported no episodes of gastroenteritis or hospitalizations since this event.

Case 5 - S.S.

A previously-healthy 16-year-old male presented to his pediatrician one day prior to admission with a history of three days of fevers, 1.5 weeks of nonbloody diarrhea, abdominal pain, vomiting, and arthralgias, as well as recent-onset headache, neck stiffness and lower extremity tingling. The primary care physician believed the illness to be of two separate disease processes. The diarrheal illness which had been ongoing for several weeks with a new viral process. Viral meningitis was noted to be possible. Concern for bacterial meningitis was low with his 3-day history of fevers and symptoms that were not worsening. The patient was sent home while laboratory testing was pending with strict precautions to go to the ED for worsening symptoms, dehydration, and/or new-onset altered mental status. Labs resulted the next day with a complete blood count within normal limits, and blood cultures with Gram-negative bacilli, which prompted hospital admission for bacteremia. On admission, the patient had a temperature of 103°F and was found to have nuchal rigidity & positive Brudzinski & Kernig's signs. WBC was 5.8 with ANC of 3.77 (normal 3.8-10.4) (normal ANC 1.40-6.10 $10^3/uL$) and CRP of 4.8 mg/L (normal <5.0 mg/L). Repeat blood cultures and CSF studies were drawn, and IV ceftriaxone was started empirically due to suspected non-typhoidal salmonella vs. shigella bacteremia with clinical meningitis.

The patient was hospitalized for 4 days in total with his symptoms eventually resolving by day 3. *Salmonella spp* was identified from initial clinic blood cultures, and a stool culture was also positive for *Salmonella spp*. Repeated blood cultures and CSF studies on admission were negative and demonstrated no culture growth. 16S testing was sent to Mayo Clinic for a definitive meningitis rule-out which resulted negative for bacterial DNA. Brain CT & MRI were negative for abscess. The patient was sent home on IV

ceftriaxone with midline access at meningitic dosing. This regimen was switched to bacteremic dosing after 16S rRNA testing came back negative, and the patient completed 14 days of ceftriaxone with complete clinical improvement.

There were multiple potential exposures identified including recent lake swimming, drinking unpasteurized milk, and the patient's job as a veterinary technician where he recently took care of a horse with *Salmonella spp*. At infectious disease follow-up 10 days after discharge, the patient reported feeling well overall with only some headaches that resolved with conservative management.

Seven months later, the patient once again presented to his pediatrician with acute-onset vomiting and profuse nonbloody diarrhea. CBC showed leukocytosis of 18, with neutrophilic predominance of 91% (normal 40% - 70%). Blood culture showed Gram negative rods, and stool culture was positive for *Campylobacter jejuni*. Patient was sent home on 7 days of ciprofloxacin and recovered without complications within a few days. An immune workup was pursued, and the patient was found to have hypogammaglobulinemia of 433 (normal 487-1,327 mg/dL) and normal IgM, IgA, and IgE. Clinical course most likely compatible with potential isolated hypogammaglobulinemia, most likely transient. Workup was reassuring otherwise with normal tetanus, diphtheria, HiB, and pneumococcal serology. He has continued to follow with infectious disease and immunology every 6 months since and has yet to experience another episode of invasive GI disease. Further testing showed normalized IgG.

Review

An abridged review of relevant literature for invasive NTS was performed through PubMed with the search term, "non typhoidal salmonella bacteremia case report." Studies were only included if they fit the demographic of our case review including children under 18-years-old, case reports, and nontyphoidal salmonella bacteremia. This search was performed by the authors without the assistance of medical librarians. This was a limited search accessible by freelance open access search.

Discussion

NTS in rare cases can cause iNTS. In an epidemiological study from the American Academy of Pediatrics, the highest incidence rate of NTS blood stream infection was seen in children <1 year of age at 7.47 per 100,000 children.¹⁷ Of these children with NTS bloodstream infection, 3% had focal infection such as osteomyelitis, pneumonia, meningitis, pancreatitis and myocarditis.¹⁷ Of these children with

focal infection, 28.6% were found to have an underlying comorbidity.¹⁷ Due to iNTS in immunocompetent pediatric patients being low in prevalence and potentially underdiagnosed, the authors hope that the five cases of iNTS infection presented in this case series can contribute to relevant literature on pediatric iNTS (Table 1).

In the cases reviewed from the literature (Table 2), the majority of these invasive cases appear in children under 5, with an average age of 3.6 years. In contrast, the majority of our patients in this case series were older, with a mean age of 12.4 years. The cases from the literature review were consistent with the risk factor for children less than five years of age being more susceptible to iNTS. This contrasts with

our older patients who should have had increased protection from systemic infection.

Additionally, the patients from our case series were immunocompetent (excluding the patient in case 5 with transient hypogammaglobulinemia). Case 5 was found to have hypogammaglobulinemia which may have contributed to his susceptibility for systemic infection. From the literature, one case had acute lymphoid leukemia which could also increase susceptibility to systemic infection.

Our five cases had variable complications ranging from bacteremia, septic arthritis, abscesses, pyelonephritis, transaminitis and meningismus. While the cases in the

Table 1. Case series of invasive nontyphoidal Salmonella.

Patient	Presentation	Comorbidity	Exposure	Diagnostic culture	Antibiotic/HD/surgery	Outcome	Complication
17 y/M	Right sided lower back pain, muscle weakness, and numbness	No known	Pet reptiles possibly	Urine and blood culture positive for Salmonella	IV ceftriaxone and metronidazole, oral amoxicillin outpatient	Survived, discharged after 1 week	Pyelonephritis, septic arthritis, iliopsoas abscess
9 y/M	Right ankle pain	No known, no hemoglobinopathies	Pork processing plant	Aspiration positive for Salmonella, blood culture negative	IV ceftriaxone and vancomycin, vancomycin discontinued, oral amoxicillin outpatient	Survived, discharged after 4 days	Septic arthritis
5 y/M	Abdominal pain, nausea, vomiting, fever	No known	Pork processing plant, farm fresh eggs, family immigrated from Ethiopia	Blood culture positive for Salmonella	IV ceftriaxone and metronidazole, discontinued ceftriaxone and metronidazole, amoxicillin from susceptibilities	Survived, discharged after 3 days	Bacteremia
15 y/M	Bloody diarrhea, vomiting, and diffuse abdominal discomfort	No known, immune workup normal	Pork processing plant, swimming in freshwater lake	Blood culture positive for group B nontyphoidal Salmonella	IV ceftriaxone, transitioned to IV ampicillin, oral amoxicillin outpatient for 14 days	Survived, discharged on hospital day 6	Bacteremia, mild sepsis, transaminitis
16 y/M	Fevers, nonbloody diarrhea, vomiting, arthralgias, photophobia, neck stiffness	Hypogammaglobulinemia	Swimming in freshwater lake, horse with Salmonella	Blood culture positive for Salmonella, CSF negative	IV ceftriaxone 2 g BID	Survived, discharged on hospital day 4	Bacteremia and meningitic presentation

Table 2. Clinical characteristics of patients with invasive NTS based on review of literature.

Patient	Presentation	Comorbidity	Exposure	Diagnostic culture	Antibiotic/HD/surgery	Outcome	Complication	Reference
14 y/F	Left-sided abdominal pain, fever	No known	Unknown	Salmonella group B in stool, seropositive O antigen GBS	IV Ciprofloxacin 20mg/kg	Survived, discharged day 7	Splenic infarct	Kupeli et al. ¹⁸
1.3 y/F	Refusal to walk, loss of appetite, weight loss	No known	Unknown	Blood culture positive for <i>Salmonella enterica</i>	IV cefazolin, IV ceftriaxone for 4 weeks, amoxicillin/clavulanate for 2 weeks	Survived, discharged after several days, gradual improvement after discharge	Spondylodiscitis	Yaari et al. ¹⁹
35 d/M	Fever, irritability, poor activity for 1 day, increased size of right parietal cephalohematoma	No known	Unknown	Positive group B salmonella in cephalohematoma fluid and blood, negative stool culture	Ampicillin and gentamicin, ceftriaxone,	Survived, discharged after 2 weeks IV ceftriaxone, shrunken cephalohematoma and negative fluid and blood culture 1 week after discharge	Infection of cephalohematoma	Wang et al. ²⁰
1 y/M	2 weeks of high fever and cough, diarrhea for 1 week	No known	Unknown	Pleural fluid culture positive for Group B salmonella, blood culture negative	Gentamicin 5 mg/kg daily, cloxacillin 100 mg/kg daily, cefotaxime 100 mg/kg daily for 16 days	Survived, discharged about 2 weeks later with full recovery	Pleural empyema	Kanungo et al. ²¹
2mo/ M	High fever, diarrhea with blood, irritability	No known	Unknown	CSF negative, blood positive for <i>Salmonella enteritidis</i> , stool positive for <i>Salmonella enteritidis</i> after discharge	IV cefotaxime 300 mg/kg/die for 6 weeks	Survived, discharged after 7 weeks	Meningitis	Monica et al. ²²
5 y/M	7-day fever and arthralgias especially of right elbow	No known, normal immunoglobulin levels and T- and B-cell lymphocytes	Unknown	Joint aspiration and blood culture positive for <i>Salmonella enterica</i> , stool negative	IV ceftriaxone 1 g/24hrs for 2 weeks	Survived, full recovery of right elbow	Septic arthritis	Pezone et al. ²³
2 y/M	8-day fever, diarrheal illness	No known	Bite on a sand dollar	Blood culture positive for non-typhoid salmonella	IV antibiotics for 24 hours, discharged on oral antibiotics	Survived	Bacteremia	Trigo ²⁴
11 mo/F	Fever for 4-5 days, diarrhea for 20 days	Malnutrition	Unknown	Blood culture positive for <i>Salmonella enterica</i> serotype Virchow	Parenteral cefotaxime and gentamicin	Survived, discharged day 10	Bacteremia	Randhawa et al. ²⁵

Table 2 Cont.

Patient	Presentation	Comorbidity	Exposure	Diagnostic culture	Antibiotic/HD/surgery	Outcome	Complication	Reference
11 mo/F	Fever for 4-5 days, diarrhea for 20 days	Malnutrition	Unknown	Blood culture positive for <i>Salmonella enterica</i> serotype Virchow	Parenteral cefotaxime and gentamicin	Survived, discharged day 10	Bacteremia	Randhawa et al. ²⁵
6 y/M	5-day spiking fever	No known	Unknown	Blood and stool cultures positive for <i>Salmonella virchow</i>	IV cefotaxime for 10 days	Survived, discharged day 10 in excellent health	Bacteremia	Bitsori et al. ²⁶
5 y/M	Progressive painful swelling of left elbow	Insignificant, small VSD at birth	Unknown	Negative blood culture, synovial fluid positive for <i>Salmonella virchow</i>	IV ceftriaxone for 3 weeks, oral TMP/SMX for 2 weeks after discharge	Survived, full recovery, discharged after 3 weeks	Septic arthritis	Bitsori et al. ²⁶
4 y/F	24 hour history of fever and neck stiffness	No known, hemoglobin electrophoresis and serum immunoglobulins were normal	Unknown	Blood culture positive for <i>Salmonella virchow</i> , Widal test negative	IV clindamycin and ceftriaxone for 4 weeks, oral cefuroxime for 2 weeks after discharge	Survived, discharged after 4 weeks, uneventful 3-month follow-up	Prevertebral abscess and bacteremia	Bitsori et al. ²⁶
4 y/F	High grade intermittent fever and generalized bodyache for 6 days	Acute lymphoid leukemia	Unknown	Scalp abscess pus and blood culture positive for <i>Salmonella typhimurium</i>	Cefotaxime 500 mg TID for 10 days	Survived, discharged home with full recovery after 10 days	Scalp abscess	Baliga et al. ²⁷

literature also had variable complications such as bacteremia, spondylodiscitis, septic arthritis, meningitis, abscesses, and pleural empyema. This shows the variable presentation that can be associated with iNTS.

Interestingly, our five cases had a mean hospital duration of 4.8 days with a range of 3-7 days of admission. This is in comparison to an average hospital duration of 18.1 days (ranging from 7-49 days) of the nine cases with available data on hospital duration in the literature. With our patients being older and the majority being immunocompetent, this may have contributed to their shorter hospital duration.

The source of infection can be challenging to identify. However, one potential source of infection may have been linked to a local pork processing plant for our patients as three out of our five patients had this exposure. *Salmonella* is a foodborne illness. The Department of Health was aware of this exposure and following; however, it is unclear if this was an outbreak or not as other cases of NTS were occurring at this time from different exposures as well. We were not

able to identify the type and strain of *Salmonella* bacterium for all of the cases; however, this would have been helpful to further elucidate this concern for a shared exposure.

High case fatality rate of 10-30% due to risk factors such as severe anemia, malaria, human immunodeficiency virus, and malnutrition has been reported.⁴ Our five cases did not have any of the previously listed risk factors. Alternatively, one case had malnutrition from the literature. The majority of the other cases from the literature review had good outcomes. From our cases, all patients had good outcomes with full recoveries. There may be bias in this observation with a preference to share cases with good outcomes or cases in resource-abundant locations with access to surgical and medical interventions.

In conclusion, while iNTS most commonly affects pediatric patients less than 5 years of age with hemoglobinopathy or immunodeficiency, this is not always the case for iNTS. Thus, a high index of suspicion is needed for iNTS. For NTS, blood cultures should be collected and focal infections ruled out.

Additionally, patients should receive an immunologic and hematologic workup. These recommendations are expressed in our learning points below.

Learning points:

1. NTS infection can be more invasive beyond gastroenteritis and can present as systemic infection secondary to seeding of major organs especially in the immunocompromised host or in infants.
2. For invasive NTS infection, disseminated diseases such as meningitis, osteomyelitis, and endocarditis should be excluded.
3. For patients without risk factors for invasive NTS infection, an immunologic workup should be completed to rule out an occult inborn error of immunity.

Conclusion

This case series discusses five cases of iNTS infections. These presentations are atypical in healthy children without immunodeficiency or hemoglobinopathy. These cases are then contrasted with a review of other iNTS infections and their complications.

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IMAGES IN MEDICINE:

NSTEMI Due to Thrombosed Aneurysm of the Left Main and Left Circumflex Coronary Artery

Dawood Shehzad, MD; and Hammad Chaudhry, MD

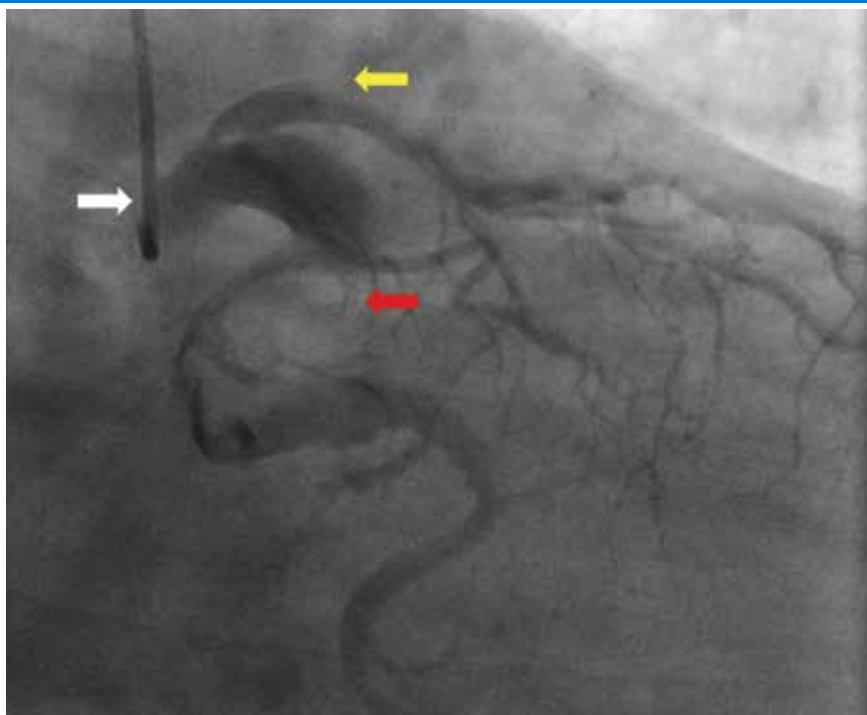
A male in his mid-60s with a past medical history of hypertension and hyperlipidemia presented to the emergency department with chest discomfort that began during yardwork. He described substernal chest pressure radiating to the neck and jaw, associated with nausea and diaphoresis. The pain was refractory to over-the-counter analgesics, prompting presentation to the emergency department. He denied any history of smoking, alcohol abuse, childhood Kawasaki disease, connective tissue disease, or known coronary artery disease. Home medications included metoprolol succinate 12.5 mg once daily.

Initial laboratory evaluation demonstrated an unremarkable complete blood count and comprehensive metabolic panel. High-sensitivity troponin on presentation was 302 ng/L and rose to 2065 ng/L, 5301 ng/L, and 13 849 ng/L on serial measurements obtained every three hours. A 12-

lead electrocardiogram showed nonspecific T-wave changes in the inferior and lateral precordial leads. Transthoracic echocardiography revealed a left ventricular ejection fraction of 55–60% with hypokinesis of the apical lateral wall; right ventricular function was preserved.

The patient was evaluated by cardiology and diagnosed with a non-ST-elevation myocardial infarction (NSTEMI) with a TIMI (Thrombolysis in Myocardial Infarction) risk score of 3. Coronary angiography demonstrated severe aneurysmal dilation of the left main coronary artery and proximal left circumflex artery, with a large thrombus within the proximal left circumflex resulting in TIMI 2 flow to the distal vessel. The right coronary artery was patent. The left anterior descending artery demonstrated a 50% ostial stenosis but was otherwise angiographically normal. (Figure 1)

Figure 1. Left anterior oblique caudal (spider view): large aneurysmal left main coronary artery (white arrow), with proximal left circumflex with large thrombus (red arrow). The left anterior descending has a 50% ostial lesion but is otherwise patent (yellow arrow).



Given the large thrombus burden within an aneurysmal coronary segment and concern for distal embolization, systemic anticoagulation was initiated with rivaroxaban 20 mg once daily in addition to aspirin 81 mg and high-intensity statin therapy with rosuvastatin 40 mg daily. Due to the aneurysmal left main anatomy and high procedural risk associated with percutaneous coronary intervention, cardiothoracic surgery was consulted. The patient was deemed an appropriate candidate for surgical revascularization and underwent single-vessel coronary artery bypass grafting with left internal mammary artery to left circumflex artery (Society of Thoracic Surgeons predicted risk of mortality 0.36%). His postoperative course was uncomplicated, and he was discharged in stable condition with close outpatient follow-up.

Coronary artery aneurysm (CAA) is defined as a focal enlargement of the coronary artery exceeding the 1.5-fold diameter of the adjacent normal segment. Atherosclerosis is the main cause in adults and Kawasaki disease in children.¹ Incidence ranges from 0.3% to 5.3%.¹ There is no consensus regarding the management strategy of these patients given low incidence and lack of randomized clinical trials.

Treatment options depend on clinical presentation, etiology, aneurysm variables such as size, location, expansion over time, the presence of thrombus and/or any coexisting atherosclerosis. In non-acute coronary syndrome (ACS) cases,

dual antiplatelets or therapeutic anticoagulation are used. Unfortunately, no high-quality evidence exists to support or contradict the use of an antiplatelet or antithrombotic regimen in these patients.² In acute coronary syndrome due to a CAA culprit lesion, percutaneous coronary intervention (PCI) is most often performed. PCI in these patients is technically challenging and thrombectomy (aspiration or mechanical) is frequently used.² The emphasis is to restore flow, however the occurrence of no-reflow or distal embolization is common. The decision to pursue PCI in CAA patients without acute coronary syndrome is rather complex, due to the lack of supportive data.² Surgical management is generally favored for large or complex aneurysms, left main involvement, multivessel disease, or when coronary anatomy is unsuitable for PCI. Timely recognition and appropriate management are essential to prevent complications such as distal embolization, myocardial infarction, or sudden cardiac death.

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Artificial Intelligence in Dermatology: Addressing Algorithmic Bias in Skin of Color

Lucas Goetz, MS IV

Artificial intelligence (AI) has rapidly emerged as a promising tool in dermatology. Machine learning algorithms capable of analyzing clinical and dermoscopic images have demonstrated diagnostic performance comparable to dermatologists in identifying certain skin lesions.¹ These technologies have the potential to improve access to dermatologic care, assist clinicians in triaging suspicious lesions, and support diagnostic decision-making in both primary care and specialty settings.²

Despite these promising developments, concerns have emerged regarding the equitable performance of AI algorithms across diverse patient populations.³ In particular, many dermatologic AI systems have been trained on image datasets that predominantly include lighter skin types.⁴ As a result, questions have been raised about whether these algorithms perform equally well in patients with darker skin tones. Addressing this issue is critical to ensure that advances in artificial intelligence do not unintentionally reinforce existing disparities in dermatologic care.

Machine learning models rely heavily on the datasets used for training, and limited diversity in these datasets can contribute to algorithmic bias. Publicly available dermatologic image datasets are disproportionately composed of images from lighter skin types, which may result in reduced accuracy when algorithms are applied to patients with darker skin tones.^{4,5}

This issue is particularly important in dermatology, where many conditions present differently across skin tones.⁶ Variations in pigmentation, erythema visibility, and lesion morphology can affect how diseases appear clinically. For example, inflammatory conditions in darker skin may present with less visible erythema. Algorithms that are not trained on diverse images may therefore misinterpret or fail to recognize certain presentations of disease. In practice, this could lead to delayed diagnoses or incorrect risk assessments for patients with skin of color.

These concerns also have important implications for health equity. Dermatologic disparities already exist in several conditions, including melanoma, where patients with darker skin tones are often diagnosed at later stages and experience worse outcomes.⁷ If artificial intelligence tools are deployed without careful validation across diverse populations, there is a risk that these technologies could exacerbate existing inequities.

In addition, AI tools are being integrated into settings such as teledermatology platforms, primary care clinics, and mobile health applications. These environments often serve patients with limited access to dermatology specialists. Ensuring that algorithms perform reliably across diverse populations is essential to prevent unintended harm and to maintain trust in emerging digital health technologies.

Addressing algorithmic bias will require collaboration among researchers, clinicians, regulators, and technology developers. An important step is developing more diverse training datasets that include a broader range of skin tones, geographic populations, and disease presentations. Sharing images and collecting data from multiple centers may help improve dataset diversity.

Regulatory agencies also play an important role in ensuring that AI systems are evaluated across representative patient populations. Developers may be required to demonstrate algorithm performance across multiple skin types before clinical implementation. Clearly reporting what data were used and how algorithms perform may help ensure responsible use of AI technologies.

Looking ahead, artificial intelligence may help improve dermatologic care, especially in underserved areas where access to specialists is limited.² However, this potential will depend on fairness and transparency in how algorithms are developed and evaluated. Expanding diverse image datasets, improving validation methods, and encouraging collaboration among researchers and clinicians will be key in making sure AI tools benefit all patients. As these technologies continue to evolve, dermatologists will play an important role in guiding their responsible use in clinical practice.

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Mason's Story: Rebuilding Heart Health After a Lightning Strike

Just a short time after his family moved away from Omaha, 15-year-old Mason was struck by lightning during a high school soccer practice. He initially received care at a local hospital, but his family soon decided to return to their hometown of Omaha.

"We just felt like he needed a higher level of care and a place we trusted," says Mason's mom, Chelsey.

The lightning struck Mason's chest, causing damage and scarring to his heart and affecting nerves and muscles throughout his body. The team of cardiac experts at the Dr. C.C. and Mabel L. Criss Heart Center at Children's Nebraska was ready to help him recover, enrolling him in Children's Cardiac Rehabilitation Program – one of only a few pediatric programs of its kind in the nation. Through monitored cardiovascular and strength training, providers help rebuild patients' strength in a safe, supportive environment.

"In this pediatric program, we can really help patients adopt new, healthier habits that really change the trajectory of where their life is going," says Caleb Ross, MS, EPC, ACE-ES, a cardiac exercise physiologist at Children's.

Mason successfully graduated from the Cardiac Rehab program, surpassing expectations along the way.

"Mason has had the greatest success that we've seen in the history of our program, and I kind of knew and expected that to happen because of who he is," says Caleb.

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- Cardiac Neurodevelopmental Program
- Cardiac Rehabilitation
- Cardiothoracic Surgery
- Cardiovascular Genetics
- Diagnostic Testing & Advanced Cardiac Imaging
- Electrophysiology
- Fetal Heart Program
- Fontan Program, in partnership with Children's Adolescent Medicine and Gastroenterology, Hepatology & Nutrition
- Interventional Cardiology
- Lipid Heart Clinic
- Pediatric Cardiology
- Pediatric Pacemaker and Implantable Cardioverter Defibrillators (ICD) Program
- Pulmonary Hypertension Program, in partnership with Children's Pulmonology
- Single Ventricle Program



Scan the QR code or visit ChildrensNebraska.org/ReferHeart to learn more about Children's Criss Heart Center and how to make a referral. For immediate consult or transport, call Children's Provider Priority Line at 855.850.KIDS (5437).



Member News

Visit www.sdsma.org for the latest news and information.



**SAVE THE
DATE**

SDSMA Legislative Day is February 2

Advocate for your patients and the medical profession at the South Dakota State Medical Association's 2027 Legislative Day in Pierre! The association will be sponsoring food for legislators in the Speaker's and President's lobbies in the State Capitol on Tuesday, February 2.

Join your colleagues to interact with legislators and promote the SDSMA's advocacy priorities.

This is a great opportunity to meet and become better acquainted with your elected representatives. More information will be provided as the date nears.

SDSMA Foundation: "A Night of Gratitude"

Join us in Sioux Falls on Thursday, September 24 for an evening of celebration, impact and gratitude! Don't miss the SDSMA Foundation's special event that includes food, socializing, and celebrating medical student scholarship recipients and the incredible supporters and partners who make the SDSMA Foundation's mission possible.

The night will include a social hour with live music and drinks, dinner, and inspiring stories from scholarship recipients, donors and partners.

WHAT: SDSMA Foundation "A Night of Gratitude – Celebrating Our Donors"

WHERE: Monick Yards Downtown Sioux Falls, 605 E 8th St

REGISTER: www.sdsma.org

DRESS: Black tie optional

Schedule

6:00-7:00 pm – Social hour & music

7:00 pm – Dinner

7:30 pm – Recognition and words from SDSMA Foundation's donors, families, partners and scholarship recipients.

Learn more and register by September 4 to attend this first-time event at www.sdsma.org.

Membership Survey: Share Your Feedback

The SDSMA is committed to advocating for physician practices, professional growth, personal well-being, and patients. The association has a number of benefits and programs to help physicians tackle the challenges in everyday practice and offers opportunities for networking with other physicians.

If you haven't done so yet, **please take a moment to share your thoughts in the brief survey** that was sent to members recently via email. We want to ensure we keep growing the programs, benefits and networking events that matter most to physicians. Your feedback helps us understand how we can meet members' needs. Thank you for your membership and input.

Welcome, USD SSOM Class of 2030!

The University of South Dakota Sanford School of Medicine welcomed the new class of 2030 during orientation week July 20-24.

SDSMA President Ben Meyerink, MD, led the Affirmation of the Physician at the White Coat Ceremony on July 24 in Vermillion and SDSMA staff provided students with information about their SDSMA membership and opportunities for involvement.

Four-year student memberships in the SDSMA are sponsored by member physicians. If you would like to sponsor a student in next year's incoming class, please email membership@sdsma.org.

Member News

2026-27 Health Leadership Institute Cohort Begins in October - Now Accepting Participants

The HLI is now accepting participants for the 2026-27 cohort! Those interested may contact Justin Ohleen at johleen@sdsma.org or 605-336-1965. Sessions 1 and 6 will be held in Sioux Falls. Sessions 2 through 5 will be virtual.

Schedule:

Session 1 – Self Awareness - October 16-17, 2026

Session 2 – Interpersonal Communications - November 13-14, 2026

Session 3 – Teamwork and Collaboration - December 11-12, 2026

Session 4 – Systems Awareness - January 22-23, 2027

Session 5 – Wellness Centered Leadership - February 26-27, 2027

Session 6 – Influencing Organization Change & Culture – April 2-3, 2027

Learn more about the HLI at sdsma.org.



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Call for Submissions – Third Annual *South Dakota Medicine* Humanities Supplement



For the past two years, the *South Dakota Medicine* has published an online Humanities Supplement. The journal plans another edition of the supplement this fall and encourages submissions of creative work – visual art, poetry, short fiction, memoir, and historical reflection.

The maximum word length for narrative reflections is 1,500 words. Please review submission guidelines at sdsma.org. Submissions of work may be made at any point through **September 1, 2026**.

How to submit: Material may be sent to Elizabeth Reiss at ereiss@sdsma.org.



SDSMA Leaders Gather for Annual Retreat

The SDSMA hosted its annual retreat for board members and past presidents on July 16-17 at Grand Falls Casino and Resort. It was a full agenda with updates from the CEO, strategic planning discussion, advocacy and policy review, and other general business and membership discussions. *Pictured back row, L to R are CEO Tammy Hatting; Drs. Mandi Greenway, Laura Hoefert, Ben Meyerink, Keith Hansen, Brian Wilson, Ty Hanson. Front row, Drs. Rob Allison, Megan Smith, Sarah Flynn, Deepak Goyal.*



American Medical Association Delegate Report – 2026 Annual Meeting

Representatives from the South Dakota State Medical Association joined nearly 700 delegates and alternates from around the U.S. for the 2026 American Medical Association Annual Meeting in Chicago June 5-9. Those attending from SDSMA included Robert L. Allison, MD; Robert J. Summerer, DO; Ben Meyerink, MD; Mary Carpenter, MD, and CEO Tammy Hatting. Medical students who attended the meeting included Riley Hellman, Avery Dooley, Madeline Melanson, and Jaelyn Morehead.

The gathering was filled with policy debate that will help shape the future of health care in the nation. The AMA's advocacy efforts are directed by the House of Delegates, which works in a democratic process to create a national physician consensus on emerging issues in public health, science, ethics, business and government. SDSMA delegates spend each day in a variety of meetings including the North Central Medical Conference, the rural health caucus, the scope of practice partnership, the litigation center, the Organization of State Medical Association Presidents, the House of Delegates, the Inauguration ceremony and several social events. AMA delegates spend many hours of prep work, research and phone calls to prepare for the AMA Annual Meeting to dedicate South Dakota's voice in each setting.

AI

The way in which AI-enabled decision support systems are reshaping how information is synthesized and applied in the practice of medicine was an area of discussion. AI tools can offer rapid analysis and evidence-informed recommendations that enhance human expertise, not replace it. And they can improve efficiency, workflow and detection of high-risk conditions. But there is reason to be wary. In response, delegates moved to ensure that evidence-based care is integrated in all health AI systems and that transparency remains at the forefront of efforts.

Food is Medicine

Delegates affirmed that "food is medicine" and committed to advancing nutrition education, research and policy efforts to improve chronic disease outcomes. "Good nutrition is one of the most powerful tools we have to improve health and prevent disease," said Bobby Mukkamala, MD immediate past president. "What we eat and drink directly affects our risk for many chronic conditions, making nutrition a critical component of both prevention and long-term health. Embracing the principle that food is medicine can help individuals live healthier lives and strengthen the health of our communities."

Prior Authorization

The AMA continues to fight to fix prior authorization by challenging insurance companies to eliminate care delays, patient harms, and practice hassles. Despite insurer pledges to fix the broken system, physicians and patients are encountering time wasting, clinically dangerous prior authorization roadblocks. Delegates voted to take more steps to hold companies responsible and get patients the care they need. The AMA will seek

legislation or regulation regarding insurance company utilization review to require that: 1) The person charged with authorization decisions provide their full name, specialty and National Provider Identifier, in order to maintain transparency, fulfill the requirements of HIPAA, and allow for accountability should the decision be called into question; and 2) The reviewing physician be licensed in the appropriate state or jurisdiction and, therefore, accountable to appropriate state medical boards or regulatory authorities for the consequences of these clinically important decisions.

Physicians Aren't "Providers"

Navigating the healthcare system is a challenge for many patients, and one reason is the system's persistent use of confusing terminology around who is a physician. Delegates acted to eliminate this confusion—and thereby boost patient safety—by deliberately avoiding use of the term "provider" when referring to any clinician with a medical degree. The AMA already had policy stating that it supports requiring healthcare entities, when using the term "provider" in contracts, advertising and other communications, to specify the type of clinician being referred to. The policy also supports this concept in state and federal health system reform.

With its latest action, the AMA adopted new policy to "oppose the use of the term 'provider' when used to include physicians." The resolution states that the AMA believes the use of the term 'provider,' when used to include physicians, negatively impacts patient education and awareness, transparency and the ethical responsibilities of physicians to patient safety and professionalism."

Patient Access to Anti-Obesity Medications

Glucagon-like peptide-1 (GLP-1) receptor agonists marketed as Ozempic, Wegovy and more have helped many patients across the country lose weight, better manage and prevent type 2 diabetes and other conditions that dramatically affect patients' life expectancy and quality of life. Due to payer restrictions, many patients have difficulty accessing these medications. Recognizing obesity as a complex chronic disease that often requires long-term management, delegates took a range of actions to give more patients affordable access to anti-obesity medications.

Presidential Inauguration

As part of the national ceremony swearing in Willie Underwood III, MD, MPH as the 181st president of the AMA, state medical leaders were recognized. SDSMA President Ben Meyerink, MD was honored alongside fellow state medical society presidents during the event.

Next stop: The 2026 Interim Meeting of the AMA House of Delegates is in November in Orlando.

Robert L. Allison, MD, Delegate

Robert J. Summerer, DO, Alternate Delegate



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