In the Spotlight:

**AAP SOCC Studied Pediatric Critical Care Workforce**
By: Carley Riley, MD, MPP, MHS, FAAP

Results of the most recent workforce survey conducted by the American Academy of Pediatrics Section on Critical Care (AAP SOCC) were published in *Pediatric Critical Care Medicine* ahead of publication in July. In the manuscript, “Practice Patterns in Pediatric Critical Care Medicine: Results of a Workforce Survey,” Radabaugh et al present current data on the practice patterns of the pediatric critical care medicine workforce in the United States. For their study, they surveyed all active members of the AAP SOCC and non-duplicative individuals certified by the American Board of Pediatrics in pediatric critical care medicine. The survey inquired about work environment, number of hours worked, training, clinical responsibilities, work satisfaction and burnout, and plans to leave the practice of pediatric critical care medicine. With their paper, the authors provide a description of the typical intensivist and a snapshot of the current pediatric critical care medicine workforce, which may be experiencing a mild-to-moderate undersupply.

The majority of the 923 respondents were white, male, non-Hispanic, university-employed, and taught residents. Respondents who worked full time were on clinical intensive care service for a median of 15 weeks per year and responsible for a median of 13 intensive care unit beds, working a median of 60 hours per week. Total night call responsibility was a median of 60 nights per year, and about half of respondents indicated night call was in-hospital. Fewer than half were engaged in basic science or clinical research. Compared with earlier data, there was minimal change in work hours and proportion of time devoted to research, but there was an increase in the proportion of female pediatric critical care medicine physicians.

For more information, read the full manuscript and access supplemental information on the AAP SOCC website.

**AAP SOCC Launches Career Development Survey**
By: Christina Cifra, MD, FAAP

The transition from trainee to career clinician can be a daunting process. The importance of mentorship and career development opportunities cannot be overemphasized, especially for ensuring career fulfillment and success for pediatric intensivists, which ultimately lead to advancing the field.

Recognizing this, the American Academy of Pediatrics Section on Critical Care (AAP SOCC) has recently launched an ongoing survey to determine perceptions of current PICU fellows and recent graduates.
regarding the extent of career development support they received during fellowship training. Results from this survey will help determine crucial gaps in career development support and will inform the creation of a national mentoring program in pediatric critical care through the AAP SOCC.

We expect to report preliminary results of the survey at the AAP SOCC Executive Committee meeting at the AAP National Conference and Exhibition this coming October. Look out for the final results to come later as well as for more news about the pediatric critical care mentoring program.

What's Happening Now?

Council of Pediatric Subspecialties (CoPS) Update

The CoPS executive committee convened in Chicago in July. To see their latest contributions, click here.

National Preparedness Month

Each year during September, the AAP supports the Federal Emergency Management Agency (FEMA) sponsored National Preparedness Month to enable citizens to prepare for and respond to all types of emergencies, including natural disasters and terrorist attacks. This year’s theme is “Don’t Wait. Communicate. Make Your Emergency Plan Today.” The AAP Children and Disasters Web site has a dedicated Web page for National Preparedness Month. This Web page includes ideas for members who wish to get involved or implement general preparedness activities, including strategies to address influenza prevention and control in high risk children.

AAP Children and Disasters News

Hot off the presses! The AAP is pleased to announce the release of a new clinical report “Providing Psychosocial Support to Children and Families in the Aftermath of Disasters and Crises.” For additional highlights of other current AAP pediatric disaster preparedness initiatives, check out their August newsletter.

ICD-10 Implementation Right Around the Corner

The ICD-10 launch date is October 1. Be prepared with these resources from the AAP.

Academy Reaffirms its Support for Mandatory Influenza Immunization Policy

The Academy has reaffirmed its support for a mandatory influenza immunization policy for all health care personnel (HCP) nationwide.

Many individuals at high risk of influenza and its associated complications are in frequent, close contact with HCP because of their need to seek medical services. Therefore, immunization of HCP is a crucial step in efforts to protect those at risk of health care-associated influenza, according to the AAP policy.
statement Influenza Immunization for All Health Care Personnel: Keep it Mandatory. The policy is available at www.pediatrics.org/cgi/doi/10.1542/peds.2015-2920 and will be published in the October issue of Pediatrics.

What Opportunities Exist?

“Speak up for Kids: White Coat Rally at the Capitol”- Tuesday, October 27, 12pm-1pm

If you plan to attend the AAP National Conference & Exhibition, bring your white coat and join your fellow pediatricians for a white coat rally. AAP leaders and special guests will share updates about strong federal policies needed to protect child health, and participants will attend the event outside the steps of the US Capitol. A session to prepare for the rally, “Getting Ready to Rally”, will be held Monday, October 26. For more information on the rally and an overview of the advocacy sessions offered at this year's AAP NCE, visit this website.

Follow @AAPGlobalHealth on Twitter

Did you know that AAP has a new Twitter handle dedicated to highlighting global child health news and activities? The handle shares original content about the Academy’s work, news from partners and campaigns, and messages spotlighting our members’ international efforts. We encourage you to join the conversation by following @AAPGlobalHealth.

ICAAP Reopens Web-Based Training and Quality Improvement Project on Transitioning Youth to Adult Health Care

The Transitioning Youth to Adult Health Care for Pediatric Providers course and quality improvement (QI) activity is reopen! The activity includes a wealth of resources to improve care of transitioning youth – including national clinical guidelines, videos, skills building tools for youth, and QI tools. It teaches learners how to use medical home and QI strategies to improve care of transitioning youth, especially those with special health care needs. Maintenance of Certification (MOC) Part IV credit is available. Register today!

AAP National Conference and Exhibition – October 24-27, 2015

It’s time again for the AAP NCE! This year’s conference will take place in Washington D.C. Registration is open. AAP members receive discounted rates. Check out the Schedule at a Glance to see all the NCE has to offer and view the updated AAP Section on Critical Care (AAP SOCC) program schedule here.

Society of Critical Care Medicine 45th Annual Critical Care Congress – February 20-24, 2016

Registration is now open for the Society of Critical Care Medicine’s (SCCM) 45th Critical Care Congress, to be held February 20 to 24, 2015, at the Orange County Convention Center in Orlando, Florida, USA. The Society’s annual Congress cultivates inspiration and creativity by bringing together all members of the multi-professional, multidisciplinary team. Join more than 6,000 critical care clinicians for this
unique five-day event. Participate in cutting-edge educational sessions and hands-on workshops that expand your critical care knowledge and enhance the care you deliver to patients. Connect with world-renowned leaders, experience a stimulating environment of new ideas and obtain passionate perspectives. Return home to your intensive care unit refreshed and motivated to share and apply new knowledge. Register by December 16, 2015 for savings.

**PREP ICU Q&A**

To subscribe to the *PREP® ICU Self-Assessment* programs, visit [http://prepicu.aap.org](http://prepicu.aap.org).

**Question**

A 12-year-old girl presents with respiratory failure and shock. Restoration of hemodynamic stability requires administration of 4 L of isotonic saline and aggressive catecholamine administration. Twenty-four hours after admission, she is markedly edematous but still requires ongoing volume expansion to maintain a central venous pressure of 8 mm Hg. Blood culture is positive for gram-positive cocci. Echocardiogram documents normal cardiac contractility and no chamber enlargement. Urine output is 2 mL/kg/h. To reduce her total body edema, she is given 1g/kg of 25% albumin and 1 mg/kg of furosemide.

Which of the following is necessary for this treatment of anasarca to succeed?

A. active renal albumin resorption must be intact  
B. capillary permeability to albumin must be low  
C. central venous pressure must be lower than interstitial pressure  
D. lymphatic flow must be submaximal  
E. renal vessels must be impermeable to albumin

**Answer**

Correct answer: B

In sepsis and other systemic inflammatory conditions, patients are prone to develop edema. In the lung, this may impair ventilation and gas exchange. In the chest wall, it may impede mechanical movement of the thorax. Ascites may impair diaphragmatic excursion. In closed spaces, such as the head and abdomen, it may increase pressure, cause compartment syndromes, or compress vital structures. Subcutaneous edema contributes to skin breakdown. Edema is visible evidence of severe illness. It tends to worry families and clinicians.

Normally, systemic capillaries "leak" fluid into the interstitial space at a continuous rate that approaches 30 L/d in adults. This fluid is rich in small molecular nutrients but poor in albumin because of restrictive capillary permeability to large molecules such as albumin. This capillary fluid flux is normal and vital to life. It carries nutrients to cells and clears cellular waste and metabolic products. The fluid that leaks into the interstitium is taken up by lymphatics and drained to the upper body, where it reenters the bloodstream via the subclavian veins.

The Starling equation describes the forces involved in transcapillary fluid flux:

\[ J = K_f([P_c - P_i] - \sigma [p_c - p_i]) \]
where \( J \) is the net fluid flux out of the capillaries into the interstitium, \( K_f \) is a proportionality constant, \( P_c \) is mean capillary pressure, \( P_i \) is interstitial pressure, \( \sigma \) is the capillary reflection coefficient, \( P_c \) is capillary oncotic pressure, and \( P_i \) is interstitial oncotic pressure.

In the typical systemic capillary, the \( \sigma \) is near 1. The capillary oncotic pressure of albumin is roughly 28 mm Hg in the blood and only 0 to 3 mm Hg in the interstitium. Albumin oncotic pressure, therefore, is a strong force to movement fluid into the interstitium. This is somewhat variable from one vascular bed to another. The renal glomerulus normally has a \( \sigma \) of 1. When the \( \sigma \) of the kidney is abnormally reduced, proteinuria occurs. Liver capillaries have very low values of \( \sigma \). This high permeability promotes the transport of protein into the liver for processing and out of the liver after hepatic synthesis.

The most critical mechanism of edema formation in sepsis is altered capillary permeability to fluid, albumin, and other blood proteins. An increase in \( K_f \) and the decrease of \( \sigma \) toward zero promote fluid leak and reduce the impact of the transcapillary oncotic pressure difference on net fluid flux. The albumin leak also reduces blood oncotic pressure and, as albumin accumulates in the interstitium, increases interstitial oncotic pressure.

The uptake of interstitial fluid into lymphatics is passive. The terminal lymphatic is highly permeable to water and protein. Lymph seeps into the terminal compartment of the lymphatic and is prevented from leaking back into the interstitium by the mechanical valve-like arrangement of the cells that form the terminal lymphatic. Lymph is then transported back to the circulation by mechanical forces that move it through a sequence of 1-way valves. These forces include peristaltic action of smooth muscle that lines lymphatics and incidental skeletal muscle activity.

As fluid pours into the interstitium during inflammation, lymphatic flow back to the circulation increases. This may be compromised by loss of skeletal muscle tone and inactivity in the paralyzed patient. Lymph flow is opposed by high central venous pressure because lymph reenters the circulation against that pressure. The potential for lymph flow is limited. Once it is exceeded by the rate of fluid flux, interstitial fluid accumulates and is recognized as edema.

In recovery, once the vascular permeability abnormalities improve and \( \sigma \) returns toward 1, serum albumin can again oppose fluid flux. Whether this promotes reuptake of fluid into the capillary or allows normal lymphatic function to remove excess interstitial fluid, the net effect is edema resolution. This occurs spontaneously in patients recovering from sepsis but may be hastened in some patients by albumin infusion. Resolution of the capillary leak in sepsis does not usually take place as rapidly as the first day after presentation, so attempting albumin infusion and diuretic therapy for the patient in the vignette may be a bit premature.

The healthy kidney does not need to reabsorb albumin because the glomerulus is impermeable to it and renal albumin resorption plays no role in tissue interstitial fluid flux. Obviously, if the kidney leaks albumin so significantly that therapeutic dosing cannot increase serum oncotic pressure, the therapy will be less effective and persistent loss of serum oncotic pressure will potentiate the edema.

Central venous pressure opposes lymph return to the circulation, but central venous pressure normally exceeds tissue interstitial pressure, yet lymph normally drains into the subclavian veins. This reflects the mechanical pumping of lymph back to the circulation and the efficacy of lymphatic valves at maintaining unidirectional flow.

**Suggested Readings**

American Board of Pediatrics Content Specifications

- Understand the factors that lead to the development of systemic edema
- Understand the factors affecting transcapillary fluid flux (Starling equation)
- Understand the factors that lead to ascites
- Understand the basic forces that determine net water flux across pulmonary capillary walls in health and disease