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Q: Can your business miles reduce your tax liability?

A: The short answer is yes. However, in order for the miles to be deductible, they cannot be incurred while commuting to your primary place of business.

Mileage can be deducted if incurred while either traveling to a temporary work location or from your primary work location to a secondary work location.

The first is straightforward. If you are covering someone’s practice short-term, keep track of the miles and they can be deducted at the end of the year.

The second is a little more complex. The mileage to your primary work location is not deductible. If you have a second job, the mileage from your home to your second job is also not deductible. However, if you travel from your first job to your second job, those miles are deductible.

With that said, the 2017 IRS rate for business miles is 53.5 cents per mile. Total mileage needs to exceed 2% of your AGI (Income) to be deductible, and you need to itemize your deductions to see any kind of tax benefit.

It is possible to deduct mileage. It’s just a little challenging to incur qualified mileage in an amount that benefits your taxes.
Beginning in the early 1990s (with the addition of pain as the fifth vital sign) there has been a dramatic increase in the use of opioids, especially for patients with chronic pain. At first, these drugs were thought to be safe with little chance of addiction. Unfortunately, this was not true. We are all aware of the epidemic associated with opioids. A recent PubMed search for the term “opioid epidemic” generated 897 articles. The statistics are staggering.

- In 2016, there were more than 59,000 overdose deaths in the U.S.
- In the U.S., drug overdoses are now the leading cause of death under the age of 50. (In 2016, heroin overdose deaths exceeded gun homicide deaths).¹
- The death rate for middle age whites in the U.S. is rising while declining in other wealthy countries (France, Germany, Canada, United Kingdom, Australia, Sweden). At the same time, death rates for the black and Hispanic population are declining in the U.S.²
- Older women have the highest prevalence (9 percent) of long-term opioid use. Concurrent use of sedative-hypnotic drugs and opioids is common in the older female patient and puts them at risk for adverse effects.¹

Representing less than 5 percent of the world’s population, the U.S. consumes over 80 percent of the world’s opioid supply, including 99 percent of the world’s hydrocodone. Our country also consumes nearly two-thirds of the world’s illegal drugs.³ It is estimated that the U.S. consumes 27,400,000 grams of hydrocodone annually. The four countries of Great Britain, France, Germany and Italy consume 3,327 grams of hydrocodone combined.³

We are not immune to this problem in South Dakota. 2016 South Dakota Prescription Drug Monitoring Program (PDMP) hydrocodone prescription records show the following: 259,700 prescriptions; 17,49 million doses; 3,410,259 days’ supply; average prescription: 67 tablets.

What Can We Do?
The nontherapeutic use of opioids has reached epidemic proportions and continues to grow every year. The medical community has a moral obligation to improve the health and the well-being of our patients. In orthopedic surgery, we see many patients taking opioids for both acute and chronic conditions.

Opioid use has been associated with negative clinical outcomes in chronic musculoskeletal problems.⁵

A recent study by Menendez, et al.⁶ highlights the danger of prolonged opioid use. Data from the Nationwide Inpatient Sample was reviewed for 2000-2011. Patient records for common orthopedic procedures (total hip arthroplasty, total knee arthroplasty, total shoulder arthroplasty and spinal fusion) were reviewed. Patients with a preoperative diagnosis of opioid-type dependence or nondependent opioid abuse had an increased odds of hospital mortality (x3.7), increased morbidity (x2.5), and prolonged hospital stay (x2.5).⁶

Unfortunately, this is a multi-faceted problem with no easy answer. Several authors have called for a culture change in perioperative surgical care.⁷,⁸ Instead of waiting for legislation, there are several things that physicians can do to fight the opioid epidemic. They include:

Multimodal pain management – To decrease opioid use, surgeons have started using multimodal pain management techniques for postoperative pain management. This includes the use of continuous plexus and peripheral nerve blocks, local anesthesia infiltration for surgical wounds, and the use of COX-2 type nonsteroidals.⁹⁻¹⁴

Prescribing habits – The medical profession needs to improve our prescribing habits for opioids. Do the residents of South Dakota really need 17.5 million doses of hydrocodone in one year for a population of 850,000? As surgeons, we are sometimes guilty of prescribing excess pain medication. One study of surgical patients found that 72 percent of the prescribed pills were not used.¹¹ In an attempt to improve prescribing opioids, Gawande⁶ has recommended the following strategies:

1. Preoperative counseling of patients regarding expectations of pain control; pain control to function
(e.g., sleep, eat, ambulate) but not to obtain zero pain relief.

2. The use of nonopioid alternatives for minor surgical procedures.

3. The use of the state PDMP to review a patient’s prescription history.

4. Providing clear disposal instructions for excess medication.

5. Prescribing the “minimum quantity necessary” of pain medication.

Another change in prescribing is the use of electronic prescriptions. This technology would make it easier to write for smaller prescriptions that could be refilled electronically. Although 81 percent of pharmacies are equipped for electronic prescribing and over 90 percent of physicians are using electronic medical records, only 8 percent of physicians are currently e-prescribing.8

**PDMP Use**

Providers should query the PDMP for a history of a patient’s use of opioids. The South Dakota PDMP website is https://southdakota.pmpaware.net/login.

As health care providers, we face a challenge in the face of the tragedy of the opioid epidemic. We need to be part of the solution. This will require a cultural change in our prescribing habits along with education for our patients regarding expectations of pain control.

**Books of the Month** – The American Spirit by David McCullough and Steering Clear: How to Avoid a Debt Crisis and Secure Our Economic Future by Peter G. Peterson.

**REFERENCES**


The Sanford School of Medicine (SSOM) at the University of South Dakota (USD) continues to achieve recognition as a leader in rural medical education. The class sizes continue to grow, as do the number of applications for admission. Recently, the size of the admitted class was increased from 50 to 70, with no reduction in quality of admitted student. Consistently, year after year, SSOM at USD shows a 100 percent match rate. This is an external validation of the quality of the education offered at SSOM.

Research during medical school education continues to be an area of concentration in SSOM. Physicians that understand evidence-based medicine are required in today’s medical environment. Research is consistently considered a key component of the education of the medical student, and is a subject of discussion during the interviews for residency. There is no better way to understand this approach to medicine than to actively participate in it. The Scholarship Pathways Program (SPP), now in its 10th year, gives students the opportunity for hands-on, self-directed experience in research, with the help of a mentor to provide guidance. Generally, 15 students per year, or nearly 128 over the course of the program, have participated in this program. A competitive application is required for admission to the program. Projects may be proposed in the areas of research, education, and service. Most projects are in the research area. Students work closely with mentors, who provide vital and important support for SPP participants. Throughout the program, they are supported by the SPP administrative staff and their mentors. The project is written up as a poster, an abstract (presented as part of this document), and as a manuscript. Most participants present their work in one or more medical venues. SPP participants have had good success in the publication of the projects.

The annual Scholars Day Symposium event, held in conjunction with graduation, is a venue where SPP participants display posters. There are formal presentations as well. In this year’s Scholars Day, four presentations from five students were featured. Danielle Thornburgh and Peter Chang (mentor: Stuart Inglis, PhD) performed a joint project and abstract. Their project involved the dissection of a cadaver with Ehlers-Danlos syndrome, kyphoscoliotic type. Their work further characterized the unusual anatomic and cellular features of this extremely rare disease. Daniel Parrott (mentor: Michael Chaussee, PhD) examined the use of copper nanoparticles (CNPs) embedded in a polymer matrix and made this into a film to use on medical equipment surfaces as an antimicrobial agent. He found that films with certain concentrations of copper nanoparticles had excellent antimicrobial characteristics. Michael Frost (mentor: Travis Spier, RN) set up a system to implement CPR instruction in South Dakota schools using medical students as CPR instructors. This project was recognized at the national level, and Michael Frost was selected to receive a 2016 Excellence in Public Health Award from the U.S. Public Health Service Physician Professional Advisory Committee. His project also was instrumental in a change in state policy for high school graduates. Kelly Wong (mentor: Eric C. Klawiter, MD) examined measures of thalamic connectivity in multiple sclerosis. She found important and significant changes in various brain volumes.

We are pleased to share this year’s Scholars Day Symposium abstracts and thank South Dakota Medicine for giving us this opportunity. If you would like to mentor a Scholarship Pathways student, please contact Dr. Candace Zeigler at candace.zeigler@usd.edu.
Introduction: Type II diabetes is a chronic disease that results from damage and malfunction of pancreatic $\beta$-cells, leading to a deficit of insulin and decrease glucose uptake. The cause is multifactorial but lifestyle is thought to be a major contributor. Standard diabetes care encourages patients to participate in diabetes self-management education (DSME) at the time of diagnosis. It strives to influence decision-making, improve self-care behaviors, decrease risk of complications, improve personal health, and raise quality of life. Blood glucose levels in diabetes are measured with HbA1c, which quantifies average blood glucose levels over a period of time. DSME significantly improves HbA1c values in type II diabetes patients. This study examined the potential role of DSME in long-term care of diabetes patients.

Methods: The Quality Improvement Department at Avera McKennan Hospital abstracted patient medical record numbers from the hospital database that had been diagnosed with Type II Diabetes and had participated in diabetes education. Patients with gestational diabetes, and type I diabetes were excluded from the study. The study included patients in ages of 30-80 years old. A spreadsheet containing medical record numbers of patients who had participated in diabetes education in the last two years was provided. Each chart was independently reviewed. Patients were grouped into those that received three or more DSM E sessions, that only had one DSM E session, and those that had several series of at least three DSM E sessions. Data analysis was performed in Microsoft Excel. Descriptive statistics, including means, standard deviations, and standard errors, were calculated as needed. Statistical tests were done as t-tests.

Results: Patient HbA1c values improved in patients that participated in at least three DSME classes. The average HbA1c at diagnosis was 8.4 percent. At six months, HbA1c decreased to a mean of 6.68 percent (p<0.0001). HbA1c values gradually increased over the next 24 months. Patients that participated in an additional three DSME sessions after a period of time showed an additional decrease in HbA1c. Patients that only participated in one DSME session had an initial decrease from 8.69 to 7.99 percent (p=0.081). Although this was a significant reduction, the average HbA1c value does not reach the goal value (HbA1C less than 7 percent). The difference in reduction between patients with three DSME classes (D: -1.76) and those with one class (D: -0.86) was significant (P-value=0.03).

Patients in all groups visited their medical provider regularly. Patients visited provider an average of one time in each six-month interval. Diabetes management was discussed. Despite regular visits to their provider, HbA1c values increased over time.

Conclusions: DSME initially reduces HbA1c values in patients with type II diabetes. This suggests DSME encourages patients to lose weight, adhere to a diabetic diet, or follow medication regimens. Over time, HbA1c values start to rise again. This occurs regardless of regular visits to a provider where diabetes management is discussed. The observed pattern of HbA1c values (decrease after DSME, followed by a gradual increase) suggests that educational sessions, including DSME, should have a perpetual role in diabetes management.
Implementing a Donor Human Milk Option for Preterm Infants

By Kate Branick, MS IV
Mentor: Michelle Baack, MD

Introduction: Mothers of premature infants are three times more likely to have an inadequate milk supply compared to mothers of full term infants. Use of mothers’ own milk has decreased the risk of infection, necrotizing enterocolitis, and chronic lung disease for infants. If mothers cannot provide their own milk, formula was a previous option, but pasteurized donor human milk (DHM) is becoming an increasingly popular option. There is still a barrier to implementing a standardized protocol for DHM use in the neonatal intensive care unit (NICU). Infants that received DHM can be compared to infants that received formula to determine if there is a difference in infection indicators. Additionally, by creating a protocol for DHM use, it can be determined if the cost of the DHM is offset by the savings created by not having side effects of denying premature infants access to human milk.

Methods: A single-center cohort was done at Boekelheide NICU at Sanford Health in Sioux Falls, South Dakota. Premature infants had the option of DHM if they were less than 32 weeks gestational age. The optional DHM protocol was implemented in April of 2014 and data was collected from 75 infants born before and 75 infants born after this date to compare use of DHM, along with complications and general outcomes associated with a stay in the NICU. Variables included time it takes for an infant to reach full feeding potential (120 cc/kg/day), the days the patients were put on total parental nutrition (TPN) after reaching full feeding potential, and human milk use in the NICU and at discharge. Complications related to prematurity that were studied included days with a central line, days on antibiotics, number of sepsis evaluations, Necrotizing enterocolitis (NEC) episodes, and number of abdominal radiographs. A non-parametric Wilcoxon rank sum test procedure was used to compare the population distributions between infants that received formula (n=9) and infants that received DHM (n=26). All statistical analyses were carried out using SAS 9.4 (Cary, North Carolina). Significance level was set at 5 percent. Additionally, in order to exam the cost effectiveness of a DHM option, data was collected on TPN days, central line days, antibiotic days, sepsis evaluations, abdominal X-rays, NEC cases, and total ounces of DHM used in order to compare before and after costs and the implementation of the DHM option.

Results: Human milk use during admission and at discharge did not change between cohorts, with 35 percent of infants utilizing a DHM over the three years during the data collection. Using the Wilcoxon rank sum test procedure to compare infants that received formula verses DHM, no statistical significance was found when observing days to full feedings, days using TPN, days with a central line, and total days on antibiotics. When comparing the cost of using DHM, the infants before the option of DHM had more complications which offset the cost of using DHM. Even with the extra cost of the DHM, the cost savings associated with having a DHM option in the NICU was $480,722.

Conclusions: The option of a DHM product for infants born at less than 32 weeks gestational age did not lead to statistically significant differences in health outcomes compared to infants that received formula. There are some contributing factors to consider, including the rate of human milk use did not change and use of DHM was capped at 30 days. Additionally, after the collection of data from 150 infants, only nine infants strictly used formula and only 26 infants used DHM. Despite the non-significance between the cohorts, the trends of fewer TPN days, central line days, episodes of sepsis and NEC led to an estimated cost savings of $480,722 even when accounting for the cost of DHM, supplies, and waste. Future directions will re-evaluate the population and the use of fortifiers in the DHM protocol.
Ehlers-Danlos Syndrome, Kyphoscoliotic Type: A Cadaveric Dissection and Molecular Analysis

By Peter S. Chang, MS IV; and Danielle Thornburg, MS IV
Mentor: Stuart Inglis, PhD
Co-authors: Scott Killian, PhD; Evelyn Schlenker, PhD; and Bill Waltz, MD, PhD

Introduction: Ehlers-Danlos syndrome (EDS) is an inherited connective tissue disorder characterized by tissue fragility, joint hypermobility, and hyperextensible skin. There are six identified major subtypes of EDS, which are differentiated based on major and minor clinical criteria, as well as laboratory findings and genetic analysis. EDS type VI is known as the kyphoscoliotic type and caused by a mutation in the procollagen-lysine, 2-oxoglutarate 5-dioxygenase 1 (PLOD1) gene resulting in decreased enzyme activity and abnormal collagen formation and processing. During a cadaveric dissection of a patient known to have suffered from EDS, multiple pathological findings were observed.

Materials and methods: A cadaveric dissection was performed, to determine the exact form of EDS, as well as to further clinically and histologically characterize this disorder. Molecular and cellular analysis techniques of haematoxylin and eosin (H&E) staining and immunohistochemistry were utilized on the donor tissue to provide additional evidence about the specific subtype of EDS. Based on a previously published method by Pousi et al., DNA extracted from donor skin tissue was screened through PCR analysis for the most common duplication mutation associated with kyphoscoliotic type EDS with DNA primers JH55 and JH71 as described by Pousi's method.

Results: The most prominent pathological finding from the dissection was severe kyphoscoliosis, suggestive of kyphoscoliotic type of EDS, a rare subtype of EDS previously known as type VI. Multiple cardiac abnormalities, including a rare quadricuspid pulmonary valve, were identified. Furthermore, lung consolidation and reduction in lung volume, bony abnormalities, bilateral diaphragmatic hernias, and long segment bowel stricture were identified. H&E staining of donor skin, muscle, and lung displayed pathological findings which was compared to a sex and age matched cadaver. Donor skin demonstrated disorganized dermal collagen fibers; donor muscle tissue showed atrophic changes. Finally, the presence of pulmonary hemorrhage and heart failure cells were seen in donor lung tissue. Immunohistochemistry was performed using an antibody against PLOD 1. When compared to cadaver controls, immunohistochemistry displayed a reduced amount of the PLOD 1 enzyme in the donor tissue, confirming our suspicion of kyphoscolitic type of EDS. Due to the quality of cadaver DNA from the degradation process, PCR results were false positives and considered inconclusive.

Conclusions: The skeletal, thoracic and cardiac abnormalities identified are suggestive of the severe clinical sequelae of kyphoscoliotic type EDS. The kyphoscoliosis in this patient appeared to have caused a substantial amount of stress within the chest cavity, which might have been a causative factor for many of the pathological changes to both the heart and the lungs. To the best of our knowledge this is the first case in the literature reporting a quadricuspid pulmonary valve in a patient with EDS of any subtype. The degree and severity of the cadaver tissue degradation during the cadaver embalming process were significant, leading to difficulties in performing H&E staining, DNA analysis, and immunohistochemistry on cadaver tissue. However, H&E tissue and immunohistochemistry findings along with the cadaveric dissection are strongly suggestive that our donor suffered from the kyphoscoliotic type of EDS.
Patient and Physician Perceptions of Genetic Testing in Primary Care

By Samuel A. Evenson, MS IV
Mentor: Susan E. Puumala, PhD

Introduction: The convergence of biomedical informatics and translational genomics is changing the practice of medicine. Primary care will play a pivotal role in this transformation. Yet, there are potential obstacles to any program that attempts to integrate genetic testing in primary care, including patient and physician reception and response. Currently, the literature is limited on patient and physician perceptions of genetic testing in primary care settings. In addition, none specifically assess how perceptions change during the course of a primary care genetic testing program.

Materials and methods: A total of 1,000 take-home paper surveys were created and distributed to internal medicine patients at 13 Midwestern clinics. Additionally, 62 electronic surveys were created and distributed to internal medicine providers at these same clinics. Questions assessed knowledge, interest, and comfort with genetic testing as well as the role of genetic counselors. Differences in response based on physician characteristics were compared using two methods for comparison of proportions. Confidence intervals were calculated using the Clopper-Pearson exact method. Component scores were created through a combination of iterative splitting and factor analysis.

Results: The response rate for the patient surveys was low (14 percent) and the response rate of providers was somewhat higher (42 percent). In general, patients cared for in internal medicine clinics expressed an understanding of both content (75 percent, 95 percent CI: 67.2 – 82.4) and rationale (81 percent, 95 percent CI: 72.7 – 86.8) for genetic testing. Patients are open to hearing about genetic risks that could affect their health (88 percent, 95 percent CI: 81.3 – 93.0) even if their visit was scheduled for a different reason. Patients felt more confident in a genetic counselor teaching them about genetic testing (78 percent, 95 percent CI: 70.0 – 84.8 percent) than their primary care doctor (56 percent, 95 percent CI: 46.8 – 64.3 ) (p = 0.01). Patients also expressed concern about keeping their genetic test results private (31 percent, 95 percent CI: 23.1 – 39.4). Four categories emerged for patients including knowledge, benefit/interest, openness, and concern. Patients generally rated their openness high and their concern low. In these same clinics, providers expressed a strong understanding of the purpose of genetic testing (88 percent, 95 percent CI: 67.6 – 97.3). However, providers were not confident in responding to questions about the impact of genetic testing on disease susceptibility (25 percent, 95 percent CI: 9.8 – 46.7). Providers were more confident answering questions about genetic variability in drug response (46 percent, 95 percent CI: 25.6– 67.2). In general, outpatient internal medicine providers feel comfortable referring patients to genetic counselors to assess disease risk (88 percent, 95 percent CI: 67.6 – 97.3) and they believe genetic testing is relevant to their practice (75 percent, 95 percent CI: 53.3 – 90.2). Components identified for physicians included knowledge, confidence, relevance, and working with genetic counselors. Most physicians were knowledgeable (67 percent), but only 21 percent were high in confidence. Knowledge was significantly higher for those who had ever ordered a genetic test (46 percent versus 91 percent, p = 0.03).

Conclusions: In our Midwestern sample, we found that both patients and providers express interest in learning more about genetic testing in the context of primary care. Primary care patients are open to genetic testing and see a benefit from engaging with it. Primary care providers, while feeling genetic testing is relevant to their practice, displayed a lack of confidence in utilizing it with their patients. Patient and physician responses indicate a role for genetic counselors in helping patients understand and interpret genetic test results. This research will be repeated in future years to compare how perceptions change during the course of a primary care genetic testing program.
Medical Students Keeping the Heart of the Community Beating: CPR in the Rapid City Area Schools

By Michael Frost, MS IV
Mentor: Travis Spier, RN, NR-Paramedic, CCEMT-P

Background: Sudden cardiac arrest is a low frequency, but high-risk event. Early initiation of bystander CPR can double or triple a victim’s chance of survival in out-of-hospital cardiac arrest (OHCA). In 2003, the International Liaison Committee for Resuscitation made a recommendation to make CPR/AED instruction a standard part of school curriculum. The American Heart Association (AHA) followed with a similar recommendation that CPR instruction should be a requirement for high school graduation. Currently, 34 states have such legislation, but South Dakota is not one of them. Major barriers preventing CPR from being a high school graduation requirement include a shortage of staff, cost, and time constraints.

Objective: To provide a model for implementing CPR in South Dakota schools using medical students as CPR instructors in the Rapid City Area Schools.

Methods: In the project, 10 medical students at the University of South Dakota Sanford School of Medicine (USD SSOM) Rapid City campus became certified AHA Basic Life Support (BLS) instructors. Heartsaver CPR/AED courses were provided to Rapid City Area Schools (RCAS) faculty and staff. After faculty was trained, eighth grade physical education teachers were contacted to offer the AHA CPR in the Schools program to their students. Medical student instructors conducted classes for eighth graders in an effort to not only educate the students on proper CPR techniques, but to expose physical education teachers to the AHA CPR in the Schools training kit. A short online survey was sent to physical education teachers to gauge their level of comfort with continuing this program on their own. A short online survey was also sent to the USD Sanford School of Medicine Class of 2019 to determine their level of interest in becoming certified BLS instructors.

Outcome: After the training in Rapid City was complete, 173 faculty and staff, representing 10.5 percent of the overall staff in the RCAS, were trained in CPR and AED use. The AHA CPR in the Schools program was offered to 650 students in the eighth grade representing four middle schools in the RCAS. Of the 11 physical education teachers present at the eighth grade CPR classes, 80 percent indicated that they would be willing to provide this course in their classes. Twenty percent of the responders indicated they would require more exposure and education about the program before incorporating it into their curriculum. All of the responders indicated that they had no formal CPR training in their classes before this project. Of the 64 incoming Pillar 2 students, 24 responded. Of those polled, 87.5 percent indicated that they would be interested in becoming a certified BLS instructor.

Conclusion: This service project provides a framework to use medical student BLS instructors as a workforce to help integrate CPR education into the South Dakota public school system. It has been recognized with the 2016 U.S. Excellence in Public Health Award from the U.S. Public Health Service. The project completed in Rapid City can be an example for the rest of the state and help support updating the current legislation to ensure CPR becomes a requirement for graduation from South Dakota high schools. Next steps for this project include aligning the USD SSOM Emergency Medicine Interest Group (EMIG) with the South Dakota Department of Education CPR in the Schools resource page and providing BLS instructor courses to medical students. The USD EMIG will coordinate the medical student BLS instructors across the state.
Introduction: Childhood obesity has been a growing epidemic for decades with substantial health consequences including type 2 diabetes. Over the past 30 years, U.S. prevalence of childhood obesity has doubled and adolescent obesity has quadrupled. South Dakota High School student obesity prevalence saw a dramatic rise from 9 percent in 2009 to 15 percent in 2015. In Rapid City, the prevalence of obesity has grown from 11.6 percent in 2012 to 16.4 percent in 2015, and prevalence of childhood type 2 diabetes has also increased in parallel. Preventing childhood obesity and diabetes would prevent costly health complications in childhood and adulthood. Currently in Rapid City, there are no organized obesity or diabetes prevention programs, but national, state and community programs do exist.

Methods: A coalition of individuals including pediatric endocrinologist Rachel Edelen, MD, the diabetes clinical outreach coordinator from the South Dakota Department of Health, the community health specialist at Regional Health, and a retired PE teacher of 30 years assembled to address childhood obesity and diabetes prevention. An extensive literature review revealed Coordinated Approach to Children’s Health (CATCH) as the optimal solution for the community. CATCH is an evidence-based, K-8, in-school and after-school program shown to prevent progression of BMI into overweight and obese categories. Formal support for the after-school program has been garnered from the director of the Spearfish Recreation Center and the leader of Kid Stop at Rapid City YMCA. Grant funding is being sought from Good and Healthy South Dakota, Regional Health, Wellmark Blue Cross Blue Shield, and the South Dakota Community Foundation to pay for curriculum and training. The assistant superintendent and curriculum director of Rapid City Schools as well as the superintendent of Spearfish Schools have demonstrated interest in implementing the program and have scheduled ongoing meetings to assess the curriculum. Two exercise science professors at Black Hills State University are partnering to perform research on the effect of CATCH on activity levels, sedentary time, and school performance.

Results: A pilot lesson of CATCH was taught at South Middle School to sixth and seventh grade health classes and eighth grade PE classes. Approximately 275 students were involved in seven classes. Students were actively engaged in the lessons, and their teachers observed the lesson being taught. The lessons were received enthusiastically, and the South Middle School’s teachers volunteered to present the CATCH program at their monthly district wide middle school PE and health teacher meeting. Strong interest was shown at this meeting as well, with teachers requesting to borrow CATCH materials for personal review. Moving forward, support of the school districts will continue to be secured. It will be essential to identify one elementary and middle school in Rapid City and Spearfish to pilot the program this upcoming school year. One grant has been applied for and another two other grants are being written in collaboration with Black Hills State University and Regional Health.

Conclusions: Childhood obesity is a growing problem in South Dakota and specifically Rapid City with serious health consequences including type 2 diabetes. A diverse team of highly qualified individuals is pursuing a solution by implementing an evidence-based program, CATCH, in Rapid City. After a year, we hope to expand the number of schools using CATCH. It is clear that the Black Hills community recognizes childhood obesity and diabetes as a problem, and they are supportive of a solution. All it takes is someone to find a solution and bring all the necessary people to the table.
The Future of Trauma Care in South Dakota: Trauma System Analysis and Policy Recommendations

By Collin Michels, MS IV
Mentor: Lon Kightlinger, MSPH, PhD

Introduction: The South Dakota Trauma System, created in 2008 and implemented in 2009, is a statewide organized effort to manage and improve the care of severely injured patients. No prior analysis has been conducted to evaluate its effects after implementation. We hypothesized that the decreased length of hospital stay would serve as a proxy measure of better and faster care and analyzed South Dakota hospital discharge data for 2008-2011 admissions to assess effects of the trauma system on the length of hospital stay. Comparative policy analysis of similar state and regional trauma systems can also serve as guidance for policymakers on the future advancements of the South Dakota Trauma system.

Methods: We defined pre-trauma system period as hospital admissions in 2008-2009 and compared to post-trauma system period defined as hospital admissions in 2010-2011. Hospitalizations were grouped and categorized based on principal diagnosis and ICD-9 codes. We used two-sample t-test to compare mean length of hospital stay between pre- and post-trauma system periods. Patients’ age, gender and race were also analyzed using a X2 test to detect any changes in the post-trauma period. Comparative policy research on trauma and emergency medical services (EMS) policy in the U.S. focused on state level mechanisms of trauma and EMS administration.

Results: The dataset included 17,389 patient records (8,782 for pre- and 8,607 for post-trauma system periods) The average length of hospital stay for all injury-related hospitalizations in the pre-trauma system period was significantly longer (five days) compared to post-trauma period (4.7 days) (p < 0.01). Three subcategories of injuries also showed significant differences in average length of stay, burns (7.3 versus 4.8 days, p = 0.02), intracranial injuries (6.4 versus 5.1 days, p < 0.01) and open wound to lower limb (4.3 versus six days, p=0.02). South Dakota provides general funding sources for EMS and trauma system administration. Further funding sources ought to be utilized for trauma system funding.

Conclusion: The two years immediately following trauma system implementation showed a shortened length of hospital stay for traumatically injured patients in South Dakota. Further work can be conducted in continuous quality improvement of the trauma system. Policymakers should consider additional state and federal funding sources as well as implementation of a codified trauma system oversight group. Trauma registry data ought to be collected with pre-hospital data. The trauma system can coordinate statewide resources, provide the best possible care for the injured patient and result in significant monetary savings for the public.
Coronary Artery Calcium is a Consistent Predictor of a Cardiac Event in a Midwest Native American Population

By Ashley Osenga, MS IV
Mentor: Adam Stys, MD

Introduction: Coronary Artery Calcium (CAC) score has a direct correlation with total plaque burden and is an independent marker for the risk of coronary events. Data on CAC in the Native American (NA) population is scant. Our study looked at CAC and Framingham scores (FS) as predictors of myocardial infarction (MI), percutaneous intervention (PCI), congestive heart failure (CHF), and death in the NA and Caucasian populations in the Midwest who participated in a cardiac screening program.

Methods: We retrospectively analyzed asymptomatic NA and Caucasian patients between the ages of 40 and 85 years who had been part of the Sanford Cardiovascular Prevention Program. Screening included baseline demographics, Framingham scores, and CAC scores derived from computed tomography. Patients with an event occurring after the screening were compared to age and gender matched cohorts without an event in the two ethnic groups. Logistic regression was used to examine CAC scores and Framingham Scores as predictors of cardiac event in these two groups. End points consisted of MI, PCI, CHF, and death. Coronary artery bypass grafting was intended for examination, but had too few outcomes in the NA population to be included.

Results: Caucasian cases (C, n=9,237) and NA cases (NA, n=263) were examined. Age was quite similar (C: 61.8±10.5); NA: 59.4±10.3). For MI: in NA cases, neither CAC (p=0.3551) nor FS (p=0.3683) predicted events; in C cases, CAC (p=0.0432) predicted events but FS (p=0.4599) did not. For PCI: in NA cases, CAC (p<0.0001) but not FS (p=0.2757) predicted events; in C cases, both CAC (p<0.0001) and FS (p=0.0179) predicted events. For CHF: in NA cases, both CAC (p=0.0006) and FS (p=0.0166) predicted events; in C cases, CAC (p<0.0001) but not FS (p=0.0849) predicted events. For death: in NA cases, both CAC (p=0.0020) and FS (p=0.0029) predicted events; in C cases, CAC (p<0.0001) and FS (p=0.0006) predicted events.

Conclusion: CAC score and FS are significant predictors of prognosis of event for Native Americans (when age and gender are statistically controlled) for MI (neither), PCI (CAC only), CHF (CAC, FS), and death(CAC,FS). For Caucasians, CAC and FS are significant predictors for MI (CAC), PCI (CAC,FS), CHF (CAC), and death (CAC, FS). CAC is a consistent marker of possibly serious cardiac disease. Cardiologists in screening programs should examine this strong signal of possible future disease and counsel patients appropriately. This result about CAC is possibly due to the measurement of this quantity, which is not bounded in range, as is FS. This study is limited in the size of the NA population, and in the self-selected nature of the cardiac screening program.
Copper Nanoparticle Film: An Inherently Anti-Microbial Surface

By Daniel Parrott, MS IV
Mentor: Michael Chaussee, PhD

Introduction: Hospital acquired infections (HAI) represent a significant threat of morbidity and mortality to the world healthcare system. Methods to reduce the incidence of HAI are required to prevent an increase in untreatable infections. An often overlooked method is to prevent bacterial spread by preventing bacterial growth on hospital surfaces. This can be accomplished effectively by utilizing copper metal. Copper has well-established and well-studied anti-microbial properties, but is used sparingly in healthcare due to the effort and cost associated with retrofitting existing hospital surfaces with copper sheet metal. Copper nanoparticles (CNPs) embedded in a polymer matrix display similar anti-microbial properties. This approach to deploying copper metal may offer a viable alternative to solid copper metal.

Materials and methods: Spherical CNPs were added to a polymer solution of polyvinyl butyral dissolved in glacial acetic acid. The CNP solution was coated over plain plastic laminate using a Meyer rod method; the newly made CNP film was allowed to dry overnight. Films of various ratios of CNPs to polymer solution were created and individually tested. Mass ratios of CNPs to polymer solution ranging from 1:10 to 2:1. Bacterial solutions of multi-drug-resistant Pseudomonas aeruginosa, multidrug resistant Stapholococcus aureus (MRSA), and Streptococcus pyogenes were prepared and carefully pipetted onto the CNP film, a copper plate, and a control of plastic laminate. After specified time intervals, the contaminated film was swabbed and transferred to growing agar plates. Agar plates were allowed to incubate at 37.5°C for 24 hours. After 24 hours, colonies were counted to assess the anti-microbial ability of the CNP film, the copper plate, and the plastic laminate.

Results: Films with mass ratios greater than 1:2 CNP:polymer matrix solution were found to strongly inhibited growth of all three bacterial species, and were actually more effective than a solid copper plate. Films with mass ratios of 2:1 or higher completely killed S. pyogenes within two minutes of exposure time. In comparison, using a solid copper metal plate, S. pyogenes was completely killed within 10 minutes. S. aureus and P. aeruginosa survived slightly longer, lasting five minutes on the CNP film and 10 minutes on the pure copper plate. During all experiments, the plastic laminate control failed to demonstrate any anti-microbial ability.

Conclusions: This small pilot study found evidence that CNP films are at least as effective as solid copper sheets at inhibiting the growth of three important bacteria species. In some instances, the CNP film was actually more effective than the copper metal plate. The suspensions used on the CNP film are relatively inexpensive and are simple to make. During these experiments, we used a Meyer rod system to coat the plastic laminate, ensuring that each film was the same thickness. The coating method can easily be altered by adding an additional 25 percent of glacial acetic acid; this transforms the solution from one that must be coated with a Meyer rod to one that can be applied via a spray bottle, allowing the solution to be applied to hospital surfaces that are otherwise not amenable to Meyer rod coating, and surfaces that are already installed in hospital environments. Future plans include a pilot study in a hospital, with the hope that by applying this solution to hospital surfaces, particularly high-touch surfaces. Methods to inhibit and reduce the spread of drug-resistant bacteria are needed and will save numerous lives.
Analysis of the Counsyl Screen in Patients Diagnosed with Cystic Fibrosis in South Dakota

By Trevor Watson, MS IV
Mentor: Keith Hansen, MD

Introduction: Cystic fibrosis (CF) is a genetic disease that affects multiple systems by mutations in the cystic fibrosis transmembrane conductance regulator (CFTR) protein. There are now over 1,700 recognized genetic variants which can cause CF. The state of South Dakota has populations that are at high risk for developing this inherited disease. There are 127 individuals followed at our CF center diagnosed by newborn screen and other methods and it is our policy to sequence these individuals. The Counsyl screen is a commercial screen utilized by our reproductive endocrinology and infertility and obstetric clinics for pre-conception and prenatal screening of various genetic diseases. This study aimed to determine how many genetic variants in our CF patients could have been detected in preconception counseling by the Counsyl screen.

Materials and methods: We accessed and collected the genotypes of 127 patients diagnosed with CF using the CF Foundation database. This represents the total number of known patients with CF in South Dakota in the last 20 years. We examined the known genetic sequences of our CF patients and cross-referenced them manually with the genetic variants (99) tested by the Counsyl screen. We recorded the amount of times both parents, one parent, or zero parents would have been detected by the screen (Table 3). The specific mutations that would be or would not be detected were recorded (Table 4).

Results: Our analysis determined that the Counsyl screen would have detected both parents at a rate 84.2 percent (n=107), one parent at a rate of 13.4 percent (n=17), and neither parent at a rate of 2.3 percent (n=3). 15.8 percent of couples would have only one or neither partners detected. The most common mutation detected was the F508, detected in 168 alleles. This represents 66.9 percent of our sample. This was followed by the M1101K mutation in 24 alleles at 9.6 percent.

Conclusions: Despite the number of variants screened, there remains a 15.8 percent residual risk that the Counsyl screen would not detect CF genetic variants in one or both parents. However, genetic sequencing is a promising solution to this problem. It could be used when one parent is detected on a screen. Future investigations could include looking at states with similar population demographics. Increasing the study size would also help to make the results more accurate.
Evaluating Thalamic Connectivity in Multiple Sclerosis

By Kelly Wong, MS IV  
Mentor: Eric C. Klawiter, MD

Introduction: Local and distant functional connectivity combines network theory and resting state functional connectivity MRI (fcMRI) to estimate regional variations in intrinsic connectivity within spatially defined local cortical neighborhoods and thalamocortical connections, respectively. Both are important for network efficiency. Changes in functional connectivity may serve as an early marker of pathology. It enables us to explore changes in local functional brain connectivity based on functionally-defined cortical networks in the thalamus in relapsing-remitting (RR) multiple sclerosis (MS) compared to healthy controls (HC) and to compare methods for automatic segmentations of the thalamus. We expect to find atrophy in the thalamus that confers alterations in intrathalamic LFC. We chose not to make a hypothesis on the segmentation methodology.

Materials and methods: Anatomical and fcMRI data in 27 RRMS subjects (mean disease duration 7.59 years; median EDSS=2.0, range 1-6.5) and 51 age- and gender-matched HC were acquired at 3T. Thalamic volumes and areas of volumetric change between the two groups were created using FSL’s FIRST. LFC maps were generated for each subject by correlating the time course extracted from each voxel to all voxels contained within a 14 mm radius around that central voxel. Fisher’s z-transformed LFC values were compared between groups at the voxel level. Automatic segmentations of the thalamus were compared using both Freesurfer and FSL’s FIRST.

Results: In comparison to HC, the MS group showed decreased volume in overall thalamic (p=0.007), left thalamic (p=0.010), and right thalamic (p=0.005) volumes. Cluster peak z-scores in MS were decreased in MS compared to HC (p=0.019). There were no differences between MS and HC for any of the individual thalamic nuclei. Peak clusters of LFC medial thalamus were shifted superiorly, laterally, and anteriorly in MS by an average of 6.3 mm (SD=4.8) in the left thalamus and laterally and posteriorly by an average of 5.9 mm (SD=4.1) on the right. FSL’s FIRST generated a more accurate thalamic segmentation than the Freesurfer segmentation.

Conclusions: Local functional organization in RRMS corresponds to atrophic changes of the thalamus, including magnitude of connectivity in addition to location. Alterations in local functional connectivity may be secondary to the plasticity of the brain secondary to lesion load. We here have optimized our methodology for segmenting the thalamus, allowing us to investigate functional connectivity for future work.
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Prescription opioid deaths have quadrupled since 1999.

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Tamoxifen is a selective estrogen receptor modulator (SERM) with proven efficacy in the prevention and treatment of estrogen receptor (ER) positive breast cancer. Tamoxifen, as administered, has a low affinity for the estrogen receptor, requiring conversion to its active metabolites endoxifen and 4-hydroxytamoxifen by a number of cytochrome P450 enzymes (Figure 1). Because endoxifen levels are higher than 4-hydroxytamoxifen levels in women taking tamoxifen, and because endoxifen has a much higher affinity for the estrogen receptor than tamoxifen, endoxifen is thought to be the major active metabolite of tamoxifen. Conversion to endoxifen is catalyzed primarily by CYP2D6, and while genetic variation in CYP2D6 has been shown to alter endoxifen blood levels, the data linking genetic variation in CYP2D6 to changes in clinical outcome for tamoxifen have been inconsistent and inconclusive.

**Status**

Current evidence is insufficient to support routine CYP2D6 testing in breast cancer patients treated with tamoxifen. To date, genotype-phenotype association studies have yielded results that have been conflicting and inconclusive. This is partially due to inherent difficulties and inconsistencies in CYP2D6 testing. CYP2D6 testing is notoriously complex because more than 100 different allelic variations have been described and the phenotypic implications of all these variants remain unclear. This introduces misclassification bias, and tends to drive the odds ratio toward 1.0. One study revealed that 24 percent of poor metabolizers were able to attain endoxifen levels felt to be therapeutic. Thus, factors beyond each patient’s CYP2D6 genotype can impact tamoxifen metabolism. Co-medications may mask genetic effects via potent drug-drug interaction (examples are presented in Table 1 and discussed further in the Recommendations section).

Further data supporting the correlation between CYP2D6 genotype and clinical outcomes in the adjuvant setting is drawn from, among other sources, retrospective evaluation...
Table 1. Selected antidepressants and CYP2D6 inhibition

<table>
<thead>
<tr>
<th>Strong inhibitors of CYP2D6</th>
<th>fluoxetine</th>
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<tr>
<td>Moderate inhibitors of CYP2D6</td>
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<td>bupropion</td>
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Adapted from the U.S. Food and Drug Administration.

of outcomes for patients treated with adjuvant tamoxifen in the Austrian Breast and Colorectal Cancer Study Group (ABCSD) 8 trial. In this trial, specific steps were taken in an effort to ensure CYP2D6 testing of tumor samples accurately reflected germline status. In this trial, patients deemed to be poor or intermediate metabolizers had a higher risk of an adverse breast cancer related outcome than extensive metabolizers. Further data to support a correlation between CYP2D6 status and adjuvant breast cancer outcomes includes a large meta-analysis of nearly 5,000 patients from 12 different trials by the International Tamoxifen Pharmacogenomics Consortium (ITPC). CYP2D6 status was not correlated with breast cancer disease free survival in the group as a whole, but CYP2D6 poor metabolizer status was associated with a poorer disease free survival in a retrospectively defined subgroup comprised of postmenopausal patients with ER positive breast cancer receiving tamoxifen for five years (HR=1.25 CI: 1.06-1.47). This trial has come under criticism given its use of a post hoc subgroup analysis to identify a group receiving benefit and the authors acknowledge this concern while suggesting this data should lead to prospective studies evaluating the impact of CYP2D6 status on breast cancer outcomes.

While the above trials and other smaller studies have shown an association between CYP2D6 genotype and tamoxifen response in terms of disease-free survival or time to recurrence, retrospective analyses from a number of large, randomized clinical trials have shown no difference in breast cancer outcomes based on CYP2D6 status. The largest single clinical trial investigating the impact of CYPD6 status on outcome is the Breast International Group (BIG) 1-98 trial. In BIG 1-98, 8,010 postmenopausal women with ER positive breast cancer were randomized to receive tamoxifen or letrozole as adjuvant breast cancer therapy. Retrospective CYP2D6 testing on tumor tissue in paraffin blocks was able to be performed on 4,393 (61 percent) of these patients to establish CYP2D6 genotype. CYP2D6 status (extensive versus intermediate versus poor metabolism) was not associated with a significant difference in breast cancer outcomes.

Criticisms of this trial have focused on the fact that genotyping was done on preserved tumor specimens, raising the concern as to the validity of the testing in defining patients’ germline CYP2D6 status; this approach is not utilized in routine clinical practice. Another large trial, the Arimidex, Tamoxifen, Alone or in Combination Trial (ATAC) also showed no association between CYP2D6 genotype and tamoxifen efficacy, but this trial, too, had methodological issues putting the results in question. In the case of the ATAC trial, a minority of the trial samples (18 percent) were tested, thus opening the study up to wide range of possible statistical, analytical and sampling biases.

Several studies also initially reported that CYP2D6 genotype was associated with adverse drug reactions, in the form of hot flashes, in patients receiving tamoxifen. CYP2D6 poor metabolizers (two nonfunctional copies) had at a lower incidence of severe hot flashes compared to intermediate plus extensive metabolizers. However, follow-up studies failed to show an association or have reported controversial results. Data from a retrospective study did not support an association between the CYP2D6 phenotype and development of endocrine symptoms in tamoxifen-treated women.

Summary

Although studies that have addressed the ability of CYP2D6 genotype to predict the efficacy (or toxicity) of tamoxifen in the treatment of breast cancer have yielded mixed results, there is robust evidence indicating an association between CYP2D6 genotype and the concentrations of the active metabolites of tamoxifen: endoxifen and 4-hydroxy-tamoxifen. These observations have not been sufficient to move this drug-gene interaction (DGI) into routine clinical care for breast cancer patients.

Recommendations

Given a lack of conclusive data regarding impact of genotype on outcome, multiple professional societies including the American Society of Clinical Oncology (ASCO) and the National Comprehensive Cancer Network (NCCN) do not recommend routine CYP2D6 genotyping, and CYPD6 testing is not included as part of the package insert for tamoxifen.

Additional considerations include drug-drug interaction (DDI) and the availability of alternate treatment strategies for patients who are found to be intolerant to tamox-
are potent CYP2D6 inhibitors and although the clinical significance of this potential interaction with tamoxifen remains poorly defined, caution should be used when considering tamoxifen in patients requiring such agents or in initiating strong CYP2D6 inhibitors in patients requiring tamoxifen if less potent CYP2D6 inhibitors are options. Table 1 lists several antidepressants, ranked by their ability to inhibit CYP2D6. The more potent inhibitors may alter tamoxifen outcome, and should be used with caution in patients on tamoxifen.

Lastly, ongoing clinical trials are investigating the direct use of endoxifen, the active metabolite of tamoxifen, as an alternative to tamoxifen in premenopausal patients with breast cancer. If this agent works as well or better than tamoxifen, it may serve as an alternative therapy that would not require consideration of CYP2D6 activity at all.

Acknowledgments

The authors thank Dr. Russell A. Wilke for helpful comments offered during the preparation of this manuscript. This work was funded in part by National Institutes of Health (1U01HG007253) as well as through a generous gift from T. Denny Sanford that led to the creation of Imageneics (merging Internal Medicine and Genetics).

E-cigarettes. Talk to your young patients.

As a healthcare provider, your discussions with your patients—especially younger patients—will go a long way toward educating and could even prevent a dangerous habit from starting.

Unfortunately, there are many risks to using E-cigarettes: many contain nicotine which is addictive, can disrupt brain development, can complicate pregnancy, and is a known cause of SIDS; E-liquids containing nicotine are often concentrated enough to cause poisoning if ingested or absorbed through the skin; E-cigarette batteries can explode and cause burns or other injuries.

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Patient: It's not smoke, it's just water vapor.

When an E-cigarette heats up the e-liquid, the aerosol that is created is not just water vapor and it's not harmless for the user or those who are exposed to it secondhand.

 Patient: E-cigarettes help people quit smoking.

The jury is still out on whether E-cigarettes are a safe way for people to quit smoking, but we do know that they pose a health risk for young people.

Patient: E-cigarettes don't have nicotine in them.

Nicotine is very common in E-cigarettes. Because they aren't regulated, they may not be labeled to accurately show their ingredients. Our brains continue to develop through our mid-twenties and nicotine is known to damage brain circuits that control attention, learning, and susceptibility to addiction.

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A Fish Mouth Appearing Perforation of the Native Aortic Valve Due to *Streptococcus infantarius* subspecies *coli*

By Maheedhar Gedela, MD; Shawn Kelly, MD; Shenjing Li, MD; Jennifer Hsu, MD; and Adam Styx, MD

**Abstract**

Infective endocarditis due to *Streptococcus infantarius* with the subspecies (subsp.) *coli* is infrequently encountered in healthy humans. This entity is associated with hepatobiliary malignancies and colorectal neoplasia. Here, we report on a unique case of endocarditis associated with *S. infantarius* subsp. *coli* in an 80-year-old male with no known risk factors of the infective endocarditis.

**Introduction**

*Streptococcus infantarius* subsp. *coli* is one of the two subspecies of *Streptococcus infantarius* (previously well known as *Streptococcus bovis* biotype II/1) and has been associated with endocarditis in otters.1 Counihan et al. studied the pathogenesis of infective endocarditis (IE) due to *S. infantarius* subsp. *coli* in sea otters.2 Several pathogenic properties of adherence and invasion of epithelial and endothelial cells, adherence to extracellular matrix components, and the ability to resist macrophage phagocytosis have been observed to have a role in host colonization, invasion, and disease in sea otters.2 The infection due to the *S. bovis* species is commonly observed in elderly, immunosuppressive humans. There are no case reports on IE due to *S. infantarius* subsp. *coli* in the literature previously. Here, we present a case report detailing *S. infantarius* subsp. *coli* IE in an elderly, ischemic, heart disease patient who developed a fish mouth appearing perforation of the native aortic valve.

**Case Description**

An 80-year-old male with a history of coronary artery disease status post bypass surgery six years prior to admission presented with three weeks of fatigue, weakness, and lightheadedness. His physical examination revealed a temperature of 98.2 degrees Fahrenheit, blood pressure at 123/54 mmHg, heart rate at 78 beats per minute, a respiratory rate of 16 breaths per minute, oxygen saturation at 95 percent on room air, and a grade 4/6 early systolic murmur at the second right intercostal space. The remainder of the examination was essentially unremarkable, without any evidence of Janeway lesions, Osler nodes, or splinter hemorrhages. He was found to have elevated troponin and leukocytosis, which prompted further evaluation. He was empirically started on vancomycin and ceftriaxone after obtaining three sets of blood cultures. The patient’s family reported the recent onset of ataxia and vertigo. Magnetic resonance imaging of the brain revealed multiple small infarcts within the right cerebellar hemisphere, suggesting possible embolic strokes.

The three sets of blood cultures turned positive for *S. infantarius* subsp. *coli*, which was susceptible to penicillin. Transesophageal echocardiography (TEE) revealed an aortic valve vegetation with a perforation of the non-coronary cusp of the native valve (Figure 1). Due to the anatomic complexity associated with replacing the aortic valve (considering the patient’s previous bypass surgery), antibiotic therapy with ceftriaxone was recommended. After three weeks of a planned four-week antibiotic course, the patient developed chest pain and dizziness. Repeat TEE showed decreased vegetation size with a new paravalvular abscess (Figure 2). A colonoscopy was performed based on this organism’s association with colon cancer, and it revealed no findings suggestive of colon cancer. The patient then received a bioprosthetic aortic valve replacement with a complete reconstruction of the aortic annulus and an evacuation of two large...
abscesses. He also required repair of the aortic to left atrium fistula and the membranous ventricular septal defect due to the destruction from the infection, both of which were newly discovered intraoperatively. The patient was scheduled for another four-week course of ceftriaxone from the date of surgery and discharged to a swing bed facility for physical rehabilitation. The patient did clinically well without any consequences at the three-month and six-month follow-up visits.

Discussion

IE due to *S. infantarius* subsp. *coli* is infrequently encountered in healthy humans, and the virulence of this organism is unknown.3-5 One microbiological epidemiological study revealed four instances of infective endocarditis due to the *S. infantarius* subsp. *coli* in 24 bacteremia cases, but none of these patients developed cardiac abscesses.4 In another observational study, one case of IE due to the *S. infantarius* subsp. *coli* strain was reported from among 17 endocarditis-derived human *S. bovis* isolates, though no patient characteristics were described in this study.5 To the best of our knowledge, ours is the first reported case of a fish mouth valve perforation of the native aortic valve causing IE due to the *S. infantarius* subsp. *coli* organism. The source of the infection in our patient is unknown. Notably, besides his advanced age, he didn’t have predisposing factors such as malignancy or other immunosuppressive conditions.

*S. infantarius* subsp. *coli* is a member of the *S. bovis/equinus* complex. Few long-term, cohort studies have demonstrated the possible association between the gastrointestinal premalignant or malignant neoplasms in patients and the segregation of *S. bovis* as a pathogen of bacteremia or IE.7,8 Therefore, further studies are needed to establish a clear association between the several strains of *S. bovis* and

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**Figure 1.** Transesophageal echocardiography. A) Short axis view demonstrating a vegetation on the aortic side (red arrow) (left), B) Short axis view demonstrating a fish mouth shape perforation of the non-coronary cusp of aortic valve (red arrow) (middle), C) Three chamber color Doppler view demonstrating regurgitant jet (red arrow) through the non-coronary cusp of the aortic valve (right).

**Figure 2.** A) Short axis view demonstrating paravalvular aortic abscess at the base of aortic valve cusp (red arrow) (left), B) Short axis view demonstrating decrease in the size of the vegetation (red arrow) (right).
specific diseases. It is recommended that medical professionals perform a diagnostic evaluation for colonic pathology and for IE in a patient with bacteremia due to the presence of any of the subspecies of *S. bovis*. In our case, the colonoscopy showed no evidence of colon cancer.

Based on genetic distances and phylogenetic analyses, the *S. bovis* group was reclassified to the *S. gallolyticus* subsp. *gallolyticus* and subsp. *pasteurianus* and the *S. infantarius* subsp. *infantarius* and subsp. *coli*. The *S. infantarius* subsp. *coli* is typically susceptible to β-lactams and vancomycin, as are many streptococcal isolates. However, it is of paramount importance that microbiology laboratories differentiate this entity from other streptococcus species and subspecies due to the association of *S. infantarius* subsp. *coli* with hepatobiliary malignancies and colorectal neoplasia. This case also highlights the importance of considering IE as a differential diagnosis in patients presenting with cerebellar symptoms. Finally, health care providers should be aware of the new taxonomy of *S. bovis* to better understand the possible disease associations of these subspecies.
Tick Talk: Tick-borne Diseases of South Dakota

By Mark K. Huntington, MD, PhD, FAAFP; and Jay Allison, MD, FAAFP

Abstract

In addition to being a nuisance, ticks can carry disease. This article presents a brief review of ticks and associated tick-borne disease relevant to South Dakota and surrounding regions. Tick-borne diseases of special relevance in South Dakota include tularemia, Rocky Mountain spotted fever, and Lyme disease. A number of others may also be encountered in the state as well. Prompt treatment of suspected cases is important to ensure a successful recovery, and tick-avoidance measures can reduce the risks of acquiring them. Most of these conditions are nationally reportable infectious diseases.

Introduction

One of the features of summer is ticks. Tick activity is influenced by both seasonal and climatic factors. The nymphs exhibit a bimodal pattern in their questing behavior, with a major peak in the spring, followed by a lesser peak of activity in late summer or early autumn. The activity of deer ticks begins to pick up as the amount of daylight increases to 12 hours per day, and doesn’t wane until it dips below nine hours per day. Activity is inhibited as autumn temperatures approach the freezing point. The moisture in the microclimate of the leaf litter in which they reside is critical. When the relative humidity of the microclimate drops below 82 percent, survival of the ticks diminish. This is manifest by few ticks during hot, dry summers.

In addition to being a nuisance, ticks can carry disease. This article presents a brief review of ticks and associated tick-borne disease relevant to South Dakota and surrounding regions.

Lyme Disease

Epidemiology

Lyme disease, named after the community in which it was first described, not by its discoverer, hence the name is properly Lyme disease – not the possessive Lyme’s. It is an emerging infection first characterized in the 1980s, resulting from infection with Borrelia burgdorferi, a spirochete transmitted by the bite of infected Ixodes ticks. Lyme borreliosis is the most common tick-borne infection in the U.S. with an estimated 300,000 cases annually. It occurs more frequently during late spring and summer with a bimodal age distribution between the ages of five to nine and 55 to 59.

Historically, the vector’s range does not include South Dakota (Figure 1). However, because it includes bordering states, imported cases occur with an incidence in South Dakota of 0.6 out of 100,000. In recent years, I. scapularis ticks have been identified in three counties, with one having an established population. Though no locally-acquired cases have been reported, the vector is now here and local transmission may emerge.

Clinical Presentation

Early symptoms of infection include erythema migrans. Though this rash is generally described as an erythematous skin lesion with a “bull’s-eye,” it may be more homogeneous in appearance. Also common are arthralgias, fever, headache, lymphadenopathy, and fatigue. Untreated, disseminated borreliosis can lead to meningitis, carditis, neuropathy, or arthritis. Late symptoms include aseptic meningitis, cranial neuritis, ocular manifestations, atrioventricular block, cardiomegaly, and myocarditis.
Diagnosis

Early localized disease, characterized by erythema migrans, is easily recognizable, treatable, and does not require serologic testing. Those with findings suggestive of early disseminated or late disease should undergo two-step serological testing for confirmation. Additional details on specific testing may be found at www.cdc.gov/lyme/diagnosticstesting/labtest/twostep/index.html.

Coinfection of Lyme patients with other tick-borne organisms such as ehrlichiosis and babesiosis is common; maintain a high index of suspicion.

Treatment

Treatment is dependent upon stage and manifestation of the disease. Management of early disease is fairly straightforward. For adults, options include doxycycline 100 mg BID OR amoxicillin 500 mg TID OR cefuroxime axetil 500 mg BID for 14 days (adults). Treatment for children is slightly different, with options being amoxicillin 50 mg/kg per day divided TID (maximum of 500 mg per dose) OR cefuroxime axetil 30 mg/kg per day divided BID (maximum of 500 mg per dose) OR if greater than 8 years of age, doxycycline 4 mg/kg per day divided BID (maximum of 100 mg per dose).

For late disease, it becomes more complicated, dependent upon the manifestation. For drugs and dosing details, see http://cid.oxfordjournals.org/content/43/9/1089.full.

Prognosis

Signs of Lyme disease resolve upon completion of antibiotic treatment, as do the subjective symptoms for the majority of people. However, 10-15 percent of patients experience persistent, nonspecific symptoms, sometimes referred to as “post-Lyme syndrome” or “chronic Lyme disease.” Extensive investigations of this phenomenon have failed to demonstrate either a microbiological or an immunological cause of the symptoms. There is no evidence for the persistence of the organism in adequately treated individuals, nor is there any evidence of benefit from prolonged antibiotic treatment. Such unorthodox approaches can have serious – even lethal – consequences, as has been reported in Morbidity and Mortality Weekly Report. Patients who have been treated for Lyme disease and have persistent symptoms should be investigated for other etiologies or be treated symptomatically, with an approach similar to that for other chronic central pain syndromes.

Rocky Mountain Spotted Fever

Epidemiology

Rocky Mountain spotted fever (RMSF) is one of the spotted fever group (SFG) Rickettsia infections. Symptoms of SFG disease may range from mild infections to life-threatening. In the U.S., 13,599 cases of SFG rickettsiosis were reported from 2008-2012. RMSF is the most dangerous of the SFG species, and is tick-borne (Dermacentor and Rhipicephalus spp.; Figure 2). RMSF is as likely to be seen in South Dakota as Lyme disease (0.23-0.66 out of 100,000) but is more likely to have been locally acquired.

Clinical Presentation

Initial presentation is a nonspecific flu-like illness, accompanied by abdominal pain, fever, myalgia, and headache. The rash is initially macular and later...
petechial. Can involve the hands and soles and progress to eschar formation. Without treatment it may rapidly progress to death.

Diagnosis
RM SF remains primarily a clinical diagnosis: fever, headache, myalgias, petechial rash, and tick exposure. Culture, microscopic, molecular, and serologic methods are available. Only polymerase chain reaction and culture are specific for RM SF. For details on these additional diagnostic modalities, see www.cdc.gov/mmwr/preview/mmwrhtml/rr5504a1.htm.

Treatment
Treatment for suspected RM SF should not be delayed, as it is most effective at averting death if started within five days of onset of symptoms. Treatment should be initiated promptly upon clinical suspicion, without waiting for laboratory confirmation. Therapy consists of doxycycline, even in children age less than 8 years: 100 mg every 12 hours (adult); 2.2 mg/kg every 12 hours (children less than 45 kg) until at least three days after the fever abates and clinical improvement is seen, for a minimum course of five to seven days for uncomplicated cases.

Prognosis
Rocky Mountain spotted fever has the highest case fatality rate of the Rickettsia infections: 4 percent with antibiotics and up to 20-25 percent without. The most common life-threatening complications include meningitis/encephalitis, renal failure, and acute respiratory distress syndrome with a median time from onset to death of seven days. Children show a higher fatality rate than older populations.

Tularemia
Epidemiology
The causative agent, Francisella tularensis is spread by both ticks (Dermacentor spp. and Amblyomma spp. in this region) and the deer fly (Chrysops spp.), as well as by direct contact with infected animal tissues, or even through aerosols (such as in farming when an infected animal corpse is struck by machinery). In South Dakota, most cases appear related to hunting and farming rather than being vector-borne. Incidence in the state is 2.9 out of 100,000, with the majority of cases in the western part of the state (Figure 3).

Clinical Presentation
Clinical presentation consists of fever, skin ulcer at site of inoculation, and regional lymphadenopathy. Severity may range from mild to life-threatening. It is often classified based on the site of inoculation: ulceroglandular (as described above), glandular (without the ulcer), oculoglandular (conjunctival exposure), oropharyngeal (mucosal exposure), pneumonic (aerosol exposure; the most serious form), and typhoidal (general symptoms without any localizing symptoms).

Diagnosis
This condition is primarily a clinical diagnosis, in the context of an appropriate exposure history. Serologic confirmatory tests are available, comparing titers of acute to convalescent serum.

Treatment
The treatment of choice is streptomycin (15 mg/Kg IV BID x 10 days), with doxycycline (100 mg PO/IV BID x 14-21 days) as an alternative. Fluoroquinolones are not
FDA approved, but there are some reports of efficacy with ciprofloxacin (400 mg IV or 750 mg PO BID x 14 days).  

Prognosis  
With proper treatment, most patients recover without sequela.  

Hunters should be encouraged to wear gloves when skinning or handling rabbits or rodents, and to cook meat well, in order to decrease their risk of infection.  

**Babesiosis**  
Transmitted by the same tick that spreads Lyme disease, it is perhaps not surprising that this malaria-like protozoan has a similar geographic distribution. Transmission occurs mainly in the Northeast and upper Midwest, including Minnesota. The CDC reports two cases in South Dakota, likely acquired outside the state.  

Babesiosis is often asymptomatic, but may be severe, especially in those who are immunocompromised (including the elderly). Symptoms range from vague, flu-like symptoms of nonspecific flu-like symptoms, such as fever, chills, sweats, headache, body aches, loss of appetite, nausea, or fatigue to hemolytic anemia, thrombocytopenia, and disseminated intravascular coagulation. If suspected, diagnosis can be confirmed by demonstration of intraerythrocytic parasites on a peripheral blood smear. For symptomatic patients, treatment consists of atovaquone (750 mg PO BID) PLUS azithromycin (500 mg PO day one, 250 mg QD subsequent days) for 10 days; for severely ill patients, clindamycin (600 mg PO TID or 300-600 mg IV QID) PLUS quinine (650 mg TID) for 10 days. Asymptomatic patients require no treatment.  

**Ehrlichiosis and Anaplasmosis**  
Ehrlichiosis, caused by *Ehrlichia* and *Neorickettsia* species spread by *Amblyomma* ticks, presents as a nonspecific syndrome of fever, headache, vomiting, malaise, and myalgia. A rash occurs in 30 percent of adults and 60 percent of children. Elevated transaminases, leukopenia, and thrombocytopenia are common laboratory findings. Characteristic inclusions (morulae) may be seen on blood smears. Serologic confirmatory tests are available. Most cases occur in the southcentral and southeastern U.S., though a newer focus in the northeast has been noted. Although no cases have been reported in South Dakota, it is in neighboring states (Figure 4). The latest national surveillance data show an increased case fatality rate in children under age 5; hesitancy on the part of physicians to give doxycycline to children under age 8 remains a significant barrier to effective treatment. Treatment is doxycycline 100 mg every 12 hours (adult); 2.2 mg/kg every 12 hours (children less than 45 kg) for seven to 14 days.  

Anaplasmosis, caused by a related organism spread by *Ixodes* ticks, is clinically similar to other tick-borne rickettsial diseases: nonspecific flu-like illness of fever, chills, headache, myalgia, malaise. The organism may be
demonstrated on blood smears. Serologic confirmatory tests are available. Treatment is the same as for ehrlichiosis and should be initiated based on clinical suspicion; do not await confirmatory testing.

**STAR**

Southern Tick-associated rash illness (STAR) is clinically similar to Lyme disease, with a somewhat different distribution. It presents with a nonspecific flu-like illness, fatigue, fever, headache, myalgias, and a rash similar to Lyme disease. It is most commonly encountered in the southern Midwest, southeastern, Atlantic coast, or in travelers from those regions. The vector, *Amblyomma*, has a range that approaches South Dakota’s borders. No diagnostic tests are available, and its cause remains unknown. No specific treatment is currently recommended; antibiotics are of unknown benefit. For the latest developments, see [www.cdc.gov/star/index.html](http://www.cdc.gov/star/index.html).

**Tick-borne Relapsing Fever**

Seen in the southwestern and western U.S., this infection is caused by a *Borrelia* spirochete related to the Lyme agent, and spread by both *Ixodes* and *Amblyomma* ticks. Clinically, it presents with a nonproductive cough, headache, myalgia, relapsing fever, and transient petechial rash; these features are not specific enough to differentiate this from non-tick-borne relapsing fevers. Organism may be demonstrated on blood smears or cultured; serologic confirmatory tests are available. Treatment of relapsing fevers depends upon the etiological agent; for current recommendations, refer to [www.cdc.gov/relapsing-fever/clinicians/index.html](http://www.cdc.gov/relapsing-fever/clinicians/index.html).

**Powassan Encephalitis**

Powassan virus encephalitis is transmitted by *Ixodes* ticks. Though it is seen in the northeast and Great Lakes regions, it is very rare and unlikely to be encountered in South Dakota. Clinically, it may be quite severe and lead to long-term sequelae; treatment is supportive. Though a tick-borne encephalitis, it is a distinct clinical entity from “Tick-borne Encephalitis” caused by the tick-borne Encephalitis virus, also spread by an *Ixodes* tick, which is a significant public health problem in Europe.

**Colorado Tick Fever**

*Dermacentor andersoni* ticks are the vector for Colorado tick fever virus; the range of this species extends into the western portions of South Dakota, though no cases have been reported in the state. A rare condition, those living or visiting the western states during the spring or summer, at an altitude of 4,000-10,000 feet may be at risk. Clinically it presents as fever, headache, myalgias, and fatigue. There is no treatment currently recommended; the condition is fairly mild and self-limited in most cases.

**Prevention of Tick-borne Disease**

The best way to avoid tick-borne infections is tick avoidance. Avoiding wooded areas, especially those with high grass or leaf litter, can decrease the risk of tick bites. This is both difficult and undesirable to do in most of South Dakota, a state in which outdoor activities predominate. Walking in the center of paths through wooded areas can decrease the chance of exposure.

Other strategies include using insect repellent (e.g., diethyltoluamide [DEET], picaridin, or IR3535) on the skin and insecticide sprays such as permethrin for clothing (applied to clothing and allowed to dry before applying the clothing to one’s body). Showering after returning from exposures (within two hours) can be beneficial in removing non-attached ticks, along with full-body inspection for those who’ve attached. Inspection of pets and gear is important, and tumble drying clothes at high heat for 10 minutes if dry (60 minutes if clothes are wet) will kill ticks hidden on them.

From a public health perspective, early diagnosis and treatment of these diseases and identification of the areas in which they were acquired can be important in preventing spread and directing vector control activities. Most of them are nationally notifiable infectious diseases, cf. [www.cdc.gov/nndss/default.aspx](http://www.cdc.gov/nndss/default.aspx).

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**About the Authors:**

Mark K. Huntington, MD, PhD, FAAFP, Center for Family Medicine; Department of Family Medicine, University of South Dakota Sanford School of Medicine.

Jay Allison, MD, FAAFP, Center for Family Medicine; Department of Family Medicine, University of South Dakota Sanford School of Medicine.
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Dear editor,

A recent article in South Dakota Medicine by Dr. Richard Holm addressed the issue of older drivers and the clinician’s role in helping to protect their patients and the public. There are multiple issues in Dr. Holm’s article I am compelled to clarify and/or refute.

Firstly, there is an important distinction regarding his use of the terms “competent” and “incompetent” when characterizing older drivers. These are legal terms and not medical terms. Medical literature uses the term “capacity” and, as I will describe, it is not only mental capacity but also physical capacity that determines a safe older driver.

Dr. Holm also suggests that patients can decide for themselves when it is time to stop driving and seems to justify the risks attendant to older drivers by balancing them against “much riskier” 18 to 20-year-old drivers. As we will see below, neither of these propositions is true. This brief overview will review some safety data related to geriatric drivers and will present available evidence-based assessment tools that can be used in any clinic setting to provide the older driver the best evaluation and advice about continued driving.

The Safety Record for Geriatric Drivers

Why should physicians be concerned about the older driver? It is widely known that the national population is aging. South Dakota is an exception only in that the elderly population is growing faster than the national rate. By 2025, the number of people in South Dakota over the age of 65 will double, reaching 24 percent of the state’s population.

Although older drivers do not typically speed or drive under the influence of alcohol and have frequently modified their driving (shorter distances and no night driving), their mortality statistics are alarming. From the South Dakota Public Health Bulletin (Figure 1) we can see that there is a “u” shaped curve with reduced mortality rates after age 25 which peaks again, especially in male drivers, over the age of 85, surpassing younger males for deaths per 100,000 population.
This is also true in national statistics. This data contradicts Dr. Holm’s suggestion that we should be concerned only about younger male drivers.

It is true that older drivers are not able to survive injuries sustained in a crash as readily as younger drivers, and that is likely also a factor in this statistic. Older drivers will also counter that they do not drive as many miles as younger drivers. Although true, fatalities per 100 million miles driven are greater for adults over age 85 by at least a factor of 2 compared to young adults less than 30 years old (Figure 2).

It is the loss of mental and physical capacity that impairs the older driver. Studies have found that older drivers may limit their driving based on road conditions, but not medical conditions. As clinicians, we have firsthand knowledge of problems in these areas compared to police, the Department of Public Safety, and even family at times. We can and should do better at reporting impaired older drivers.

Assessing Mental and Physical Capacity in the Older Driver

It will likely surprise you that you will find patients with severe peripheral neuropathy in their lower extremities or patients dyspneic and dependent on oxygen still driving. But should they continue driving and how can a physician objectively assess them? The conversation with the older patient can begin with the question, “how did you get to this appointment?”

We can use certain evidence-based tools to assess risk of continued driving by our patients. These assessment tools continue to be refined and are now in their third edition. This is a consensus effort from several specialties and is published online by the American Geriatrics Society and the National Highway and Traffic Safety Administration as The Clinician’s Guide to Assessing and Counseling Older Drivers (the guide) accessed at www.nhtsa.gov/Driving-Safety/Older-Drivers. The second edition is in hardcopy format and free to the public, and it is expected that the third edition will soon be in hardcopy form.

From my experience leading an older driver’s clinic in a large academic center, I recommend the following:

1. Always have an “informant.” If possible, ask the informant separately if they feel safe riding with this person or would they put their grandchild in the car with the patient. The answer may give you more resolve to perform these tests for the patient’s and the public’s safety.

2. Also ask the patient about recent “near misses,” accidents, or getting lost in the presence of the informant. These events may be an indication of poor driving ability and the older person may not recall these correctly. This is in direct opposition to Dr. Holm’s assertion that you can simply ask the older driver if he or she is a safe driver and that they will self-select to stop driving. Most will not. They may display poor insight as part of their dementia. They may also assert that they have been driving for many years and that it is second nature to them. It is true that driving involves procedural memory, but not entirely. It also involves visual perception and processing, selective and divided attention, and executive skills. These are the areas that the paper and pencil tests found in the guide are designed to test in your clinic.

3. If you are familiar with this patient and/or want to dispel cognitive concerns primarily, begin with the assessments recommended in the guide. This is a bit of a shortcut, but the premise is that if they have a dementia, it is not if they should stop driving but when. The cutoff scores are quite clear in the guide. You will need to practice administering these.
tests. I recommend that the physician administer these tests. You will need hardcopies of the overall score sheet, the Montreal Cognitive Assessment (MOCA), the Trails B test, the practice Maze test, and the full Maze test. The Clock Draw will be part of the MOCA and the MOCA includes a shortened version of the Trails B which can introduce that test. You will need a stop watch, a pencil, and the test sheets mentioned. Overall, being prepared will give assurance to the patient and family that you are performing a recommended set of tests and that you are being fair, since you do this for all your patients. You may be surprised to find unrecognized dementias or mild cognitive impairments in your patients. You can also use these scores to compare over time if a re-evaluation is indicated.

4. If you are not well acquainted with the patient or are concerned about physical impairments, begin with the recommended range of motion, reflexes, strength testing and gait speed (you will need a stop watch and a means to measure distance). Vision testing can also be done in your office. The patient will be more comfortable and will understand why you would ask them to turn their head, push down their right foot, etc. before you finish with the cognitive portion of the exam.

5. You can also use this guide to provide recommendations for many diseases and conditions such as a new pacemaker, sleep apnea that is not treated, newly diagnosed Diabetes, etc.

6. There are also times that a driving rehabilitation specialist (a specialty under occupational therapy) is needed and recommended; the guide provides examples. Most of the time the patient can and should be assessed in the clinic setting, however.

7. As the name of the guide implies, counseling the older driver after the testing is involved and difficult. But feel empowered that you have performed the tests recommended and that this is a valid public safety concern. You will need to document your tests and discussion and tell the patient and family that you are recording the visit.

8. The guide gives suggested coding for the procedures and this visit should likely be a separate visit since it does require 20 to 30 minutes when you have mastered necessary testing skills.

9. The patient must be asked at the next visit “how did you get here?” as your recommendations may not have been followed. In South Dakota, mandatory reporting is not required. However, it is highly encouraged that medical professionals voluntarily submit a medical statement. Patients who are not compliant may be reported to the South Dakota Department of Public Safety at https://dps.sd.gov/licensing/driver_licensing/documents/Medicalstatement-2015_001.pdf.

Conclusion
Reduced mental and physical capacity that may hinder safe driving in the elderly is an important clinical and public health issue that primary care physicians should have the requisite knowledge and skills to assess and help to manage. Necessary skills and clinical insights can be learned from The Clinician’s Guide to Assessing and Counseling Older Drivers, available from the American Geriatrics Society and the National Highway and Traffic Safety Administration. Evaluations can be scheduled in the clinic.

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About the Author:
Ellen M. Pinholt, MD, FACP, Internal Medicine Physician and Director of Transitional Care Clinic, Regional Health, Rapid City, South Dakota.
Think About Ramifications Before Taking Away Right to Choose

By Richard P. Holm, MD, MACP

Dear Dr. Pinholt and editor,

Thank you for providing a response to my patient education piece on elder driving. Any open discussion regarding this topic should make all of us more aware of not only the topic about who should have, or not have, the privilege of driving. Also, when is it that we should, or should not, take away the rights of the elderly for writing checks, making a will, choosing where to live, deciding every and all acts of daily living. Those are privileges that go away when someone is determined legally incompetent. My point is that we need to think hard about all the ramifications that might occur, before we take away a person’s right to choose.

Dr. Pinholt made a distinction between the words “competent,” which she describes as a legal term, and “capacity,” which she describes as the proper medical term for this issue. I contend that primary care physicians need to understand and use both terms. I prefer to think “capacity” as a descriptor of a person’s ability or power to do or understand something. “Competence” is to have the legal right to make choices when someone is “capable.” In the state of South Dakota, for the most part, judges and physicians determine “competence.” For example, it is usually the primary care provider who is the official mental health care provider, for the patient in question. It is, most often, the physician who declares people psychologically incompetent and initially commits them to involuntary hospitalization for psych problems. That is how it should be, as the primary care physician usually knows the individual best. It is also the primary care physician who usually determines when a person becoming demented reaches the threshold of “incompetence.” This is defined by South Dakota Codified Law 34-12-D, the living will statute for this state. Thus, incapacity or incompetence both are common terms a primary care provider should understand and use. Bottom line, in this state, practicing physicians must legally determine not only “capacity” but also “competence” or “incompetence” when determining that important question about when to take away privileges in a demented or emotionally incapable individual.

Dr. Pinholt took me to task on my asking the elderly to choose for themselves not to drive when they may be compromised in their physical capacity to drive safely. This was meant for those who have the mental capacity to choose, or rather, who have not been declared incompetent. Of course, if someone is incapacitated mentally or emotionally, they will likely not make the right decision, but many who are only physically compromised might be encouraged to give up the reigns of the jalopy. That was my intent. No one has the right to take away the choices of a mentally competent and emotionally stable individually (unless he or she has broken the law, but that’s another story). We certainly can and should encourage our patients or their families down the safe path when there is a question regarding their physical capacity. As I mentioned in the essay, here’s where the Driver Improvement Course for Seniors through the American Automobile Association (AAA) should come in handy.

Dr. Pinholt provided graphs that point out the death rates in men older than 85-year-old, and how they finally reach the level of yearly vehicular death rates that occurs from 18-25-year-old men. Is she saying we should take away the right to drive from all 85-year-old men? I should also point out that the death rate for elderly women drivers never reaches the level of vehicular death rate from 25-year-old women drivers.

Next, Dr. Pinholt goes into detail how we determine mental competence by measurement tools. There are many methods to determine when a person is no longer capable, or no longer has the capacity, to make legal decisions. My point was that the most important component of “capacity,” and thus, “competence,” is the ability to remember new things, new happenings. I believe that simple point is worth a textbook of rules, drawn clocks, and time measured by
stop-watches. Although Dr. Pinholt's discussion had important information for physicians, my article was directed, as it is most every month, for the patient, for the public, for the non-physician.

I would make one final point. The tenor and emphasis of my article was to emphasize how important is the right of self-direction, the right to choose for oneself, the value of the privilege to drive, and to write a check, to make a will, and to self-direct. We should consider the value of every individual, no matter what his or her age, and all the consequences before we take those rights away.

I truly appreciated Dr. Pinholt’s clarification and corrections letter. Her plea to physicians was, “We can and should do better at reporting impaired older drivers,” and I don’t disagree. I also like her suggestion to ask elderly people, “How did you get to this appointment?” This should go especially for elderly men, but I would leave a final sincere wish. If I am fortunate enough to reach the ripe old age of 85, and if I still have the mental and physical capacity and therefore competence to drive, I hope some over-zealous doctor or family member doesn’t come along and take that privilege away.

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**Dr. Pinholt’s Response:**

In the context of the current discussion I feel that it is best to leave determination of “competency” to the courts and psychiatric expertise where such determinations are usually made. I prefer to simply refer to mental and physical capacity to drive safely as the issue at hand.

It is true that there are significant implications for our elderly patients if the privilege is revoked and it is not age based (that would make it rather easy to determine). But we do know that it is the accumulation of physical and mental impairments which can make an older driver an unsafe driver. These capacities can be assessed relatively simply and effectively in the clinic through the tools that I have described.

Ellen M. Pinholt, MD, FACP

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**Bezlotoxumab for Preventing Recurrent *Clostridium difficile* Infections**

By Jessica Rounds, PharmD; and Joe Strain, PharmD

*C. difficile* (C. difficile) is an anaerobic, gram positive, spore forming bacterium and is the most common cause of antibiotic-associated colitis. *C. difficile* produces two toxins, toxin A and toxin B, both of which are virulent factors affecting the severity of the infection. C. difficile infection (CDI) is defined as the presence of symptoms, usually diarrhea, and either a positive stool test for the *C. difficile* toxins or toxigenic *C. difficile*, or colonoscopic or histopathologic finding consistent with pseudomembranous colitis. Almost a half-million CDIs were reported in 2011 with 29,000 deaths. Approximately 83,000 patients experienced a first recurrence within 30 days of the initial diagnosis. Each year an estimated $3.2 billion of health care expenditures is attributed to CDIs in the U.S. alone.

In 2013, the Centers for Disease Control and Prevention (CDC) listed *C. difficile* as an urgent threat in the list of the top 18 drug resistant threats to the U.S. The categorization of *C. difficile* among the highest threats stems from increasing outbreaks as well as the identification and spread of a highly virulent strain. Current guidelines from Society for Healthcare Epidemiology of America (SHEA) and Infectious Diseases Society of America recommend treatment based on the severity of disease and includes oral or intravenous metronidazole (Flagyl) and oral vancomycin (Vancocin). The antimicrobial resistance pattern for CDIs is not well-defined but there is potential for increasing resistance leading to suboptimal treatment. Barkin et al. utilized DNA testing to evaluate *C. difficile* positive stool samples for imidazole and vancomycin resistance genes. Of the 282 specimens, 47.5 percent contained genes causing resistance to metronidazole, 6.1 percent to vancomycin and 3.2 percent contained genes causing resistance to both metronidazole and vancomycin. This study was limited to the observation of stool samples for the resistant genes and did not evaluate clinical outcomes. However, these findings warrant further investigation as resistance accounting for an increase in treatment failures to metronidazole and an increased rate of recurrence.

The significant burden of CDI, in particular challenges with recurrent infections, has led to the investigation and discovery of preventative strategies to combat CDI. Bezlotoxumab (Zinplava) was approved by the Food and Drug Administration (FDA) in October 2016 for adjunctive therapy in CDIs to reduce the recurrence in patients 18 years or older and at high risk of CDI recurrence. It is a human monoclonal antibody that provides passive immunity by binding and neutralizing the effects of *C. difficile* toxin B. It is not indicated to treat CDIs as monotherapy as it lacks antibacterial properties, therefore it must be used in conjunction with antimicrobial treatment for *C. difficile*. Bezlotoxumab is administered during antibacterial treatment for CDI as a one-time intravenous dose of 10 mg/kg infused over 60 minutes. The half-life is approximately 19 days and it is metabolized through catabolism which limits the number of drug interactions. No dosage adjustments are required for renal or hepatic impairment. The most common adverse effects include nausea, pyrexia, and headache. Heart failure and heart failure exacerbations were reported in more patients treated with bezlotoxumab compared to placebo. Reports of higher mortality rates due to cardiac failure, infection and respiratory failure were also observed in patients with underlying heart failure therefore caution is warranted in this population.

MODIFY I and MODIFY II, two similarly designed phase 3 clinical trials, demonstrated the safety and efficacy of bezlotoxumab, alone and in combination with another monoclonal antibody actoxumab, for the prevention of recurrent CDI. A recurrent CDI was defined as a new episode of *C. difficile* infection after initial clinical cure of the baseline episode. Both trials were randomized, double-blind, placebo-controlled, multicenter trials. Patients were randomized to bezlotoxumab alone, bezlotoxumab and actoxumab, placebo, and actoxumab. Actoxumab...
monotherapy was given in MODIFY I but not MODIFY II due to the lack of benefit and potentially more harm observed during MODIFY I.\(^6\)

A total of 2,559 patients were included in the efficacy analysis for the two trials. The majority of patients received oral vancomycin (48 percent) or metronidazole (47 percent). Bezlotoxumab was administered within six days after starting antibiotic therapy (median three days). Approximately 68 percent were treated in the hospital and 16 percent had severe infection. There were 27 percent of patients who had one or more episodes of \textit{C. difficile} infection in the previous six months prior to the study. Both trials were pooled to show no statistical difference in the initial clinical cure rates, defined as no diarrhea for two consecutive days after completion of standard of care antibiotic therapy, between all four groups. The primary outcome of recurrent CDI during 12 weeks of follow-up was significantly lower in the bezlotoxumab group compared to placebo and the actoxumab-bezlotoxumab group compared to placebo (Table 1). The rate of recurrent infections did not significantly differ from the bezlotoxumab alone and the actoxumab-bezlotoxumab group. The rate of recurrent infection was significantly lower in the two groups in the stratified patient population whom were deemed high risk for recurrence. Specifically a subgroup analysis showed bezlotoxumab to have a significant benefit over placebo in the following high-risk populations: age 65 years old and above, one or more CDI in the past six months, two or more previous CDI episodes in a lifetime, immunocompromised, and severe infection. Bezlotoxumab remained effective at reducing CDI recurrence throughout the 12-week study period compared to placebo.\(^6\)

### Table 1. Recurrent CDI Rate within 12-weeks of treatment following initial cure (pooled data)

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<thead>
<tr>
<th>Actoxumab-Bezlotoxumab</th>
<th>Bezlotoxumab</th>
<th>Placebo</th>
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<tr>
<td>N = 773</td>
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<td>15%*</td>
<td>17%*</td>
<td>27%*</td>
</tr>
</tbody>
</table>

* P < 0.001 vs. placebo

For the safety component of the trials, infusion related reactions were reported in 9 percent of participants and were similar between all study groups. Approximately 60 percent of patients experienced one or more adverse event in all groups. Rates of serious adverse events and death were higher in the actoxumab group compared to the other groups therefore warranting the early cessation of the actoxumab monotherapy group in MODIFY I.\(^6\)

Recurrent CDI occurs in up to 35 percent of patients and presents treatment challenges as it’s associated with more hospitalizations, worse outcomes and increased costs compared to the initial infection.\(^6\) Patients with recurrent infections have a 50-60 percent chance of another repeat recurrent \textit{C. difficile} infection. Prior to the approval of bezlotoxumab there was no FDA approved medications for preventing recurrent CDI. Bezlotoxumab provides benefit in the prevention of recurrent CDI, most notably in patients with a high risk for recurrence. The cost-effectiveness of utilizing this new preventative strategy requires further investigation.

### REFERENCES


### About the Authors:

Jessica Rounds, PharmD, Resident, Rapid City Regional Hospital.
Joe Strain, PharmD, College of Pharmacy and Allied Health Professions, South Dakota State University.
When should one worry that he or she might be having a heart problem?

Unfortunately, heart symptoms can be all over the board, and sometimes there are no indications for trouble until very late in the game. On top of this, classic heart-problem symptoms can just as easily be due to something not heart-related, like an esophageal spasm or musculoskeletal strain. That said, there are clues for heart trouble that help us know when to seek help.

It is helpful to take into consideration the age, gender, size, life-style, and situation of the individual in question. In general, there is a higher incidence of heart problems in people with a history of smoking, a family history of heart disease, older age, and if that person is male. But heart problems can occur in anyone, so never cover-up or ignore symptoms. Heart disease in some people, especially diabetics and women, can present with unusual or very minimal symptoms. Hypertensive and overweight snorers should have an inexpensive night-time oxygen test to see if a full sleep study is needed. Sleep apnea is a dangerous and important cardiac risk-factor, and I believe way more worthy of attention than cholesterol. If suspicious, talk to your doctor, since discovering sleep apnea could add years to your life.

A middle-aged or older person having a heavy sensation in the chest, neck, jaw, shoulder, or arm that comes with exertion and is relieved with rest, should be suspicious of a blockage in their coronary arteries. Called angina pectoris, this condition alone may not be dangerous unless coming on with progressively less exercise. Still, if you experience angina you see your doctor. If these symptoms come on suddenly, severely, and do not go away with rest, then you have a very urgent problem, so call 911.

Heart weakness, also called congestive heart failure (CHF) can be caused by heart-valve disease, long standing high blood pressure, chronic alcohol use, certain viral infections, and more. The most common symptom of CHF is shortness of breath, but almost every illness, especially lung disease, can cause this too.

Heart rhythm problems are sneaky. Many of us, including me, have benign sporadic palpitations that are not dangerous and mean nothing, but still worth discussing with your care provider. If you have runs of heart rate in the range of 150 beats per minute, or rates so fast or slow as to cause weakness or passing out, you should go the emergency department.

As complex as all these warning signs may seem, the most important way to diagnose heart disease starts with paying attention to symptoms.
A New England Journal of Medicine article in 2009 by Jenks et al. brought to public scrutiny the measurable condition of 30-day readmission rates in Medicare patients. The rate at that time was at 20 percent, but has since shown a decrease. Before, and certainly since that time, this area has had intensified efforts from hospitals, nursing homes, home health agencies and clinical providers to lower readmission rates which also reduces cost.

There are a number of services to help keep patients in their home living environment. They include support programs such as Better Outcomes for Older Adults Through Safe Transition (BOOST), Project ReEngineered Discharge (Project RED), Interventions to Reduce Acute Care Transfers (INTERACT) and the Care Transitions Program. Rapid and timely follow-up communication including home services and primary care providers play an important role in reducing a return to the hospital. The larger hospitals in the PPS payment program face financial penalties for excessive numbers of readmissions when compared to others.

The concept of merely avoiding readmissions has evolved to the broader term of care transition. Care transition strives to ensure patients, especially the elderly, can traverse the range of services from clinic to emergency room to hospital to post-acute care and, hopefully, return to their home environment in a safe and timely manner. The financial pressures of DRG payment, hospital bed shortages, distances and communication gaps as well as available services, especially on weekends, all challenge the goal of smooth care transition.

Hospital discharge, in addition to its clinical aspects, is a social and economic challenge. It is generally not standardized across all service sites and suffers from fragmentation of care and variability in areas of measurable quality. Nearly half of the problems associated with medications occur within the first two days following discharge. Families and care givers, while expecting that the patient is stable, are frequently confused by medication changes, wound care requirements and appropriate contacts for questions and concerns after the patient is discharged.

In 2013, a condition termed Post Hospital Syndrome was described. Providers often focus on the acute condition that precipitated the hospitalization. Patients, however, are subject to a range of conditions not necessarily related to their acute diagnosis. These areas of vulnerability may include environmental, psychologic and physiologic stress factors complicating the original condition. Hospitalized patients face sleep disruption, dietary adjustment and deconditioning, all of which can alter the recovery period and lead to an increased risk for readmission.

Communities across the Great Plains Quality Innovation Network (QIN) are collaborating to improve care coordination and medication safety. The goal is to reduce avoidable hospital admissions and adverse drug events. SDFMC is working within our state to complement these efforts by sharing data, identifying readmission root causes and offering support for community partnerships between providers and stakeholders. The larger communities have organized collaboratives that meet and share challenges and success stories. They can observe measures at a community level and note trends in specific diagnoses and conditions that relate to readmissions and adverse drug events.

Successful care transition and medication safety will always be a challenge due to multiple factors not easily amenable to provider intervention. Health care should strive to deliver elements of care that help to reduce those admissions including those that occur for the first time, not just those that reoccur. The most important word in care transition is care. Please feel free to contact myself at Stephan.Schroeder@area-a.hcqis.org or Linda Penisten, RNC, OTR/L, at Linda.Penisten@area-a.hcqis.org for more information.

**Sources**

What is a confidential monitoring program?
When an applicant or a licensee has been determined by an evaluation to be impaired in a manner where the individual demonstrates the inability to practice in their health-related profession with reasonable skill and safety due to mental health issues, physical issues, or substance use related disorders (alcohol or drug abuse, dependency, or addiction), the applicant or licensee is enrolled in a confidential monitoring program. The confidential monitoring program is an agreement between the participant (applicant or licensee) and the BMOE staff review panel to defer any recommendation for discipline on a license as long as the participant can be monitored to ensure their ability to safely practice. See the flowchart graphic for the process.

What is the purpose of the BMOE staff review panel?
The review panel administers the program for the individual. The participant’s case stays at the staff level and does not go to the full BMOE unless the participant is unable to comply with the MBMP. The review panel consists of the BMOE executive director and one BMOE board member who will, in effect, “be considered one of the staff” in order to make the recommendation as to whether the individual is eligible for the MBMP.

What are the eligibility requirements for the MBMP?
The MBMP monitors impaired healthcare providers. The potential participant will have undergone an evaluation that demonstrates their inability to practice in one’s health-related profession with reasonable skill and safety due to mental health issues, physical issues, or substance use related disorders (alcohol or drug abuse, dependency, or addiction).

Do I need to enroll in the MBMP if I already participate in a monitoring program administered by my employment or other entity?
You can continue in your current monitoring program without enrolling in the MBMP. However, you must report your participation in any and all monitoring/wellness programs, other than the MBMP, on or before you submit your annual license renewal application. You also need to be aware that the MBMP is the only state BMOE approved confidentially protected program for South Dakota licensees.

I am licensed in another state and am enrolled in that state’s monitoring program. Now I am also licensed in South Dakota where I currently practice. Do I have to enroll in the MBMP, and how do I keep my previous monitoring program informed that I am in compliance?
Yes, you do need enroll in the MBMP as it is the only state BMOE approved monitoring program. The MBMP will then contact your previous monitoring program and send reports regarding your compliance.

Do the BMOE members know who is in the MBMP?
The MBMP participation list is only known to designated BMOE staff and the BMOE investigative review panel. The BMOE members do not know who is in the MBMP except for the one board member who is assigned to the BMOE.
investigative review panel. All monitoring will remain confidential to the BMOE board members as long as the participant is compliant and doing well in the monitoring program.

Does the public know who is in the MBMP?
An individual’s participation in the MBMP is confidential to the public as long as the participant is in compliance with program requirements. The public does not have access to information that would identify participants in the program, except in rare cases where the BMOE staff files formal disciplinary charges against a participant which may include noncompliance with an MBMP contract.

Who administers the MBMP?
The MBMP is administered by BMOE staff and the established review panel pursuant to authority granted by administrative rules promulgated by the BMOE.

What happens when a licensee or applicant self-reports?
The MBMP monitors participants struggling with impairment issues related to substance abuse, mental health issues, or physical disability, and is not a disciplinary program. The MBMP considers a licensee’s or applicant’s self-report to be a positive first step toward bringing a potentially harmful situation under control before their professional reputation is damaged.

The MBMP will gather information and make referrals for evaluation as needed. The MBMP then works with the licensee or applicant to put the required supports in place to ensure the participant is able to continue to practice safely. The majority of individuals participating in the program are actively practicing.

Who evaluates the potential participants?
Potential participants are evaluated depending upon the case history of each individual. Some individuals may self-report or apply to the MBMP after having been involved in the judicial system; for example, a DUI or other incident where evaluations are already available. In other cases, there may be questions as to whether a diagnosis indicative of impairment exists. That individual would be referred to the appropriate evaluator or evaluation team prior to entering the confidential MBMP.

Who treats the participants?
Once a determination of impairment is made and the participant enters the MBMP, the participant chooses a medical and support team. The MBMP participant is an active participant with their medical and support team. As determined by the previously mentioned evaluation recommendations, this team is comprised of a monitoring physician or other healthcare provider; a monitoring therapist, psychologist, or counselor; a work-site monitor, and an aftercare monitor. The medical and support team will be approved by the MBMP.

Is it a good idea to have the licensing board administer the program?
The BMOE has a legal obligation and mission to ensure safe medical practice for the protection of the public who seek professional medical services within the State. The BMOE has promulgated administrative rules that provide a transparent process for the investigation and regulation of medical practice while providing due process rights to applicants and licensees. While the process is transparent, participation remains confidential. Healthcare facilities have immunity when reporting employees to the BMOE staff.

Who is the contact person?
For the convenience of the licensee or applicant, one person on the BMOE staff is designated for contact purposes. Separate and dedicated phones, both mobile and land-line with a toll-free phone number option, are available. A separate and dedicated email is also accessible. A separate and dedicated website is being developed.

Please contact:
Randi Sterling
Medical Board Monitoring Program (MBMP)
Phone: 605-367-7700 | Toll free: 888-340-4371 |
Cell: 605-400-4542
Email: mbmp@state.sd.us

Who answers general questions?
Any general questions should be directed to the BMOE executive director, Margaret Hansen.

Summary
The BMOE has a long history of monitoring its licensees. The BMOE has agreements in place with the monitoring companies, Affinity eHealth and Soberlink to serve the MBMP. The BMOE is continuing to research other regional and national monitoring programs including protocols, processes, budgets, and program services, to identify best practices.
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Your membership is voluntary, and we appreciate it. SDSMA Membership Services works hard to ensure that you have the programs and services you want and need, as well as marketing the association to potential new members. We want to hear from you if you have questions, concerns or ideas on how we can serve you better, or if you know of a potential new member. It’s your association and we’ll work with you to make it the best it can be.

We still haven’t told you about all the benefits of your membership in SDSMA, so stay tuned! If you’d like more information about Membership Services give us a call at 605.336.1965, visit www.sdsm.org, or email membership@sdsm.org. We never take your membership in SDSMA or your input and activism for granted.

“*For Your Benefit*” is the SDSMA’s monthly update on programs and services available to members.

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**Become a Certified Medical Examiner**

Are you interested in performing DOT physicals? Are you concerned about the health and well-being of your patients who are commercial motor vehicle (CMV) drivers? Consider becoming a certified medical examiner.

As of May 21, 2014, CMV drivers must have medical exams performed by a certified medical examiner listed on the National Registry of Certified Medical Examiners (NRCME). The South Dakota State Medical Association (SDSMA) is prepared to assist in the certification process. The SDSMA is a registered NRCME training provider for healthcare professionals seeking to be listed on the National Registry website. SDSMA’s online training course is designed to meet the core curriculum requirements for medical examiners according to the Federal Motor Carrier Safety Administration.

This training can be completed with no travel, no classroom time, and no time away from work or home. Designed for busy healthcare professionals, our course is 100 percent online. This training has a 99 percent pass rate for the national exam. To register or learn more visit https://sdsm.essentialeducationwebinarnetwork.com/.

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**Keep Your Information Up-to-Date: Log on Today**

In order for the SDSMA office to provide members with timely information, it is important that members regularly review their contact information on file with the SDSMA. Have you changed practice locations? Is your email correct? Is your mail going to the right place?

All SDSMA members have an existing online profile. Visit www.sdsm.org and log into your secure online account. Next, access your profile by clicking the “Update my Profile” link at the top of the page.

Please take a few minutes to review your profile and make any necessary updates. Updating your secure account keeps your information up to date and notifies the SDSMA of any changes so you are accurately listed in the member directory and ensures that your membership materials, emails and renewal notices are sent to the appropriate mailing and email addresses.

Do you have a new photo? Updated photos can be uploaded to your user account or emailed to membership@sdsm.org.
Legal Brief Highlight: Immunization Requirements

Prior to admission to daycare, school, or early childhood programs, children must receive the minimum immunizations recommended by the South Dakota Department of Health (SDDOH).

The child’s parent or guardian must provide documentation of the immunizations. Similar requirements have been established by the state of South Dakota with regard to immunizations of postsecondary students and individuals who are developmentally disabled entering an institution. Additionally, in some circumstances, nursing facilities and assisted living facilities must provide influenza vaccinations and pneumococcal disease immunizations.

The immunization requirements have limited exceptions. Immunization records may be shared among a variety of entities unless the patient specifically refuses to release the information. The provider is required to notify the patient or a minor patient’s parent or guardian in writing of their right to refuse to permit the sharing of immunization information. The required immunizations are subject to change and the SDDOH should be consulted with questions concerning the most recent immunization requirements at 605.773.3361 or http://doh.sd.gov/Immunize/default.aspx.

More information is available in the SDSMA legal brief Immunization Requirements at www.sdsma.org. Through the SDSMA Center for Physician Resources, the SDSMA has developed more than 50 legal briefs that are available to members. In addition, the Center develops and delivers programs for members in the areas of practice management, leadership and health and wellness.

SSOM Class of 2021

Seventy-one students are enrolled in this year’s incoming class at the University of South Dakota Sanford School of Medicine, two of whom are pursuing an MD-PhD. Eighty-two percent are or have been residents of South Dakota. The remainder come from Colorado, Iowa, Nebraska and Minnesota.

SDSMA President Robert E. Van Demark, MD, spoke to medical students about SDSMA membership and opportunities for involvement at student orientation and led the Affirmation of the Physician at the White Coat Ceremony July 19 at the Sanford Pentagon in Sioux Falls.

Four-year student memberships to the SDSMA are sponsored by member physicians. If you would like a sponsor a student in next year’s incoming class, email membership@sdsma.org or contact the SDSMA office at 605.336.1965.

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