THE ULTIMATE
“Respiratory Engineer”

AARC Honors
Dr. Bruce K. Rubin
as 2012 Jimmy A. Young Medalist

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Most physicians view respiratory problems in terms of their symptoms and treatments. This year’s winner of the AARC’s Jimmy A. Young Medal does, too. But with dual degrees in medicine and engineering, his mind’s eye is a little more like the camera that zooms inside of intricate objects on the “CSI” television shows to reveal their innermost secrets. In his case, it’s through the nasal cavity, past the pharynx, into the trachea, and then down into the lungs, where he can get up close and personal with the slippery, slimy substance he enjoys tinkering with the most: the overabundance of mucus generated by respiratory conditions ranging from cystic fibrosis (CF) to plastic bronchitis.

“I have an engineering approach to our research,” explains Bruce K. Rubin, MD, MEng, MBA, FRCP, FAARC. “This involves applying engineering principles like taking complex problems and breaking them down into manageable bits and then reassembling everything and expecting it to fit together.” That unique perspective has not
only made him one of the most highly cited pediatric pulmonology researchers in the world, but also the perfect fit for the respiratory care profession.

“Much of what therapists do, be it aerosol therapy, mucus clearance, mechanical ventilation, and so on, involves various aspects of engineering,” says the AARC member. “I am always delighted to collaborate with and speak to respiratory therapy groups, as they really ‘get’ what I do far more than most physician groups. In many ways, the AARC is my true academic home.”

Ahead of his time

Dr. Rubin’s journey to scientific prominence can be traced back to his childhood. A self-described “nerd who challenged teachers,” his interests ranged all the way from the relatively tame pursuits of coin collecting, chess, and reading, to making explosives in the backyard. “Had I been born 25 years later, someone would have put me on ADHD medications,” he jokes now.

By the time he was in high school in Miami, FL, his teachers knew they had a gifted student and sent him off to take math and science classes at the local community college. From there it was on to Tulane University in New Orleans for a bachelor’s degree with majors in physics, mathematics, and computer science, followed by his master’s degree in biomedical engineering.

His interest in medicine grew out of his experience working with physicians as a biomedical engineer, and he enrolled in the Tulane School of Medicine, graduating in 1979. His path to respiratory care was solidified when he was a Rhodes Scholar and research fellow in paediatric bioengineering at Oxford University in England. “I was working in the biomedical engineering unit of the department of paediatrics at Oxford University John Radcliffe Hospital at a time when mechanical ventilation was just being introduced for premature babies,” he recalls. “I was developing algorithms for feedback loop control of mechanical ventilation based upon transcutaneous oxygen and CO₂ measurements.”

The idea of a microprocessor-controlled neonatal ventilator was ahead of its time — indeed, much of Dr. Rubin’s original work has only recently made its way into the mainstream — but the experience set the stage for what would be a career-long exploration into key respiratory parameters such as aerosol therapy, airway mucus secretion and clearance, and secretory hyperresponsiveness disorders, including middle lobe syndrome and plastic bronchitis.

Most important investigations

Dr. Rubin has hundreds of scientific publications to his credit, but when asked to point to his most significant investigations, he cites his work with mucus in cystic fibrosis, the causes of plastic bronchitis, immunomodulation, and the role of ciliated cells in the release of mucin — plus a study that resulted in what he calls his “Andy Warhol 15 minutes of fame.”

The CF studies took place early in his career. “We were interested in why CF mucus was so thick,” he explains. “We discovered that, in reality, the viscosity of CF sputum was lower than that of sputum from persons with asthma or chronic bronchitis.” Using homemade devices to measure the properties of mucus and sputum and to show how well sputum is transported by cough, they found thin mucus is actually harder to cough up than thicker, but less sticky, mucus.

The stickiness was attributed in part to surfactant inactivation in the airway, which could be treated with a surfactant aerosol. But perhaps most intriguingly, they found that so-called “mucus” in CF patients is not really
Dr. Rubin’s research into immunomodulation was the first outside of Japan to use macrolide antibiotics such as azithromycin as immunomodulators for the treatment of CF, and the first to show how these antibiotics work at the molecular level. The team is now searching for other drugs that could potentially have the same benefit and are looking into the development of a newly discovered drug as a potential therapeutic for inflammatory airway diseases.

Most recently, he and his colleagues have been studying ciliated cells, finding they secrete an enzyme that increases ciliary beating, causing neighboring mucous cells to release mucin. “This paracrine ‘conversation’ between these cell types may explain how mucus secretion and ciliary beating and clearance are tightly coupled,” he explains.

Dr. Rubin’s 5-STEP Approach to Clinical Research

This year’s winner of the AARC’s Jimmy A. Young Medal offers these five tips to respiratory therapists who would like to join him in the pursuit of research important to the respiratory care profession and the patients it serves.

**STEP 1**
Becoming a scientist is a process. First learn to ask lots of questions, and question dogma. Then learn and read enough to formulate alternative hypotheses and explanations.

**STEP 2**
Next develop a plan for testing these hypotheses and find out what work others have already done. The most attractive hypothesis is of little value if you can’t test it in the lab (for example, anything needing a time machine is out of the question) and is of no value if it has already been well studied.

**STEP 3**
The next step is to get the help and resources you need (money, collaborators, money, equipment, ethics approval, more money) and do the research.

**STEP 4**
This is not enough; you must then analyze and understand and write up the results. Embrace the unexpected!

**STEP 5**
Finally you must get the paper published, a process that requires another set of talents. So don’t be shy about asking for help.

“Rinse and repeat as often as necessary,” says Dr. Rubin. “Warning: This can become quite addictive.” ■
Dr. Rubin’s 15 minutes of fame, however, came when he decided to zero in on a mainstay in medicine cabinets everywhere. Working with two young colleagues, he showed that the misuse of Vicks VapoRub by placing it under or in the noses of infants produces dangerous mucus hypersecretion and mucociliary dysfunction. “This has now been confirmed around the world, and I have been told that this information has prevented hospital admissions and unnecessary therapy in very sick infants,” he says.

**Love at first sight**

Dr. Rubin’s research career has taken him from Tulane and Oxford to Queen’s University at Kingston and the University of Alberta in Canada, St. Louis University in Missouri, and Wake Forest University in North Carolina. His current post is the Jessie Ball duPont Distinguished Professor and Chair and professor of biomedical engineering at Virginia Commonwealth University (VCU) School of Medicine in Richmond and physician-in-chief at Children’s Hospital of Richmond at VCU.

Considering his relentless pursuit of information about mucus and how to clear it from the lungs, it was only natural that he meet up with the respiratory care profession along the way. James B. Fink, PhD, RRT, FAARC, an adjunct professor at Georgia State University and independent consultant and chief clinical officer for Aerogen in San Mateo, CA, recalls his first encounter with Dr. Rubin at a meeting on Florida’s Captiva Island in the late 1980s. “I was amazed to find a physician — no less a pediatric pulmonologist — who really understood medical aerosols in such depth, waxing lyrically on issues impacting effective use of devices,” says the AARC member. “It was love at first sight.”

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**Abracadabra!**

Dr. Bruce Rubin is known among his colleagues for his groundbreaking research in aerosol therapy and airway clearance. His young patients at the Children’s Hospital of Richmond would cite a completely different claim to fame.

To them, he’s the doctor who entertains them with magic tricks designed to interject a little fun into what would otherwise be just another pesky visit from a health care provider. “I am known for doing a bit of magic for each patient I see,” says Dr. Rubin — who has worked with the well-known physician, activist, clown, and VCU graduate Patch Adams — and has taught magic to physicians and therapists in 23 countries on six continents. “Figuring out new ways to alter perception fascinates me.”

Those who have seen him speak at the AARC Congress have experienced a little of this sleight of hand first hand. “I think people remember my Egan Memorial Lecture mostly for the rope trick I performed to illustrate the difference between particle size and particle size distribution in aerosols,” he jokes. “Magic is an outlet for creativity and enhancing communication with patients — and with audiences.”
The two would go on to collaborate on a number of publications on topics ranging from aerosols to secretion management, and Dr. Fink remembers being invited by Dr. Rubin to join the annual convocation of the “Phlegmish Masters” at an American Thoracic Society conference one year. “As a scientist, Bruce has furthered our understanding of multiple key aspects of respiratory care,” says Dr. Fink. “His work in better understanding mucus has led many to refer to him as ‘Mucus Welby, MD.’” For years his license plate said ‘MUCUS,’ as well, and he dubbed his car the “mucus transport.”

Fellow Georgia State professor, Arzu Ari, PhD, RRT, FAARC, who has also conducted studies on aerosol therapy, first met Dr. Rubin in 2008 and confirms his significant contributions to the understanding of aerosol drug delivery and mucus clearance. “I describe him as the ‘undisputed king of aerosol and mucus research,’” says the AARC member. She has also found him to be a great friend — someone who has always been there to help her with her own career decisions. “Bruce is a renaissance man with a multi-dimensional personality and talents that enlighten the lives of people around him, but most importantly he is one of the best friends I have ever had,” says Dr. Ari. “His kind personality, good listening skills, and rational suggestions always directed me toward the right path.”

Serving as a mentor to RC researchers is something Dr. Rubin has valued throughout his career, and still does today. “I have involved respiratory therapists in most of the work I do; and in a broader sense, I have been involved in respiratory therapy research mentorship both nationally and internationally,” says the physician, noting there’s an RT working on a PhD in his laboratory right now. “I hope that many more respiratory therapists get bit by the research bug.”

Dream come true

Respiratory care researchers aren’t the only RTs who have gained ground due to their association with Dr. Rubin. Bill Lamb, BS, RRT, FAARC, who is now the national clinical manager for the Ohio Medical Corporation, had his initial encounter with the physician back in 1991 when, as respiratory therapy department director, he interviewed him for a faculty position at St. Louis University and Cardinal Glennon Children’s Hospital. Impressed by his education, experience, and accomplishments, he had no trouble recommending him for the job. But he never expected he’d get such a strong supporter of the respiratory care profession in the bargain.

“I had formed a respiratory care committee, and with my medical director’s permission, invited Bruce to attend,” recalls Lamb. The committee included division chiefs from neonatology, pediatric intensive care, and allergy and immunology, along with the hospital’s chief residents and CF specialists. In the process of debating an initiative, Lamb had brought forward the idea to start a respiratory care consult service to assess and modify care plans. “Bruce interrupted and stated that all the respiratory care should be directed and driven by RTs, as ‘these respiratory therapists know more about respiratory care than any of them would ever know,’” Lamb says he thought he was dreaming.

With Dr. Rubin’s support and expertise, the consult service not only came to fruition but was just the beginning of an expansion of services for respiratory care. Dr. Rubin soon became the department’s new medical director, and Lamb credits him with helping them start everything from a pediatric asthma center, to clinics for pulmonary disorders and technology-dependent patients, to a pediatric pulmonary function lab. They also revived an infant PFT lab Lamb had initially set up before Dr. Rubin arrived.
“Sign this”

Given Dr. Rubin’s support for his respiratory therapists, Lamb knew he would be a great addition to the AARC; and during one of his regular Monday morning meetings with the physician, he decided to make it happen. “I placed an AARC membership application that I had already completed for him in front of him and said, sign this, I’m signing you up to be an AARC member,” recalls Lamb. “He asked why and I told him about the AARC and how he should get involved, as he is an honorary respiratory therapist if there ever was one.”

Dr. Rubin remembers his initial experiences with the AARC well. “I got Bill involved in our research and, in turn, he insisted that I attend the AARC meeting that year. I had an amazing time, with rooms full of RTs who really understood and were interested in aerosols and mucus.”

That was in 1992, and he’s attended nearly every meeting since. His relationship with the AARC, however, goes well beyond the annual meeting; and in every case he believes he’s gotten as much as he’s given. “As a medical advisor to the Missouri and Virginia state societies and a member of The North Carolina State Respiratory Care Board, I have learned the legislative process. As a member of the AARC Board of Medical Advisors, I have gained understanding as to how medical societies can work to support important respiratory care initiatives. As a trustee of the American Respiratory Care Foundation, I have had the privilege of working with some of the smartest people that I have met; and I have enjoyed seeing this philanthropic foundation focus to a greater extent on leadership and career development for people entering the field.”

A long-time member of the Respiratory Care Editorial Board, where he currently serves as an associate editor, he has also had a positive influence on the Journal. “Dr. Rubin has been a strong contributor to the Journal,” says Editor in Chief Dean Hess, PhD, RRT, FAARC. “As editor, I highly value his advice.”

But ask Dr. Rubin what his favorite AARC activity has been, and he’ll point squarely to his service on the International Committee. “I am energized by the enthusiasm of our respiratory colleagues from around the world, and I have been privileged to visit many of these colleagues as an invited speaker to their home countries. It is exciting to see respiratory care becoming an essential and highly respected part of the health care team around the world and to see the amazingly dedicated and visionary young leaders develop in many of these countries.”

“Gobsmacked”

Earlier in this article Bill Lamb called Dr. Rubin an “honorary RT,” and between his groundbreaking research into the bread-and-butter topics in respiratory care and his years of dedicated service to the AARC, he certainly deserves the title. As such, the news that he had won the Association’s highest honor shouldn’t have come as much of a surprise. But it did. “I describe the feeling as being ‘gobsmacked.’ I was incredibly surprised and elated,” says the physician. “It reminded me of two other moments in my life — when I learned I had won a Rhodes scholarship to Oxford and when my wife accepted my proposal of marriage.”

On both of those occasions he held off on the celebrations, fearing the people involved would somehow take back their good news. In this case, a flood of calls and emails from friends and colleagues reassured him that the Jimmy A. Young Medal was a real and lasting honor. “I felt much more comfortable going out and celebrating immediately,” says Dr. Rubin.

When he takes the stage in New Orleans to accept the Jimmy A. Young Medal, he can do so knowing thousands of people in his “honorary profession” of respiratory care will be celebrating right along with him. ■