Students-led demonstrations on March 24th in towns and cities across the nation seek to rally support for increasing gun control and school safety. Pediatricians, parents and teachers are joining the cause.

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New Jersey Pediatrics is published quarterly by NJAAP. For information about the publication including article submissions and advertising opportunities, please contact Michael Weinstein at mwstein@njaap.org or by phone at (609) 631-5687

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Looking Towards the Future

While writing my column for the Spring edition of *New Jersey Pediatrics,* I found myself reflecting on the last few months and contemplating what the future holds for the healthcare professionals charged with caring for infants, children, adolescents and young adults and their families in the weeks, months, years and decades ahead.

As a group, physicians are in a unique position to help shape the future—the future of our local communities and the world around us. Pediatricians are an extension of each of our families, providing reliable, compassionate, and expert care as well as reassurance to those facing the unknown, helping to lead them to a better place.

In the aftermath of three big hurricanes in the Fall of 2017—Harvey, Irma and Maria, we witnessed widespread death and destruction in Texas, Florida, Puerto Rico and the U.S. Virgin Island dramatic shifts in weather produced unprecedented flooding and drought. Early December spawned what has emerged as the harshest flu outbreak in a decade. As I write this column, nearly 100 children have died and while we may be seeing the beginning of a slowdown in new influenza cases, flu is still active in most states.

While adult deaths are not reported, flu deaths in children are because they are nationally notifiable, meaning that individual flu deaths must be reported to the Centers for Disease Control and Prevention. States report flu-related child deaths in the United States to: [www.cdc.gov/flu/weekly/overview.htm](http://www.cdc.gov/flu/weekly/overview.htm).

On the afternoon of February 14, 2018, a mass shooting occurred at Marjory Stoneman Douglas High School in Parkland, Florida. Seventeen people were killed and fourteen more were transported to hospitals, making it one of the world's deadliest school massacres. Thus far in 2018, there have been 18 school shootings. Since the December 14, 2012 school shooting in Sandy Hook Elementary School that left 20 1st graders and six adults killed by assault rifle, there have been at least 239 school shootings nationwide. In those episodes 438 people were shot, 138 of whom were killed.

What can we do? Pediatricians can play an important role in serving as expert advisors to local, state, and federal agencies and committees on disaster and terrorism preparedness. We can work to advance meaningful legislation to keep children safe from violence. To begin, I encourage each of you to familiarize yourselves with the AAP Disaster Preparedness Kit. Download it from [www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Children-and-Disasters/Pages/Pediatric-Preparedness-Resource-Kit.aspx](http://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Children-and-Disasters/Pages/Pediatric-Preparedness-Resource-Kit.aspx)

Now as we move toward warmer weather, our focus will turn towards important springtime issues including: sports-related injuries (see our CME activity on Concussions), counseling families on asthma and allergies, continuation of strong and clear recommendations for immunizations and their efficacy in preventing diseases, screening and providing anticipatory guidance to families to lessen the high numbers of Child Abuse and Neglect Fatalities, which in the US averages 1500 yearly. In these and other areas, I urge each of you to get involved and stay engaged.

Your New Jersey Chapter, American Academy of Pediatrics provides each of you with a platform to find and express your passion, but first, you need to step forward. You need to take the plunge. You need to advocate and let your voices be heard. Here are just a few ways to get started.

- On March 15, we will host our Resident Career Day.
- On April 25, New Jersey's healthcare professionals and advocates come together for an evening celebrating five honorees whose care, support and advocacy have made a genuine difference in the lives of children and families in New Jersey. I urge each of you reading this to attend and to meet the honorees, network with colleagues, participate in the Tricky Tray and enjoy a wonderful meal in the company of others like you who are dedicated to improving the health and well being of children, their families and the healthcare professionals that care for them in the state of New Jersey.
- On May 22-23 we will hold our 2018 Annual Conference & Exhibition: *Restock Your Pediatric Toolbox.* We have assembled nationally recognized speakers, commenting and lecturing on time relevant topics and the opportunity to secure MOC part 2 credits.
- On October 17, 2018 we will co-host with New Jersey State School Nurses Association our School Health Conference with a variety of educational sessions including practical learning, and networking. In addition, we continue to hold webinars on a variety of topics throughout the year.

I encourage each of you to remain a strong voice for your patients, their families and your colleagues.
Children need and deserve to feel safe. What can we do to protect our children? As with so many others across the country, our hearts ache for the families and friends of the children and teachers killed in the Marjory Stoneman Douglas High School in Parkland, Florida.

A movement, spearheaded by the courageous young survivors, is spawning passionate pleas for change. On March 24th, these intrepid youths will take to the streets in Washington DC (and sister communities across the country) to participate in the March for Our Lives, demanding action to end gun violence in our schools.

When children and families speak out, and their pediatricians stand behind them, it is impactful. Watch for NJAAP updates to keep informed on opportunities to become engaged in the March 24th event. Don’t do marches? Perhaps partner with youth to speak out to legislators, message your support via social media, or write letters to the editor. AAP is pursuing policy change for the following at both the state and federal levels:

- **Stronger gun laws.** Enactment of common-sense firearm legislation, including stronger background checks, banning assault weapons, addressing firearm trafficking, and encouraging safe firearm storage.
- **Opposing legislation to weaken current gun laws.** Federal legislation to force all states to accept concealed carry permits from other states would undermine the laws of states with strong requirements for concealed carry.
- **Violence prevention programs.** Support for programs addressing the needs of at-risk children and children exposed to violence.

**Research.** Funding for gun violence prevention research and public health surveillance.

**Physician counseling.** Protecting the crucial role of physicians in providing anticipatory guidance to patients about the health hazards of firearms.

**Mental health access.** Ensuring children and their families have access to appropriate mental health services, particularly to address the effects of exposure to violence.

The updated NJAAP Agenda for Children 2018-2020 (www.njaap.org) highlights the Chapter’s priorities. The Agenda, which is shared with all NJ State legislators and partners, continues to be a significant tool for proactively influencing the legislation and policies that impact children’s well-being and support the pediatricians and pediatric health teams providing their care. A special thank you to our Government Affairs Committee, staff, and our advocates from Public Strategies Impact (PSI).

**Need copies of the NJAAP Agenda for Children to share when you visit legislators in your district? Contact us and we’ll send them to you.**

It’s hard to touch on the topic of advancing common sense gun laws without also addressing the critical importance of increasing access to mental health services.

- Forty percent of children ages 10-14 years old who commit suicide do so with a gun found in their home.
- Healthy, well-adjusted children and young adults aren’t mass shooters.

Early identification of mental and behavioral health issues in children and connecting them to resources is an integral part of prevention and population-based care.

continued on page 5
Medical Director’s Column: NJAAP Comes of Age

Steven Kairys, MD, MPH, FAAP
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Jersey Shore University Medical Center
Medical Director, K. Hovnanian Children's Hospital

Having been Medical Director of NJAAP for over 16 years, it has been such a pleasure to see it become such a force for children and for pediatricians.

Sixteen years ago, NJAAP had an active board of directors that worked hard for children, but their voices were little more than whispers from down the lane. In addition, most pediatricians in the state had little idea about the Chapter’s work and saw it as superfluous and not worth the yearly membership fee. The legislature and the state agencies viewed the Chapter as being well meaning, but was largely ineffective in influencing any day-to-day decision making. We argued with the managed care companies and had a small project designed to help child day care nurses improve their child health skills. In fact, the Pediatric Council on Research and Education (PCORE) was a legal action designed to enable NJAAP to accept federal dollars for that child care project.

Outside of the five or six pediatricians on the board, there were few volunteers from the rest of the state. Management saw its role as scheduling and arranging the basic conferences and meetings. There were two part-time employees.

Fast forward to 2018. NJAAP’s work touches nearly every pediatrician in the state, through conferences, email, webinars, MOC, toolkits, partnering for improved mental health services, pursuing patient-centered medical home, advocating for pediatrician reimbursement, malpractice rate reductions, or helping with individual crises and problems.

NJAAP is a relevant and active partner in improving the lives of children and families in NJ.

And perhaps most important of all, it is team effort that continues to grow. Hundreds of pediatricians are currently active on committees, publications, projects, advocacy and government legislating, on changes to managed care, immunization and prevention. They are volunteering their time and their passion to improve care for children. They are the real voice of the Chapter and the growing strength in numbers is surely being felt at every level of state government. In fact, state government now seeks out NJAAP for its programs and its mission.

In a state where child health has always seemed a little backwater—a side stream of the main shows in Philadelphia and New York — it is rewarding to see the side stream become its own water source.

The reach of the Chapter continues to expand beyond its customary borders of traditional health care. Initiatives in immigrant advocacy, sexual and gender identity, human trafficking, bullying and mental health, and now guns and even climate change demonstrate the Chapter's willingness to put work and effort into the social determinants that feed so much of the misery confronting children in our society.

The Agenda for Children continues to grow and the Chapter has shown tremendous capacity to expand its reach.

The second major driver has been the staff and leadership. The staff is now a seasoned crew of child health leaders capable of independent advocacy and grant writing. And Fran Gallagher continues to develop new approaches to advocacy, networking, and organizational maturation.

NJAAP is relevant.

Are you one of the 400+ NJ pediatricians who are registered with the Pediatric Psychiatry Collaborative’s Regional Hubs across NJ and have access to a Child and Adolescent Psychiatrist, Psychologists and LCSW’s on behalf of your patients? It’s now available statewide and at no cost to the pediatrician or the child/family. The Hubs are funded by the NJ Department of Children and Families. Check www.njaap.org for full details.

April 25th marks the eighth Annual Children’s Ball and I hope you will join us. Held at The Palace in Somerset, this year event shines a Spotlight on Children and awards Pediatrician of the Year to Jeff Bienstock, MD, FAAP, for his decades of leadership, dedicated efforts, and innovative approaches here in NJ and across the globe. Additionally, the event acknowledges Champions for Children: Assemblywoman, Pamela Lampitt and Congressman, Frank Pallone and this year’s Youth Achievement Award winner, Stephanie Reifman for her amazing accomplishments on H.A.P.P.Y. Week.

You will want to be certain to register for this year’s Annual Conference & Exhibition too—come Re-stock your Pediatric Toolbox with over 200 pediatricians and 50+ exhibits. New for 2018, we will begin on May 22 with a two-hour workshop followed by a cocktail reception; on May 23rd there are exceptional speakers for plenary and workshop options. Visit the website for details and be sure to visit often as we keep it updated with new resources and key information. Look forward to seeing you at our Spring events!

Kind Regards,
The world of sports related concussion (SRC), is an evolving area of interest and research that presents pediatricians with a morass of new recommendations and annual updates. Staying informed on the emerging recommendations and the science behind them can be challenging. While our understanding of SRC has grown, there is still so much more that is neither fully known nor completely understood. Therefore, the constant dissemination of new information continues to be released. The goal of this article is to help shed some light on where we stand today and provide insight as to what is coming down the pike.

The Evolution of Concussion Diagnosis

Concussion is no longer a graded injury diagnostically. Loss of consciousness (LOC) is NOT associated with ninety percent of concussions. Additionally, scaling concussions in an attempt to try to predict one’s recovery time is no longer performed. We now recognize the importance of diagnosis and treating concussions on an individual basis. Mild traumatic brain injury (mTBI) became the favored term, but even now the validity of that particular description is being questioned. The average recovery time for concussion is up to 4 weeks. Researchers are looking into the commonalities of symptoms or situational events that might cause one’s symptoms to be prolonged beyond those four weeks in a post concussion syndrome.2-5

Recent Literature Findings

Pathophysiology

Considerable research has been, and continues to study, the underlying pathophysiology of concussion, in an attempt to gain a clearer understanding at the cellular level. We know that a concussion is not routinely associated with structural brain injury, at least not that can be seen with a standard MRI or CT scan. Rather, the dysfunction occurs at the level of cell membranes, ion flux and neurotransmitters along with mismatched energy demands, lactic acidosis and oxidative stress. All of this, plus decreased cerebral blood flow, shifts in arterial CO2 and altered vasoreactivity to the injured area, combine to create the symptom profile known to many patients and physicians alike.1,6,7

More recent areas of research are focused on micro-structural disturbances, including but not limited to, axonal, cytoskeleton and myelin damage. Also, the role of the neuroinflammatory response and its possible role in chronic neurocognitive and degenerative changes over time, has been a significant area of interest.1,8 Are these changes only related to diagnosed concussions or do repetitive sub-concussive blows also set these cascades into motion? Scientific researchers are looking at commonalities between TBI, chronic neurodegenerative conditions and the precursors to these diseases to determine if common substrates and pathways exist. Investigating these pathways may prove crucial to finding objective monitoring, interventional strategies and treatments.1,6

Clinical Facts

Categorically speaking, you can think of concussion as grossly affecting four main areas, each of which will then explain a myriad of sub-symptoms. These four areas include:

- changes to the autonomic nervous system
- vestibular oculomotor dysfunction
- cognitive changes and
- emotional disturbances.9

These four do not stand on their own, but have a large degree of overlap and symptom severity that will vary from patient to patient and throughout the clinical course- making these scores and scales very fluid and mobile.
Clinical Course: “When in Doubt, Sit Them Out”

1. Hold all children with a possible concussion out from play.
2. Have them see a healthcare provider immediately. Primary care doctor is recommended. If ED or UC first, follow-up with your PCP shortly thereafter.
3. Brain rest for the first few days than back in the saddle. Develop good sleep hygiene going forward.
4. Return to school with academic accommodations. Provide a detailed letter to schools.
5. Begin aerobic rehabilitation. This is light sub-aerobic threshold activity. No ball sports and verify that it is non-contact.
6. Start other therapies if necessary: vestibular, vision, cognitive, mental health, etc.
7. Neurocognitive (ImPACT) testing once symptom free. (helps to compare to baseline)
8. Complete the return to play protocol (RTP).
9. Resume all possible contact sports only once cleared by a physician.

The clinical course can sometimes feel like Pandora’s box opening up with a vast array of symptoms, complaints and frustrations. Take time to understand where the student is coming from and individualize the care to his/her needs. Understand and empathize with the burden of going to school, a provocative array of stressors and cognitive irritants, as well as the emotions of losing their participation in sports, at least in a formal fashion. And finally, educate and counsel so the family knows that you are there during their child’s time of need.

Not only is the doctor-patient-family dynamic crucial, but so is the relationship or infrastructure you develop with the school system. Make clear and plausible recommendations to the schools. Try to curtail the needs to the student, e.g. some students have more difficulty with photosensitivity and screen time; take that into consideration, especially in this very technology-savvy age. Using pre-printed notes, glasses that reduce screen glare and more verbal instruction can be instrumental in allowing the student to succeed day to day.

Modify activities, but get the students moving again with sub-aerobic activity. The RTP should not begin until symptoms have ceased, he/she is tolerating a reasonable academic load and has passed expectations on neurocognitive testing, if age appropriate.

Finally, as the patient improves, open up the discussion on the risks and benefits with sports. Discuss that increasing numbers of concussions throughout one’s lifetime can have consequences, even though we do not know the extent, if any.

As a physician, look at the amount of time it takes a patient to heal, the amount of force needed to generate a concussion and the chronological time frame of injury or injuries. Does the patient need to sit out the remainder of the season or full year? Does the patient need to try other sports with reduced risk?

There is no ‘one-way fits all’ road map for these tough situations. As clinicians, not every conversation is easy and straight forward, but it is our role to educate and guide families with evidence based care.

When Things Are Not Improving:

- Subspecialty Referrals - Sports medicine for specialized concussion care or to neurology if persistent headaches with concern for migraines. Consider counseling/mental health services if there is an emotional component to symptoms.
- Consider expansive neuropsychological testing if necessary, especially if prolonged academic issues.

Active/Aerobic Rehabilitation

John Leddy and his colleagues within the Department of Orthopedics and Sports Medicine at SUNY Buffalo have been very influential in the arena of concussion rehabilitation. Strict brain rest till such time that the symptoms completely abate is no longer recommended. Sub-threshold aerobic level exercise, which improves cerebral blood flow, has been very effective and safe for the treatment of concussions and post concussion syndrome—both in clinical studies and following fMRI studies. The Buffalo Concussion Treadmill Test (BCTT), based on the Balke cardiac protocol, varies the intensity each minute of the test by increasing the incline grade. The endpoint for this exercise test is symptom exacerbation or 20 minutes, whichever comes first.

Physical Therapy (PT)/Vestibulo-Ocular (VO) therapy/Vision therapy

Remember, associated neck pain, spasm and whiplash-type pathology can be a leading cause of cervicogenic headaches and must be addressed and treated. This should be included in your PT referral prescription. Certified PT’s, who also specialize in concussion and VO therapy, can incorporate musculoskeletal (MSK) work into their PT plan of care.
CME from page 7

Cullen KE et al describes the vestibular system as a “...complex network that includes the inner ear, brainstem, cerebellum, cerebral cortex, ocular system and postural muscles.” Injuries to these systems, along with ocular dysfunction in saccadic motion, convergence and accommodative insufficiency, can drive a host of unwanted symptoms ranging from: balance issues, reading problems, poor comprehension, photosensitivity, screen intolerance, and motion sickness to name a few. Having associated VD dysfunction with concussion is common and can be seen in upwards of 81% of patients with post concussion syndrome. Neuro-opthalmic pathways are particularly vulnerable to concussion, so screening patients for these disorders should be part of all concussion evaluations. If further visual issues linger, specifically saccadic dysfunction, accommodative deficits and convergence insufficiency, even after vestibular therapy, consider a referral to a developmental optometrist.

How Many Concussions Are “Too Many?”

Sub-concusive blows and the consequences they may have are also the focus of recent research. There are concerns that the more hits a patient takes, the more likely they will experience related issues later in life. Chronic traumatic encephalopathy (CTE), neurodegenerative, neuroinflammatory, and mood disorders are on the minds of all those who treat concussions. The potential benefits of eliminating contact when possible is gaining increased traction, even moving some universities to decrease the number of contact practices. The application of sensors to helmets to try to quantify the forces sustained by athletes is just one more example of initiatives underway, but additional research studies are needed.

For the time being, we must continue to educate and implement safe strategies to ensure patients are fully recovered before suiting up for practice and prematurely risking additional injury. Multiple concussions should warrant a doctor-patient-family discussion as to the risks and benefits of continued play. Given the evolving nature of the evidence, such a partnership can help assure that smart choices are being made for the long-term benefits of the patient.

References


CME Quiz on page 9
CME Quiz

1. Loss of consciousness takes place in approximately 90% of all concussions.
   a. True  b. False

2. Scaling concussion is the accepted method for predicting a patient’s recovery time.
   a. True  b. False

3. Recent SRC research has focused which of the following micro-structural disturbance?
   a. Axonal
   b. Myelin
   c. Cytoskeleton
   d. All the above

4. Which of the following is not one of the four main areas affected by concussion?
   a. Vestibular oculomotor dysfunction
   b. Cognitive changes
   c. Neurodegeneration
   d. Emotional disturbance

5. In cases where prolonged academic issue surface, the pediatrician should:
   a. Refer patient for neuropsychological testing
   b. Refer patient for vision testing
   c. Prescribe migraine medication
   d. Examine sleep hygiene

6. The current recommendation for guiding SRC rehabilitation is strict brain rest.
   a. True  b. False

7. A leading cause of cervicogenic headaches include:
   a. Spasm
   b. Neck pain
   c. Whiplash-type pathology
   d. All the above

8. Sub-threshold aerobic level exercise has been very effective and safe for the treatment of concussions and post concussion syndrome.
   a. True  b. False

9. The endpoint for the Buffalo Concussion Treadmill Test is symptom exacerbation or 20 minutes, whichever comes first.
   a. True  b. False

10. Based on evolving evidence, multiple concussions to a patient should result in:
    a. Cessation of all sports activity
    b. Provider-Family risk/benefit conversation
    c. Development of a return to play care plan
    d. Purchase of safer sports equipment

CME Instructions

Read the CME-designated article and answer the Spring 2018 issue, quiz questions above. Print your name and phone number and mail or fax this form within six months from the date of issue to: NJAAP CME Quiz, 50 Millstone Road, Building 200, Suite 130, East Windsor, NJ 08520 Fax: 609.842.0015

NAME ______________________________ PHONE ______________________________

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Submitter must answer 8 of the 10 questions correctly to qualify for CME credit

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Legal Update: What to Expect—and Mistakes to Avoid—in 2018

Guillermo J. Beades, Esq
Frier Levit Attorneys at Law

In 2017, pediatricians in New Jersey saw an increase in private payor audits and in some instances, were heavily scrutinized and penalized by the Vaccines for Children (VFC) program. These added stresses, which pose direct threats to a practice’s bottom-line, were in addition to the continual assaults on vaccinations and other matters unique to the practice of pediatrics.

The increased auditing from private payors and New Jersey Medicaid, along with the VFC enforcement actions compelled some practices to close their doors and moved some pediatricians to abandon the solo practitioner/small practice business model. However, this is not to say that pediatricians should abandon hope or even that the future of pediatrics is bleak. Rather, 2017 should be viewed as an opportunity for helping pediatricians learn to avoid past mistakes.

Looking forward, pediatricians and pediatric practices should be prepared to address the following issues in 2018.

Audits. They are Here to Stay

Insurers routinely audit providers for one simple reason: they work. Post-payment audits are the most common audits and the increase in use in 2017 was a direct result of their success. 2018 is likely to see the continued use of audits, particularly in pediatrics.

Small practices are the most at risk since they do not have internal billing departments with certified professional coders and billing experts, who can properly code, review documentation and bill. Some small practices unwittingly submit bills with the wrong CPT code that is suggested by the electronic medical records system, and without conferring with the AMA’s CPT Manual. These practices, if audited, can find themselves on the wrong side of a large overpayment demand.

Large and busy practices are at risk for a different reason. These practices tend to bill certain codes more frequently than their peers due to their size or volume of business. Often labeled as “outliers,” these practices are targeted for both pre and post-payment audits.

Whether you get audited is somewhat out of your control. However, with a proper compliance plan, self-audits and proper training of billing staff, you can avoid being penalized with a large overpayment demand or potential fraud action.

VFC Issues

The New Jersey Department of Health (DOH) dedicated considerable efforts in 2017 towards the VFC program. Expired medications, failure to keep proper temperature logs, failure to track medications on the NJIIS / NJMODS systems, failure to note lot numbers and other violations resulted in pediatricians being suspended from the program and ordered to pay restitution. In cases of more serious violations, some pediatricians were kicked out of the program altogether, ordered to pay a large restitution and referred to both the Medicaid Fraud Division and the Board of Medical Examiners.

DOH has been interpreting the rules of the VFC program without deference to years of compliance, positive outcomes or any goodwill a practice may have accumulated over numerous years. In the eyes of the DOH, the VFC rules are black-and-white and their punishment for even slight deviations are met with draconian punishments.

In 2018, pediatric practices with considerable Medicaid patient populations should be alert, but not frightened, by the VFC. The VFC program has set rules and procedures that are straightforward and accessible to all practices. Almost every VFC action taken in the past year has been preventable, and typically, the result of some carelessness on the part of the practice’s VFC coordinator or staff who failed to abide by a rule, such as keeping temperature logs.

Solo Practitioners & Small Practices Seeking New Business Models

Decreasing reimbursements, increasing overhead costs and the aggressive expansions of hospitals and multi-disciplinary practices have impacted the number of solo practitioners over the past 10 years. According to one AMA study, in 2008 solo practitioners made up nearly 25% of all practices, down from 30% in 1994 and 40% in 1984. Now, it is estimated that less than 17% of physician practices are solo practices. Small practices have not seen a similar reduction, but in recent years, they have been the target of hospitals and large practices looking to expand geographically or into a specific field, such as pediatrics.

While selling your practice or forming a super group may be an attractive alternative, they may not always be in your best interest. Before selling, first consider all the options and compare them to your long-term goals to determine the best choices for you. There are many factors that should be considered prior making a decision to sell your practice to a hospital or group. Although unwinding your practice from a hospital may be possible, it comes at a great cost and may have unintended consequences.

Contact a healthcare attorney who specializes in these types of transactions to help you determine if selling your practice or becoming a member of a super group, is in your best interests. There is no one-size-fits-all answer to this question, so what works for someone else, may not work for you.

The decline of solo practitioners and small practices does not equate to the demise of them, only the need to rethink and possibly restructure the business side of your medical practice.

In summary, while 2017 was full of challenges, the good news is that avoiding them in 2018 is possible, if you remain alert and informed.
Philip D. Murphy was sworn in as New Jersey’s 56th Governor and Sheila Oliver was sworn in as New Jersey’s second Lieutenant Governor on January 16, 2018. Governor Murphy has appointed new Commissioners of the Departments of Health, Human Services and Children and Families. The Senate must confirm all three appointments.

Governor Murphy nominated Dr. Shareef Elnahal to serve as Commissioner of Health. Prior to leading the Department, Dr. Elnahal worked as a physician executive in the United States Department of Veterans Affairs, serving as the Assistant Deputy Under Secretary for Health for Quality, Safety, and Value in the Veterans Health Administration. He was also an adjunct assistant professor at the Georgetown University Department of Health Policy and Management.

Carole Johnson was nominated to be Commissioner of the Department of Human Services. She previously served in the Obama White House as senior health policy advisor and member of the Domestic Policy Council health team. The Commissioner-designate also has served on Capitol Hill working for the U.S. Senate Special Committee on Aging and for members of the U.S. Senate Finance Committee and U.S. House of Representatives Ways and Means Committee. In addition, she managed health care workforce policy issues for the U.S. Department of Health and Human Services Health Resources and Services Administration.

Christine Norbut Beyer, Murphy’s choice to lead the Department of Children and Families, previously served as an assistant commissioner at the department. At the time of her appointment, she was working as a senior director at the national child advocacy group Casey Family Programs, a position she held for the past six years.

The 2018th Legislature was sworn in on January 9, 2018. As was previously reported, the Senate President continues to be Senator Sweeney and the new Assembly Speaker is Craig Coughlin. The Assembly Committee on Women and Children has a new Chair, Assemblywoman Gabriela Mosquera and the Assembly Human Services Committee also has a new chair, Assemblywoman Joann Downey. The Senate Health, Human Services and Senior Citizen Committee continues to be chaired by Senator Joseph Vitale.

Senator Vitale has said that the committee will focus attention on the issues of maternal and infant mortality and those issues were discussed at one of the first committee meetings. Following the discussion at a subsequent committee meeting, legislation requires the Commissioner of Health to gather and compile information necessary to develop a New Jersey Report Card of Hospital Maternity Care. Legislation also requires a Child Fatality and Near Fatality Review Board to study racial and ethnic disparities that contribute to infant mortality.

The Assembly Women and Children’s Committee began the issue focusing on child trafficking issues and released legislation establishing Child Trafficking Awareness Pilot Program in DOE to train school district staff about warning signs and how to prevent child trafficking.

The Senate Education Committee released a package of bills dealing with child hunger, including legislation that requires a “breakfast after the bell” program in all schools with 70% or more of students eligible for free or reduced price meals and expands summer meal program to all school districts with 50 percent or more of students eligible for free or reduced price meals.

Finally, we expect that the legalization of recreational marijuana will be one of the legislative issues considered this spring. Governor Murphy has indicated support for legalization and the Chairman of the Senate Judiciary Committee, Senator Scutari has introduced legislation that would legalize the possession and personal use of small amounts of marijuana for persons age 21 and over. Senator Rice has introduced legislation that decriminalizes possession of 10 grams or less of marijuana and personal-use amount of regulated marijuana-infused products.

Assembly Judiciary Committee Advances 6-BILLS for Reducing Gun Violence in NJ
A-1181 (Jones/Mosquera/Sumter/Downey/Barclay)—Requires firearms seizure when certain health care professional determines patient poses threat of harm to self or others
A-1217 (McKeon)—Extreme Risk Protective Order Act of 2018
A-2761 (Greenwald)—Reduces maximum capacity of ammunition magazines to 10 rounds; exempts firearms with .22 caliber tubular magazines from 10 round limitation
A-2757 (Greenwald/Holley)—Requires background check for private gun sales
A-2758 (Greenwald)—Codifies regulations defining justifiable need to carry handgun
A-2759 (Greenwald/Murphy)—Prohibits possession of ammunition capable of penetrating body armor
In December 2017, a New Jersey Climate and Health Profile Report was prepared and released by Rutgers University in consultation with the New Jersey Climate Adaptation Alliance. The report provides a framework to utilize existing data, epidemiological studies, and models of weather patterns to assess the future public health burden from climate risks and lays the foundation for developing best practices for adaptation.

**The science is clear: New Jersey’s climate is changing.** There has been a long-term upward trend of 2.7 °F per century (NCEI 2016). The statewide average temperature for New Jersey in 2012 was the highest in 118 years of records. Nine of the ten warmest calendar years on record have occurred since 1990 and the five warmest years have occurred since 1998, consistent with the long-term upward trend (Broccoli et al. 2013). Unusual summertime warmth has also been a marked impact, with nine of the 15 warmest summers on record occurring since 1999 (Robinson 2016). The summer of 2010 was the warmest on record since statewide record keeping began in 1895; three of four warmest summers on record for New Jersey have occurred since 2010 (Robinson 2016). There has also been an upward trend in annual precipitation and the sea level in New Jersey is rising.

**Continued changes in climate have the potential to dramatically affect population health.** Direct impacts may include an increased rate of heat-related morbidity and mortality as a result of extreme exposures like heatwaves, while indirect impacts of a heatwave might include changes in the pattern of infectious diseases and fluctuation in water flows and food yields. The most recent research issued by the United States Global Climate Change Research Program (USGCRP 2016), *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, concludes that climate change is a “significant threat” to the health of Americans and the report serves as a critically important assessment and culmination of current science to inform ongoing collaborative efforts in New Jersey (USGCRP 2016).

In terms of hazards, we face air quality changes; extreme heat; precipitation changes and storms; ecosystem changes and threats.

The climate impacts will include: increased ground-level ozone; fine particulate matter changes; pollen and allergen production; increased frequency and intensity of heat waves; flooding; storms; drought; wildfire; changes in disease vector reproduction and migration patterns.

Health impacts will likely include: respiratory illnesses; cardiovascular disease; mortality; heat-related illness and mortality; exacerbation of existing medical conditions; greater stress on electricity systems potentially leading to health outcomes associated with power outages; injuries and fatalities; CO2 poisoning; food and water contamination; stress and mental health impacts; respiratory illnesses; mold exposure; food insecurity; vector borne illnesses; food and water borne illnesses; and harmful algae blooms.

Despite the daunting list of potential climate and health impacts, the most effective and efficient approach to protect the public health of New Jerseyans from changing climate conditions is to **build consideration of changing climate conditions and the anticipated impact and consequences of those conditions into existing public health programs and systems**, rather than creating a new overlay of initiatives on top of existing public health programs and services. Particular attention must be given to ensure that such an approach will be sufficiently protective of the populations and communities that are most vulnerable to changing climate conditions.

The Climate and Health Profile Report identified a five-part framework to strategically focus its efforts moving forward, in recognition that advancing these efforts is dependent on a collaborative approach among public health practitioners, state and local decision makers, the research community, healthcare providers, and the nongovernmental community. Overall, success in advancing this framework will be measured by the extent to which changing climate conditions, and the resulting impacts from those conditions, are fully integrated into planning, decision making and delivery of public health programs, policies and services statewide. The report recommends:

**ACT**
- Implement specific actions that have already been identified as important to minimize public health risks from changing climate conditions.
- Identify specific communities and populations most vulnerable to changing climate conditions and work in consultation with those populations and communities to design interventions that prioritize their needs.

**PLAN**
- Integrate climate science and projections for changing climate conditions into existing public health programs and decision-making, including the State Health Improvement Plan and community health planning conducted by counties and health care systems.
• Consider the public health impacts of climate change as part of state and local planning and decision-making such as infrastructure investment, land use planning and community development.

ASSESS
• Through data analysis and community engagement, assess disease burden resulting from changing climate conditions and make the resulting data available to state and local public health practitioners and health systems to inform planning and programs.
• Identify existing public health programs that can be modified to serve as delivery mechanisms for interventions to address health outcomes of changing climate conditions.

SUPPORT
• Develop and assist in the deployment of data, tools and other resources to assist local public health practitioners in implementing interventions to address climate-related health outcomes.
• Provide support to health systems to anticipate how changing climate conditions may affect their own operations and needs of their patients.

BUILD CAPACITY
• Expand the ability of New Jersey’s public health practitioners to undertake interventions to address climate-related public health impacts through training, development of best practices, and information sharing.
• Educate lawmakers and other decision-makers about the impacts of changing climate conditions on public health in New Jersey and about the resources needed by public health practitioners to address those impacts.

Much work remains to be done, but the climate and health report makes clear the scope of our challenge, and lays out a list of actions steps the state and individuals can begin to take. Thankfully, the New Jersey Chapter, American Academy of Pediatrics has already convened a climate change working group, which will be critically important for implementing interventions that address climate-related health outcomes.

To learn more, or get involved with this committee, please contact Bethany Kondavaty at BKondavaty@njaap.org.

Letter to the Editor

In a supposedly developed country like ours with an important and strong heritage of democracy, it is time for reason and responsibility to assert itself! In 2018 it is a sign of serious and irrational paranoia to think that our government is trying to deny the rights of our citizens to arm and protect themselves. On the contrary, the lives of our citizens are seriously and regularly threatened by criminally motivated or mentally ill individuals with guns, especially automatic and semi-automatic rifles, including the AR 15. When the second amendment of our constitution was passed over 200 years ago, the only guns available were flintlocks, which had a cumbersome reloading process. These weapons were barely able to kill even one person. Our forefathers could not have imagined the availability of automatic rifles that had the capability of killing many individuals within a few minutes. For the last 20 years, the threat has been especially poignant for our school children.

The American Academy of Pediatrics (AAP) and all pediatricians have as one of their responsibilities the duty to speak to the protection of children. Now is the time for us to speak up, LOUDLY! Gun control legislation is one important solution for the current, unacceptable situation. The fastest and most effective way to accomplish this is to pass legislation at the federal level. Many rational efforts to accomplish this have been attempted over the past 20 years or so, but each time, rebuffed by selfish and irrational legislators financially supported by the formidable National Rifle Association (NRA).

Perhaps if pediatricians were to lend their leadership and assistance, the needed legislation could be passed. I suggest a straightforward effort to publicly identify and oppose current representatives—and those considering running for office—who accept money from the NRA. This might be a powerful strategy for ensuring the timely passage of rational and common-sense gun control legislation. It is time for each member of NJAAP to aggressively speak out on behalf of all the children before more tragically die. Look for opportunities in your towns to support the March 24th, March for Our Lives events being held in cities and towns across New Jersey and other states. Demonstrate your support of these interpret young people, who are gathering on that day, by joining them with your signs: “Pediatricians support effective gun control and responsible legislators”.

Lawrence D. Frenkel, M.D.
Children’s Advocate
The New Jersey Chapter, American Academy of Pediatrics (NJAAP) is a valued voice on the benefits of quality pediatric healthcare and preschool. Pre-K Our Way, a New Jersey nonprofit and nonpartisan organization, agrees that high-quality pre-k education is a wise investment in the health and education of all children and is an especially wise investment in New Jersey’s 3- and 4-year-olds.

Unfortunately, our state’s nationally recognized high-quality pre-k program is available only in a limited number of school districts.

Every year for the past decade, a new group of 3- and 4-year-olds has been passed over and denied access to NJ’s pre-k. Without access to NJ’s high-quality, full-day pre-k, they’ve also been denied access to the early health interventions that can impact the future—and the future for their families. That’s not right! New Jersey has one of the best, most successful, high-quality public preschool programs in the country. Under a decade-old law, every at-risk 3- and 4-year-old in New Jersey should have access to state-funded, full-day pre-k. However, there are fewer than 65 school districts with it. Under the law, the number should now be in the hundreds—and 50,000 more children, every year.

New Jersey’s school aid formula says much about goals for public education—and children. It is a statement of our commitment to equality, quality and improving educational outcomes. A decade ago, the Legislature and Governor included a provision in the state aid formula to expand New Jersey’s state-funded, high-quality pre-k for more 3- and 4-year-olds in hundreds of communities. There is no more important educational investment than to expand that program to more children – as promised in 2008. New Jersey’s families and communities support pre-k expansion, agree that it is a priority and want it funded as a regular part of school funding.

Governor Murphy and the Legislature have an opportunity to keep a promise made by state law a decade ago. They have an opportunity to make an important investment in our state’s future—an investment that delivers on the decade-old promise of high-quality pre-k to 50,000 of NJ’s 3- and 4-year-olds. These children have been waiting, too patiently, across hundreds of communities in virtually every NJ community.

Pre-K Our Way values NJAAP’s constant support for pre-k expansion, and its frequent participation in local meetings with leaders and residents from numerous communities in support of pre-k. Like NJAAP, Pre-K Our Way believes that pre-k for more 3- and 4-year-olds is an investment that supports good health, and is an investment in New Jersey’s future. Please encourage your patient families, colleagues and community leaders to visit www.prekourway.org to learn more about how to bring high-quality pre-k to hundreds more communities in our state — and to the 50,000 kids waiting each year. Expand NJ’s Pre-K—NOW!
Resident Voice: Treatment and Addiction

Morgan Bowling, DO
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The United States is home to approximately 5% of the world's population yet consumes the vast majority of the world's painkillers. As pediatricians, this crisis affects our patient population in numerous ways. Newborns suffer from Neonatal Abstinence Syndrome. Children can be accidentally poisoned. Teens can develop addiction after breaking an ankle in a lacrosse game or experimenting at a party. As doctors, educators, and advocates, we are charged with both treating and protecting this vulnerable population. To do that, we must return to one of the great pillars of medical education, history is 90% of the diagnosis. In order to fully appreciate today's complex world, we must first understand the history of opioid development, marketing, and overabundance.

6,000 years ago the Sumerians discovered hul gil, the “plant of joy.” Centuries later, a Swedish botanist called it Papaver somniferum, Latin for “sleep inducing”. We know it today as the poppy plant. The seedpod contains a milky white liquid that hardens into opium, containing a myriad of substances, most notably alkaloids like morphine and codeine.

Opium commerce began when Arab merchants brought the drug to China in the 7th century. Twelve hundred years later, opium reached the United States as Chinese laborers sought work in gold mines and railroads, bringing recreational use with them. At the turn of the 19th century, a chemist’s apprentice isolated opium's most active ingredient and named it morphium after the Greek god of dreams, Morpheus. Fifty years later, a Scottish physician developed the hypodermic needle for the purpose of injecting morphine, hypothesizing that if injected rather than ingested, users wouldn't develop such an “appetite” for it. Perhaps unsurprisingly, his wife is allegedly the first person to die from an IV drug overdose.

Over the last 60 years, the role of prescription opioids in addiction has become increasingly more significant. Arthur Sackler, a psychiatrist turned advertiser, reinvented pharmaceutical sales by marketing directly to physicians. In the 1960s, he helped Valium become the industry's first 100 million dollar drug, which later spurred a highly successful OxyContin marketing campaign. While these medicines can be safe when used appropriately, the flooding of the market undoubtedly led to drug diversion. In 1986, Russel Portenoy, a young pain specialist from New York, published an article in the journal Pain imploring doctors to move past their opiophobia. This article came in the wake of the palliative care movement following Cicely Saunders' hospice work in London during the 1960s. Pain was to be taken seriously and Dr. James Campbell, then President of the American Pain Society, urged it to be considered the 5th Vital Sign.

The non-addictive painkiller has been referred to as the Holy Grail. The quest for this elusive cure-all and its powerful and potentially devastating effects have driven society to a precipice, with politics, medicine, industry, law enforcement, education and religion coalescing around it. In 2010 unintentional drug poisoning surpassed motor vehicle accidents as the leading cause of injury death in the US. Between 2006 and 2012, more than 22,000 children were treated in US EDs for opioid poisoning. Nearly 1 in 4 high school seniors in the US have some lifetime exposure to prescription opioids, either medically or non-medically. The statistics are endless. But what does this all mean for today's practicing physicians?

In the midst of this public health crisis, we as physicians still know the important role opioids play in treating patients. As a pediatric resident, the sickle cell population immediately comes to mind as an important subset of patients who benefit from these potent drugs. So how do we balance the need to treat pain with the understanding that the cure may also be a curse?

First, do no harm. As pediatricians in training, we’ve dedicated ourselves to learning the art of this oath. But an innate conflict exists between alleviating our patients’ pain and mitigating the public health crisis that our profession helped foster. As the next generation of physicians, we must utilize the myriad of resources that are being offered, including prescription drug monitoring programs, AAP courses on pain management, CDC prescribing guidelines, and symposiums with organizations such as Partnership for a Drug-Free New Jersey. Despite these resources, the practice of medicine remains an art and ultimately, we must rely on our clinical judgement when prescribing controlled substances. With opioids, a well-intended treatment could become a debilitating addiction or premature death for an otherwise-healthy child. As residents training amidst one of healthcare’s greatest crises, it seems imperative that we think critically and creatively when balancing the health of not only our patients but also our society.

References
Effects of Levels of Permissive Hypercapnia on Duration of Ventilation and Short-Term Morbidities in Preterm Neonates

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Background:

Preterm birth continues to be the most common cause of infant mortality in the first month of life worldwide (Liu et al., 2012). In the world, approximately 15 million babies are born prematurely each year (5% to 18% of all deliveries) (Christopher Howson, 2013). Advances in prenatal, perinatal and neonatal care have improved survival of extremely low birth weight infants (Fanaroff et al., 2007). Prematurity, however, continues to be associated with multiple morbidities; including the need for prolonged ventilator support, intraventricular hemorrhage (IVH), periventricular leukomalacia (PVL), bronchopulmonary dysplasia (BPD), necrotizing enterocolitis (NEC) and may lead to the development of BPD (Ryu, Haddad, & Carlo, 2012). Despite changes in ventilation strategies that have been implemented over the last decade, BPD continues to be one of the most common morbidities seen in the extremely premature infants and has actually increased in prevalence (Stoll et al., 2015), likely due to improved survival of younger gestational age infants. One of the strategies that had been used to address development of BPD and improve survival of preterm babies with fewer morbidities has been permissive hypercapnia.

There is no exact definition of permissive hypercapnia and different studies have defined it as the lowering of the intensity of mechanical ventilation with an acceptable PaCO2 of greater than 40, 45, 50 or 52 mm Hg (Ambalavanan & Carlo, 2001; Fabres, Carlo, Phillips, Howard, & Ambalavanan, 2007; Mariani, Cifuentes, & Carlo, 1999; Thome & Ambalavanan, 2009; Thome & Carlo, 2002; Thome et al., 2015). Aggressive pursuit of normocapnia in ventilated neonates, as practiced in previous decades, is thought to have contributed to respiratory distress syndrome, air leaks and chronic lung disease/bronchopulmonary dysplasia. Large randomized clinical trials comparing high versus low tidal volume and respiratory rates have shown that ventilation with higher rates and low tidal volumes was associated with a significant reduction in air leaks (such as pneumothorax and pulmonary interstitial emphysema) (Carlo et al., 2002). Permissive hypercapnia along with low tidal volumes, high respiratory rates and high positive end expiratory pressures is one modality used to decrease lung injury caused by mechanical ventilation (Thome & Ambalavanan, 2009). Permissive hypercapnia is thus thought to reduce the incidence of BPD and protect against ventilation induced brain injury (Fabres et al., 2007; Miller & Carlo, 2007).

Permissive hypercapnia expands cerebral blood vessels and increases cerebral blood flow, thereby protecting against subsequent PVL. It also allows for more efficient unloading of oxygen to tissues, and thus protects against tissue hypoxia and associated complications such as ROP. However, extreme hypercapnia may be associated with increased risk of intracranial hemorrhage, hypoxemia, and hyperkalemia (Fabres et al., 2007). The use of permissive hypercapnia also has a potentially greater risk for accidental severe hypercapnia which may cause decreased myocardial contractility and fatal arrhythmias (Rogovik & Goldman, 2008). Maintaining optimal PaCO2 is important in balancing the risks and benefits of permissive hypercapnia.

Mariani et al (Mariani et al., 1999) recommended the strategy of permissive hypercapnia as safe and feasible to reduce the duration of assisted ventilation, the incidence of respiratory distress syndrome (RDS or BPD) and lung injury.

Although there have been numerous studies discussing possible benefits and effects of permissive hypercapnia (Ambalavanan & Carlo, 2001; Ma & Ye, 2016; Mariani et al., 1999; Miller & Carlo, 2007; Rogovik & Goldman, 2008; Thome & Ambalavanan, 2009; Thome et al., 2015), a consensus has not been reached as to the optimal levels of hypercapnia, its timing and duration. The aim of this retrospective study is to evaluate whether a specific level of permissive hypercapnia and/or specific timing of permissive hypercapnia during the hospital stay will decrease duration of ventilation and other short term morbidities in extremely preterm neonates.

Methods:

This study was a retrospective analysis of records of all neonatal intensive care unit (NICU) patients from January 2007 to December 2012. It included all infants born 28 weeks gestation or younger, weighing less than 1500 grams and admitted to the level III NICU at Cooper University Hospital. The protocol was approved by the institutional review board for human use. Infants were included if they qualified based on gestational age and birth weight, had ventilator support requirement after birth and had at least one blood gas analysis.

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Infants were excluded if they had any major congenital abnormalities. These patients were identified and data was obtained from the neonatal data base (Neonatal Information System, Medical Data Systems, Wayne, PA) and an electronic hospital record system (EPIC, EPIC Systems Corp., Verona, WI). All data in the neonatal database was collected by a trained database specialist, immediately after discharge of the neonate from the NICU, using standard Vermont Oxford Network (VON) definitions.

The primary outcome evaluated by this retrospective study is the effect of specific levels of permissive hypercapnia in the first week of life and in the first month of life on duration of ventilator support and oxygen requirement, as well as its effect on BPD and death. As part of secondary outcomes, we evaluated the effect of permissive hypercapnia on short term neonatal morbidities such as BPD, necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), periventricular leukomalacia (PVL), and retinopathy of prematurity (ROP). We also analyzed common prenatal and neonatal variables that have been shown previously to be associated with respiratory morbidities, such as birth weight and gestational age.

In the first 2 weeks of life mild, moderate and severe hypercapnia were defined as PaCO2 45-50 mmHg, 50-55 mmHg and >55 mmHg respectively. In weeks 4-12 mild, moderate and severe hypercapnia were defined as PaCO2 45-55 mmHg, 55-65 mmHg and >65 mmHg respectively. Carbon dioxide (PaCO2) measurements were recorded as a maximum value noted and average over 24 hours on day of life one. Similarly, maximum PaCO2 and average PaCO2 values were documented for weeks 1 through 12 while the patient was receiving mechanical ventilation. Effects of mild, moderate, and severe hypercapnia in the first week of life were analyzed as early hypercapnia, and PaCO2 < 40 was considered hypocapnia. Hypercapnia in weeks 4 through 12 was considered late hypercapnia.

Measures of PaCO2 dispersion, including the standard deviation (SD) of PaCO2 and the maximum to minimum range were calculated. The relationship between the mean highest, lowest, and average PaCO2 and BPD, BPD or death were calculated using Kruskall Wallis Test and Chi Square tests. The same relationship was calculated for IVH, severe IVH and ROP. Severe IVH was defined as IVH grade III or IV as described by Papile et al(Papile, Burstein, Burstein, & Koffler, 1978). Area under the curve (AUC) of the receiver operating characteristic (ROC) curve was also calculated. ROC curves plot sensitivity versus 1-specificity.

Comparisons between groups were performed using Student t-test, Mann Whitney U Test for continuous data. Kruskall Wallis Test, Chi-square, and Spearman Rho Correlation were used for categorical data. A multivariate logistic regression analysis with BPD, IVH, severe IVH, and ROP as the dependent variables was performed, with independent variables including the main prenatal and postnatal variables as well as the maximum CO2, minimum CO2 and average CO2 at each time point. These were also performed for the respective CO2 values and separated into early and late in neonate’s life. All statistical analysis was performed with SPSS (SPSS version 23.0.0.0, IBM Corp) and Minitab (Minitab version 15.0, State College, PA).

Results:

Out of 182 babies evaluated, there were no demographic differences between groups (Table 1), except for weight. Babies in the early hypercapnia group were significantly smaller (843 grams vs 909 grams, p=0.05) than in the normocapnia group; there was no significant difference seen in birth weight between the late groups.

PaCO2 levels throughout hospitalization were different between first day, first week, 1st month and after the 1st month, which is considered late in the hospitalization. Mean of the average and maximal PaCO2 in the first 24 hours was 43.1 (SD 11) and 51.3 (SD 13.1), for the first week was 44.6 (SD 8.3) and 60.2 (SD 18.9), for the first month was 53.8 (SD 5.9) and 74.6 (SD 25.1), and the average late in the hospitalization was 53.5 (SD 6.2) (Figure 1). There was no significant difference in the mean PaCO2 seen in each group between early and late time periods (Figure 2).

There was a significantly lower rate of BPD (40 vs 57%, p = 0.01), lower incidence of death and BPD (41 vs 62%, p = 0.005), and fewer days of oxygen use (63 vs 83, p = 0.01) in babies with normocapnia in the first week of life compared with those who have had any level of hypercapnia. There was no difference in the number of days ventilated, or the incidence of IVH, severe IVH, or death between those who maintained normocapnia versus hypercapnia in the first week of life (Table 1). There were no difference in the rate of BPD, IVH, severe IVH, incidence of BPD or death, or number of days patient was ventilated between those who were normocapnic versus hypercapnic after the first month of life. Those neonates with normocapnia after the 1st month of life had fewer days of oxygen requirement (69 vs 96, p = 0.02) compared to those who had any level of hypercapnia (Table 1).
Babies with severe hypercapnia in week one and weeks 6-12 of life (late portion of hospitalization) required oxygen for longer period (p=0.006) as compared to those with mild-moderate and normocapnia (Figure 3). Those with severe hypercapnia in the 1st week of life were ventilated more days (median 95 days) (p=0.022) as compared to the other groups (median of 30, 32, 38 days in normocapnia, mild and moderate hypercapnia respectively). Mean PaCO2 levels in the first week were higher in babies who later developed BPD (p=0.014), however, this difference disappeared after the 4th week of life. Babies with hypocapnia (PaCO2 levels < 35 mmHg) early in hospital stay (1st, 2nd, and 4th week of life) had higher risks of developing IVH (p=0.032, 0.008, 0.05 respectively) (Figure 4), and higher rates of developing BPD (p=0.041 and 0.036 in 2nd and 4th week).

There was no increase in the rate of IVH, severe IVH, PVL, NEC, ROP, or death with increase in mean PaCO2 or maximum PaCO2’s early or late in neonate’s hospitalization. Babies with severe hypercapnia in week one and weeks 6-12 required oxygen for longer period (p=0.006) as compared to those with mild-moderate and normocapnia (Figure 3). Those with severe hypercapnia in the 1st week of life were ventilated more days (median 95 days) (p=0.022) as compared to the other groups (median of 30, 32, 38 days in normocapnia, mild and moderate hypercapnia respectively). Mean PaCO2 levels in the first week were higher in babies who later developed BPD (p=0.014), however, this difference disappeared after the 4th week of life. Babies with hypocapnia (PaCO2 levels < 35 mmHg) early in hospital stay (1st, 2nd, and 4th week of life) had higher risks of developing IVH (p=0.032, 0.008, 0.05 respectively) (Figure 4), and higher rates of developing BPD (p=0.041 and 0.036 in 2nd and 4th week).

There was no difference in the duration of respiratory support based on hypercapnia as seen in the ROC curves and analysis of AUC (Figure 5). AUC of maximal PaCO2 first 24 hours was 0.52, maximal PaCO2 first week 0.6, maximal PaCO2 first month 0.64, average PaCO2 first 24 hours 0.54, average PaCO2 first week 0.62, average PaCO2 first month 0.54. Maximal PaCO2 in the first week and month of life, and average PaCO2 in the first week of life, may be associated with prolonged duration of respiratory support, however, it was not a significant change.

There was no increase in the rate of IVH, severe IVH, PVL, NEC, ROP, or death with increase in mean PaCO2 or maximum PaCO2’s early or late in neonate’s hospitalization.

Table 1: Demographics of Neonates compared between Normocapnia and Hypercapnia

| Description based on normocapnia and hypercapnia groups and also subdivided into early and late in patients' hospital stay. |
|--------------------------------------------------|--------------------------------------------------|------------------|------------------|------------------|
| Birth Weight, grams (mean) | Normocapnia N = 97 | Hypercapnia N = 85 | P | Late (1-6 months) |
| Gestational Age, weeks (mean) | 26.2 | 25.9 | 0.16 | 25.7 | 25.3 | 0.38 |
| BPD, n (%) | 38 (40) | 50 (57) | 0.001* | 6 (60) | 70 (74) | 0.34 |
| Days on Oxygen, n | 62.6 | 82.5 | 0.01* | 68.5 | 95.7 | 0.02* |
| Days on Ventilator, n | 28 | 40.5 | 0.71 | 25.5 | 55.1 | 0.66 |
| Severe IVH, n (%) | 11 (11) | 9 (11) | 0.87 | 1 (10) | 12 (13) | 0.79 |
| Death/BPD, n (%) | 39 (41) | 51 (62) | 0.005* | 6 (60) | 69 (75) | 0.45 |
| Death, n (%) | 1 (1) | 4 (5) | 0.12 | 0 (0) | 2 (2) | 0.1 |

Figure 1: Mean PaCO2 over time

Average PaCO2 seen in the first week, first month and after the first month of neonate’s life.

Figure 2: Mean Carbon Dioxide Values Early (1st week) versus Late (1-6 months) in Hospitalization

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**Figure 3: Mean Days on Oxygen Early versus Late**

Average number of days with oxygen requirement, as seen in different groups of PaCO2 (hypocapnia, normocapnia and different levels of hypercapnia) compared early versus late in neonate's life.

![Image of bar chart showing mean days on oxygen](image1)

* p<0.05

**Figure 4: Maximum Carbon Dioxide Values and Development of IVH**

Correlation between mean maximum PaCO2 values during hospitalization and IVH grade.

![Image of graph showing carbon dioxide levels and IVH](image2)
Figure 5: ROC Curves for PaCO2 and Duration of Respiratory Support

ROC curve of maximal PaCO2 first 24 hours (A), maximal PaCO2 first week (B), maximal PaCO2 first month (C), average PaCO2 first 24 hours (D), average PaCO2 first week (E), average PaCO2 first month (F), in relation to the outcome of duration on respiratory support.

A. ROC Curve
   Sensitivity
   1 - Specificity
   Diagonal segments are produced by ties.

B. ROC Curve
   Sensitivity
   1 - Specificity
   Diagonal segments are produced by ties.

C. ROC Curve
   Sensitivity
   1 - Specificity
   Diagonal segments are produced by ties.

D. ROC Curve
   Sensitivity
   1 - Specificity
   Diagonal segments are produced by ties.

E. ROC Curve
   Sensitivity
   1 - Specificity
   Diagonal segments are produced by ties.

F. ROC Curve
   Sensitivity
   1 - Specificity
   Diagonal segments are produced by ties.

Discussion:
Our study indicates that severe permissive hypercapnia (> 55 mmHg) in week 1 and (> 65 mmHg) after 2 weeks of life does not increase neonatal morbidities such as BPD, ROP, IVH and severe IVH. Normocapnia is associated with decreased duration of respiratory and oxygen support needed. Hypocapnia (<35 mmHg) in the first month of life is associated with increased probability of short term morbidities.
Discussion:

Our study indicates that severe permissive hypercapnia (> 55 mmHg) in week 1 and (> 65 mmHg) after 2 weeks of life does not increase neonatal morbidities such as BPD, ROP, IVH and severe IVH. Normocapnia is associated with decreased duration of respiratory and oxygen support needed. Hypocapnia (<35 mmHg) in the first month of life is associated with increased probability of short term morbidities.

There are some limitations to this retrospective study, due to biases resulting from confounding factors associated with the availability of data. One of the limitations is that the PaCO2 levels were documented from available blood gas results. These blood gases were arterial, arterialized capillary, or venous, thus introducing some variation. Arterial blood gas samples were initially drawn from indwelling arterial catheters, however, neonates that were less ill did not have these catheters at all, and arterial catheters were removed after 3–10 days. They were also collected on clinically indicated schedule and not based on a standard clinical protocol with specific data collection procedures. The study was pragmatic and more representative of what occurs typically in the NICU as a result of these factors.

Neonates who are younger or sicker may have more frequent blood gas evaluations, documentation of blood gas values for longer number of weeks due to longer duration of respiratory or ventilator support, thus requiring blood gas monitoring. There may have been more variability in their PaCO2 values with more extreme numbers due to likely lability of the patients.

Our study has multiple strengths as well. The sample size and the prolonged monitoring of blood gas samples are larger than in some of the other studies (Mariani et al., 1999; Thome & Ambalavanan, 2009). In addition, data from all the blood gas samples were included, without limiting the analysis to selected time points. Our study not only analyzed the influence of the maximal PaCO2 on respective morbidities, but also of hypocapnia and the average PaCO2. In addition to evaluating whether any hypercapnia is beneficial or detrimental to a developing preterm neonate, we also evaluated the effect of hypocapnia and the effect of different levels of hypercapnia on the baby.

Severe hypercapnia early (first day/week) in patient’s life were associated with increased duration of oxygen and respiratory support requirement and higher risk of development of BPD. Extremes in PaCO2, especially early in baby’s life were associated with higher risk of developing IVH. As noted in the study, higher level of CO2 was not associated with higher grade of IVH, however, those babies with grade 4 IVH appeared to have the higher maximal PaCO2’s in the first day of life. This may be explained as those with severe IVH early in hospital stay tended to have increased PaCO2 in the first day of life. Based on the structure of this study, it is impossible to identify a causative pathway.

Our study suggests that frequent and close monitoring of PaCO2 may be important and that extreme or widely fluctuating PaCO2 levels should be avoided in the extremely preterm infants. We routinely evaluate PaCO2 levels in the NICU, however, for many years hypercapnia was feared and considered potentially detrimental (Ambalavanan & Carlo, 2001, 2006; Carlo, Martin, & Difiore, 1988; Mariani et al., 1999). However, as based on results of other studies and ours, it appears that mild to moderate hypercapnia is safe (Ma & Ye, 2016; Mariani et al., 1999; Rogovik & Goldman, 2008; Thome & Ambalavanan, 2009; Thome et al., 2015). The benefit of hypercapnia as it relates to BPD or other respiratory outcomes (Ma & Ye, 2016; Miller & Carlo, 2007; Thome & Ambalavanan, 2009; Thome et al., 2015) and the possible association with increased risk of IVH (Fabres et al., 2007; Thome & Ambalavanan, 2009) is still being discussed. Both Thome at al and Fabres at al noted that the fluctuations in PaCO2 levels appear to be the most concerning in relationship to development of IVH. We found similar outcomes in our study with fluctuations from minimal to maximal CO2 having the highest association with development of IVH. Possible mechanisms that may explain this is ischemia during the period of hypocapnia, followed by hemorrhage or extension of existing hemorrhage during reperfusion.

Further trials, preferably randomized controlled trials, will be required to evaluate whether mild to moderate hypercapnia is the only safe option, or whether more significant level of hypercapnia may be safe and have more meaningful benefit in relation to BPD and other respiratory outcomes.

Bibliography


continued on page 23
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Case Study: Nonsteroidal Anti-inflammatory Drugs Induced Acute Kidney Injury in Two Children: Management, Risk Factors, and Brief Literature Review

Eduardo Fastag, MD, Pediatrics Resident, New York Medical College, St. Joseph's Regional Medical Center
Betsabee A. Castillo, MD, Pediatrics Resident, New York Medical College, St. Joseph's Regional Medical Center
Roberto Jodorkovsky, MD, Division Chief, Pediatric Nephrology, and Pediatrics Program Director, St. Joseph's Regional Medical Center

Introduction:

Drug induced acute kidney injury (AKI) is an important cause of mortality and morbidity in the pediatric population. In recent publications, 16% to 20% of acute injury cases were attributed to nephrotoxic drugs.1-4 Non steroidal anti-inflammatory drugs (NSAID) use has been associated with the development of AKI. 81 cases of children diagnosed with AKI secondary to NSAID have been reported from 1993 to 2013. Clinical manifestations were variable, including acute reversible and irreversible renal failure, acute interstitial nephritis, chronic kidney disease, non-nephrotic proteinuria, nephrotic syndrome and electrolytes abnormalities.2,5-7

In addition to discontinuing the offending drug and correcting dehydration, when present, management of NSAID-induced AKI is largely supportive.8 There is some evidence that steroids may be beneficial to treat patients presenting with more severe symptoms, or who fail to recover promptly.9, 10

We report two cases of NSAID-induced AKI; one child was treated successfully with steroids after his clinical course deteriorated, and the other child recovered promptly after receiving supportive therapy. A brief review of the literature, including mechanisms of action and risk factors involved in NSAID-induced AKI, follows the case presentations.

Table 1. Patient 1

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<thead>
<tr>
<th></th>
<th>Admission</th>
<th>Day 1</th>
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<td>0.3</td>
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continued on next page
Our patients were mildly dehydrated and took NSAID for only a few days, suggesting that impaired renal vascular auto regulation was the most likely mechanism causing their AKI. Dehydration is a well-established risk factor for the development of AKI in children taking NSAID.5, 8, 12, 13 Balestracci et al reported a prevalence of 54% of ibuprofen-associated AKI in their cohort of dehydrated children with acute gastroenteritis.9 Studies have suggested that NSAID-associated AKI is usually mild, self-limited, and non-oliguric,8, 9, 12 which was the case with patient 2. Patient 1 experienced a more severe disease, showing rapid deterioration of his renal function within 48 hours. Treatment with steroids was associated with prompt reversal of the rapidly declining kidney function, leading to complete recovery within 3 weeks of treatment. González et al reported a more favorable prognosis of adult patients with NSAID-induced AKI treated with steroids starting early during their management, whereas 50% of untreated patients required chronic dialysis. The authors recommended starting steroids early on to prevent the progression of renal fibrosis.9 Authors universally agree that the first therapeutic step in patients with drug induced AKI is to discontinue the offending drugs and manage fluids and electrolytes carefully according to the AKI and hydration status. Steroids can be entertained in severe cases, or when renal function deteriorates rapidly. Steroids may lower the risk for long-term damage. NSAID should be avoided in dehydration or preexisting renal dysfunction.

**Table 2. Patient 2**

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continued on page 27
Proper vaccine storage and handling has been an important factor in preventing and eradicating many common vaccine-preventable diseases. Yet, each year, storage and handling errors result in revaccination of many patients and significant financial loss due to wasted vaccines. Failure to store and handle vaccines properly can reduce vaccine potency, resulting in inadequate immune responses in patients and poor protection against disease. Patients can lose confidence in vaccines and providers if they have to be revaccinated because the vaccines they received may have been compromised.

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This toolkit provides information and resources to assist you in properly storing and handling your vaccine supply, including information on:
• Storage and temperature monitoring equipment and setup
• Vaccine organization and storage
• Vaccine temperature and storage equipment monitoring
• Vaccine inventory management, transport, and preparation
• Emergency storage, handling, and transport
• Vaccine storage and handling plans and development

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• Diphtheria, Tetanus, and Pertussis (D'TaP)
• Haemophilus influenzae type b (Hib)
• Hepatitis A
• Hepatitis B
• Human Papillomavirus
• Influenza
• Meningococcal
• MMR
• Pneumococcal
• Polio Oct 2015
• Rotavirus
• Tetanus, Diphtheria, and Pertussis (Tdap)
• Understanding the Basics: General Recommendations on Immunization
• Vaccines For Children
• Vaccine Storage and Handling
• Varicella
Conflict of Interest

The Authors declare no conflict of interest.

References

As pediatricians and pediatric specialists are increasingly called upon to render judgement on school-related issues, it is imperative that practitioners keep abreast of trends emerging in education and psychology that overlap with their pediatric practice. One trend in recent years is the awareness of and increase in the use of the term “executive functioning” as a significant component related to school success and difficulty. Parents have become increasingly comfortable in using the term and in asking questions about executive functioning, to the point where it behooves practitioners (physicians and other pediatric practitioners alike) who are working with children to have working knowledge of executive functioning as it applies to children in their everyday lives. This article offers an overview of executive functioning for pediatricians and pediatric specialists with the goal of being able to speak to parents more comfortably about the relevant issues.

Formal Definition

As noted in the book, *Late, Lost & Unprepared* (2008 Cooper-Kahn & Dietzel), a formal definition of executive functioning is as follows:

"The executive functions are a set of processes that all have to do with managing oneself and one’s resources in order to achieve a goal. It is an umbrella term for the neurologically-based skills involving mental control and self-regulation."

Informal Definition—Helpful Metaphors

When properly used, metaphors help parents understand medical and psychological terms and jargon that can lead parents to have an “aha moment,” where something seemingly complex is immediately understood. With executive functioning there are two metaphors that I find particularly helpful for parents when explaining the issues. Two snippets taken from recent feedback sessions conducted with parents shed light on the metaphors and their applicability with executive functioning:

To a parent of a middle school age child:

“Your child is struggling with “executive functioning” issues. Think of executive functioning as the rudder steering a boat. With a floppy rudder the boat flounders and goes nowhere. That’s what weak executive functions are like. These have become particularly apparent in the more challenging middle school years.

Neurological Underpinnings

Neurologically speaking, the primary “seat,” or region where executive functioning resides is in the prefrontal cortex of the frontal lobes. While other areas of the brain also play a contributory role, immature frontal lobe development is seen as the primary neurologically-based reason why children (and adults) are struggling with their executive functioning. Of particular importance to bear in mind is the fact that relative to brain maturation, the frontal lobes are the last region of the brain to fully mature. With some people, their frontal lobes do not reach maturation until well into the latter adolescent years or even into the 20s.

Common Executive Functions

In practical terms, common executive function issues include the following:

- Problems with inhibition
- Difficulty shifting from one activity to another
- Task initiation difficulty
- Planning and organizing to complete a task
- Organization of materials (i.e., knowing where to put your stuff)
- Self-monitoring difficulty
- Sustaining mental effort

Assessment

Assessment of executive functioning typically takes place within a neuropsychological or psychological assessment. Since an assessment battery has limitations, practitioners must choose tests that they feel are most productive in yielding the greatest amount of clinical information within the artificial constraints of time limits. To date, there is no single “gold standard” test or x-ray of executive functions and clinicians typically gather data from a variety of sources including rating scales, clinical history and a battery of psychoeducational/ neuropsychological tests in order to reach reasonable conclusions as to the nature of the executive functioning in a child.

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One instrument, the BRIEF-II (Behavior Rating Inventory of Executive Functioning-II) is particularly helpful for the clinician in determining age level concerns with the key executive functions. The test yields a usable and helpful graph (see accompanying graph) of the different executive functions as well as a parent-friendly narrative explaining the child’s performance.

While the BRIEF is very helpful it should not be used alone in assessment. Clinical history and a range of other tests help to round the picture by providing insight into other overlapping concerns such as learning.

What to Do? How to Help?

In working with parents around these issues, it is important to emphasize that there is no cure, no “magic bullet.” Additionally, practitioners need to understand that there are no across the board treatments applicable to a broad range of kids and they need to assess the multiplicity of variables interacting on a case-by-case basis. What may work for one child or situation may be totally inappropriate for the next.

As a general rule, practitioners working with these children should be striving to help students improve their executive skills by practicing discrete skills to be internalized to mastery. For example, teaching the use of making prioritized daily checklists is an example of tackling discrete executive function skills. However, organizing the disorganized and structuring the unstructured is an ongoing challenge. Children (and adults) with these issues need to overlearn skills and practice them to mastery over time so they become automatic and internalized.

Parents also are in need of coaching as to how to best set up the environment. There is a delicate balance that needs to be struck between helpful support and too much involvement on the parent’s part and there is a tendency to want to do too much for the child with these issues.

Reference:
Should NOM be Considered for Acute Uncomplicated Appendicitis in Pediatric Patients?

Namal Seneviratne, Undergraduate Student
The College of New Jersey; Summer Clinical Internship Program
Rutgers, Robert Wood Johnson Medical School, New Brunswick, NJ

Yi-Horng Lee, MD
Chief, Pediatric Surgery, Rutgers, Robert Wood Johnson Medical School
Surgeon-in-Chief, Bristol-Myers Squibb Children's Hospital
Robert Wood Johnson University Hospital, New Brunswick, NJ

Introduction

In the United States, acute appendicitis (AA) is the most common reason for abdominal surgery, with a known incidence of 7.7%. This is predominantly a pediatric disease, as the greatest frequency occurs in the age range of 10-19 years. Appendectomy has been the primary method of treating appendicitis with low mortality and morbidity. Early appendectomy has traditionally been advocated due to the unpredictable and potentially grave outcomes of untreated appendicitis including perforation leading to sepsis and possibly death. However, there has been an increased interest recently in a non-operative approach to appendicitis in the pediatric population, in an effort to mitigate potential post-operative morbidities, cost and exposure to general anesthesia. An analysis of the National Inpatient Sample database concluded that the use of NOM in all AA patients has risen from 4.5% (2004) to 6% (2011).4

The non-operative management (NOM) of appendicitis is not a new discovery. During World War II, crew members of naval vessels who developed appendicitis were treated with antibiotics, as an appendectomy would be impossible. The recent resurfacing of non-operative appendicitis is multifaceted: more accurate imaging techniques including CT and MRI allow for the identification of perforation and appendicolith (which render NOM less effective), and the development of broad-spectrum antibiotics allow for effective treatment of potential pathogens. The use of NOM for appendicitis in the adult population is well tested with well powered clinical trials and deemed effective, however NOM in the pediatric population remains relatively unexplored. Furthermore, authors of pediatric NOM literature, though often supporting the same evidence, arrive at different conclusions on whether or not NOM should be actively offered to patients with uncomplicated appendicitis. This paper reviews the literature concerning pediatric NOM and the arguments for and against its clinical usage.

Methods

The PubMed database was searched with the following terms: “non-operative appendicitis children” and “antibiotic appendicitis children,” yielding 714 results total, which were screened for relevance based on title and abstract. Citations from relevant studies were also cross referenced with the PubMed search results to identify frequently cited studies. Of the 714 screened papers, 166 full papers were reviewed, and 16 were selected for analysis inclusion in this paper.

Inclusion criteria were studies that had a sample group that was given non-operative, antibiotic treatment for appendicitis in a population below the age of 18. Both comparative (appendectomy vs. non-operative groups) and solely non-operative studies were analyzed due to the relative paucity of randomized clinical trials in the pediatric population in this area.10-21 Studies that did not have strict acceptance criteria (i.e. no limitation on WBC levels or presence of appendicolith) were included for the purpose of comparing effectiveness of antibiotic treatment vs. operative treatment in differing clinical scenarios and in order to further elucidate the scope of cases in which NOM could be effectively utilized. Studies with grades of evidence I-IV were considered and included in this analysis due to the relative paucity of randomized controlled trials in this area.

How is NOM Used Clinically?

Appendicitis is a largely clinical diagnosis that is supported by imaging, the presence of leukocytosis and/or fever. Typically, patients who present with signs and symptoms of acute appendicitis typically undergo imaging and labs upon presentation, which reveals if they are a candidate for immediate appendectomy or have an indication for potential NOM. In all of the studies analyzed, the presentation of the patient determined whether they qualified for NOM or immediate appendectomy. In most studies, patients experiencing complicated appendicitis, such as abscess, peritonitis, and perforation, are not viable for NOM and ultimately undergo surgery at some point in their disease course. For patients with uncomplicated appendicitis, some studies limited NOM treatment to patients that experienced pain within 48 hours of treatment, had an appendix diameter less than 1.1 cm, had a white blood cell count below 18,000/uL, and had a C-reactive protein level below 4 mg/dL, though others administer NOM to any case of acute uncomplicated appendicitis. Antibiotic administration varied throughout the analyzed studies. In the NOM trials analyzed, patients were treated with intravenous antibiotics for 1-5 days (Table 1). If their condition failed to improve or worsened, an interval appendectomy was performed. However, if they improved clinically, they were discharged and continued to take oral antibiotics for 5-10 more days (though some studies delivered all antibiotics through IV, and there was no oral phase). A meta-analysis comparing initial rates of success between operative and non-operative management of appendicitis found that non-operative management (152/168) had a lower success rate than appendectomy (0/236).23

In addition to the lower success rate, non-operative appendicitis may result in recurrence, which results in a total 1 year success rate ranging from 40.0% to 87.5% over a 1 year follow-up period, though some studies suggest that a longer follow-up may be beneficial to better define the success rate of non-operative treatment.17,20,21

continued on next page
Table 1. Pediatric clinical trials analyzed for this review.

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<td>positive imaging;</td>
<td>ciprofloxacin and metronidazole or ampicillin,</td>
<td>amoxicillin-clavulonic</td>
<td>Worsening/continuous pain; perforation</td>
<td>10/12</td>
<td>9/12 (12)</td>
</tr>
<tr>
<td>(2014)</td>
<td>pain within 48 hours;</td>
<td>gentamicin and metranidazole (duration unknown)</td>
<td>clavulonic acid (duration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>no abscess/phlegmon</td>
<td></td>
<td>unknown)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hartwich et al.</td>
<td>pain within 48 hours;</td>
<td>piperacillin-tazobactam (duration unknown)</td>
<td>amoxicillin-clavulonic</td>
<td>no improvement; recurrence during antibiotics</td>
<td>21/24</td>
<td>17/24 (2 elected for NOM) (12)</td>
</tr>
<tr>
<td>(2016)</td>
<td>no abscess/perforation;</td>
<td></td>
<td>clavulonic acid (10 days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>no penicillin allergy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minneci et al.</td>
<td>pain within 48 hours;</td>
<td>piperacillin-tazobactam (24 hour minimum)</td>
<td>Amoxicillin-clavulonic</td>
<td>tenderness unresolved</td>
<td>35/37</td>
<td>28/37 (12)</td>
</tr>
<tr>
<td>(2016)</td>
<td>appendix diameter &lt; 1.1cm; WBC &lt; 18,000</td>
<td></td>
<td>clavulonic acid (10 days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Svensson et al.</td>
<td>no perforation/abscess</td>
<td>meropenem and metronidazole (48 hour minimum)</td>
<td>ciprofloxacin and metronidazole (8 days)</td>
<td>child is not “clinically well”</td>
<td>22/24</td>
<td>21/24 (12)</td>
</tr>
<tr>
<td>(2015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanaka et al. (2015)</td>
<td>no abscess/phlegmon</td>
<td>cefmatazole, sulbactam &amp; ampicillin &amp; ceftazidime,</td>
<td>N/A</td>
<td>CRP above 0.5g/dL; tenderness unresolved</td>
<td>77/78, 73/77</td>
<td>55/77 (12)</td>
</tr>
<tr>
<td>Mahida et al. (2016)</td>
<td>symptoms within 48 hours; WBC &lt;18,000/uL; diameter &lt; 1.1cm; appendicolith</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gorter et al. (2017)</td>
<td>“simple”, imaging w/in 8 hours; sepsis, peritonitis, fecolith</td>
<td>amoxicillin-clavulanic acid, gentamicin (48-72 hours)</td>
<td>amoxicillin-clavulonic acid (4 days outpatient (after 72 hours inpatient)</td>
<td>Body temp. &gt;38°C; comfort scale &gt;3; lowered WBC/CRP; no complex appendicitis</td>
<td>25/25</td>
<td>23/25 (2)</td>
</tr>
<tr>
<td>Steiner et al. (2015)</td>
<td>no abscess</td>
<td>ceftriaxone and metronizadole (3-5 days)</td>
<td>amoxicillin-clavulonic acid (5 days)</td>
<td>no improvement of symptoms between 12-24 hours</td>
<td>42/45 (no perforation in any failures)</td>
<td>40/45 (6-14)</td>
</tr>
<tr>
<td>Caruso et al. (2017)</td>
<td>no peritonitis, sepsis, abscess, or perforation</td>
<td>cefotaxime (72 hours)</td>
<td>unspecified antibiotic (5 days)</td>
<td>no improvement; imaging and blood tests indicate worsening</td>
<td>115/197</td>
<td>103/197 (not mentioned)</td>
</tr>
<tr>
<td>Koike et al. (2014)</td>
<td>no perforation/abscess</td>
<td>cefoperazone (48 hours)</td>
<td>cefcapene pivoxil (3 days)</td>
<td>CRP &gt;1.0mg/dL</td>
<td>125/134**</td>
<td>101/125 (18)</td>
</tr>
<tr>
<td>Kaneko et al. (2004)</td>
<td>US “grade” I or II</td>
<td>flomoxef (until tenderness resolved)</td>
<td>N/A</td>
<td>tenderness not resolved</td>
<td>22/22</td>
<td>16/22 (24-45)</td>
</tr>
</tbody>
</table>

*If the first antibiotic failed, then the next was attempted, until the CRP level was below 0.5g/dL and tenderness resolved

**All 9 failures were due to history, loss of imaging data, or patient choice during the treatment.
Recurrence is of primary concern for pediatric patients undergoing NOM, given their long future lifespan and high potential for loss of Quality-Adjusted Life Year (QALYs). Data suggests a wide range of recurrence rates suggests that further studies should be conducted in order to investigate predictors of recurrence. One known predictor of recurrence is the presence of appendicolith, as seen in the study by Tanaka et al., where 47.4% of the appendicolith patients, but only 23.7% without appendicolith were readmitted or required interval appendectomy.16,24 Furthermore, a study specifically observing NOM success in patients with appendicolith had to be discontinued due to the extremely high failure rate (60%) of the first 5 NOM patients.17 Though some studies account for patients with appendicolith, some completely ignore it. The presence of intraluminal appendiceal fluid at the time of initial presentation and CRP levels above 103 mg/L had a positive correlation with recurrence rate, and may be another exclusion factor in further NOM trials.16,24 Further identifying predictors of recurrence would help make NOM a more reasonable clinical option, as appropriate patients could be better identified and long term expectations could be discussed with families in a more definite manner which would potentially increase the appeal of NOM or many patients.

One major concern with NOM is that uncomplicated appendicitis is progression to complications such as perforation, abscess, peritonitis and/or sepsis. However, in the Huang et al. meta-analysis of 5 comparative clinical trials, morbidity of operative management accounting for post-op complications such as surgical site infection and ileus compared with morbidities of NOM in uncomplicated cases was not significantly different.23 Additionally, in a cohort of 619 patients from 12 different clinical trials that underwent NOM, there were only 5 cases of progression to perforation.12,18,20,21 Other studies reveal that delaying surgery with antibiotics (interval appendectomy) does not increase the chance of perforation.26

Secondary Benefits of NOM

NOM has multiple benefits over appendectomy, the primary benefit being the avoidance of surgery which may result in post-op ileus, obstruction, surgical site infection, urinary tract infection, and post-operative pain in addition to the risks of general anesthesia particularly in the pediatric population. In a study by Tanaka et al., a survey revealed that patients that underwent appendectomy instead of NOM primarily complained of the post-operative pain as the most significant morbidity.21 Additionally, studies that compare the cost of NOM and appendectomy show that NOM is more cost effective. According to a meta-analysis of 3 comparative studies, NOM was on average $1,310 less expensive than appendectomy.23 Additionally, a cost analysis using a decision analysis framework model found that the overall average cost of appendectomy over 2 years was $111,119, while that of NOM was $8,842 and studies examining patient quality of life after 1 year found that NOM patients had similar or better quality of life on long term follow up vs. operative management. Furthermore, according to Minneci et al., patients that undergo NOM on average have less disability days than those that undergo appendectomy (8 versus 21 days), which is an important consideration for both pediatric patients and their parents, who may miss time from work to take care of them.18

Drawbacks of NOM

In addition to its lower initial success rate and risk of recurrence, there are multiple drawbacks to NOM. Although NOM is more cost effective than appendectomy initially, if there is recurrence and subsequent appendectomy in addition to initial NOM, the total cost of care will be higher. According to the decision analysis framework of cost comparison between appendectomy and NOM, NOM is overall more effective than appendectomy if the 1 year recurrence rate is beneath 39.8%, and in a series of simulations, NOM was more cost effective 92% of the time.27 Overall, the cost-effective aspect of NOM is a risk that depends on recurrence, though that risk may change as more predictors of recurrence are revealed so that patients may be better screened.

Patients that undergo NOM typically have longer hospital stays, as the Georgiou et al. meta-analysis evinces, the average length of stay in 4 comparative studies is 48 days longer for NOM patients.22 However, length of stay may vary greatly depending on the method of antibiotic treatment: treatments where the patient remains in the hospital until all symptoms resolve may be longer than those that have a lower threshold for hospital discharge. In addition to missed time at school and/or work for the child due to prolonged hospitalization, this may also result in more missed days from work for the parent(s) resulting in greater financial burden for the family. The gross financial impact of the different treatment strategies were not commented on in these studies, but do merit further evaluation as addressing the burden of disease on the family unit is essential in treating the pediatric population.

continued on next page
Additionally, since there is no way to pathologically observe the appendix with NOM treatment, the patient may have a normal appendix, but still undergo prolonged antibiotic treatment unnecessarily. In fact, Liu et al. showed in their meta-analysis that up to 7.3% of patients undergoing immediate appendectomy for uncomplicated appendicitis, were found to have normal appendices at the time of surgery. If treated non-operatively, these patients would have been exposed to a prolonged course of antibiotics that would have otherwise been avoided. Additionally, the concern for appendiceal carcinoid tumor or metastasis from a GI source, although very low risk in the pediatric population, must be kept in mind as a cause for appendicitis. Due to the possible sequelae of missing one of these diagnoses, the clinical suspicion for one of these abnormal causes must always be exercised and pursued if appropriate.

Overall, NOM is an interesting and promising alternative to the appendectomy, though it requires further research and more standardized recommendations. After more indicators of recurrence are discovered through further trials, NOM may become a viable treatment option to offer pediatric patients with appendicitis.

Summary

NOM has definitely gained more attention as of late and it certainly provides an additional treatment option for patients with appendicitis. However, the practice is not yet widespread. Identifying the appropriate patients for NOM remains challenging, especially in an environment where the use of CT scan has been discouraged and the presence of fecolith has been difficult to diagnose sonographically. Hence, appendectomy remains the mainstay therapy for acute appendicitis. We encourage each institution to individualize their protocol with collaboration between pediatric surgeons and emergency medicine physicians using the evidence available. Although NOM can be used, the involvement of surgeons remains paramount in case of treatment failure. At this point, NOM should only be used when there is a long-term follow-up mechanism in place so its efficacy can be further studied.

References


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