



# The State of the World of Musculoskeletal Health

ORTHOPAEDIC SURGERY AND RHEUMATOLOGY  
2016–2017 ANNUAL REPORT

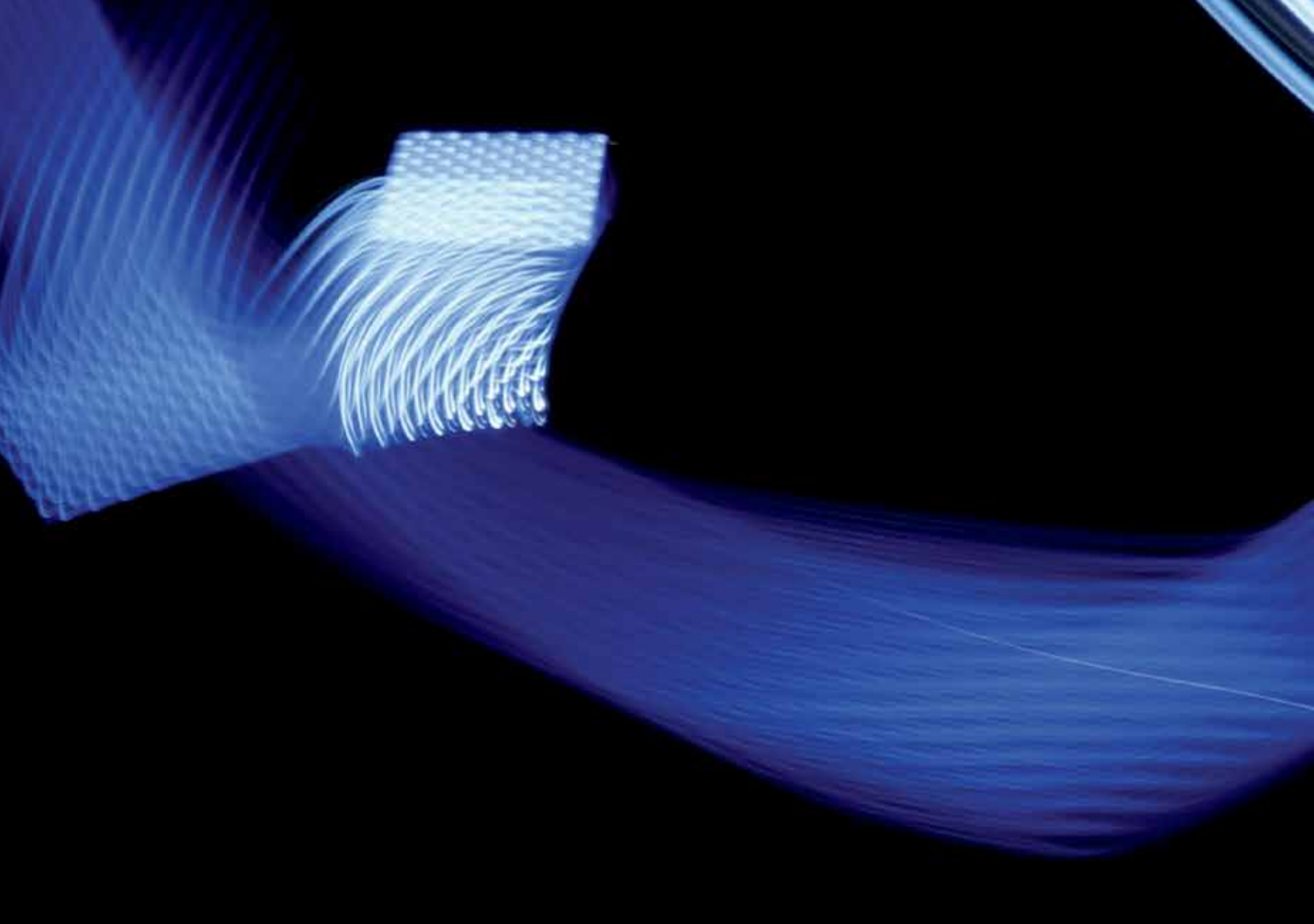
**HSS**

HOSPITAL FOR SPECIAL SURGERY

“With more  
precise methods  
of diagnosing  
and treating patients  
and cutting-edge  
surgical technologies,  
the opportunities  
to advance  
musculoskeletal  
care have never  
been greater.”

Louis A. Shapiro, President and Chief Executive Officer

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# Message from the Surgeon-in-Chief and Physician-in-Chief



Given our position at the leading edge of innovations and research in orthopaedics and rheumatology, it is our privilege and responsibility to report on the state of the world of musculoskeletal medicine. There has perhaps never been a more exciting time in the field. New technology is enabling us to provide more personalized, effective care than ever before. With three-dimensional surgical navigation, we can place implants safely and precisely; and gene expression analysis has enabled us to identify molecular pathways that are activated during disease activity. We are on the verge of a revolution in imaging: machine learning will, in the near future, help clinicians diagnose fractures and other disorders quickly and accurately, allowing patients a more precise treatment plan in some cases.

Other areas of innovation that are important for advancing musculoskeletal care depend on collaboration. Our Department of Medicine physicians work closely with our orthopaedic surgeons to improve spine surgery outcomes, for instance. We are currently testing medication interventions to strengthen bone prior to spinal fusion procedures. In addition, our basic scientists attend meetings with physicians to learn about clinical challenges. This often leads to discussions about problems that are best addressed through multidisciplinary research, such as post-surgical knee stiffness. Our arthrofibrosis study involves clinicians and scientists from nearly every department at HSS — Orthopaedic Surgery, Research, Biomechanics, Radiology and Imaging, and Pathology and Laboratory Medicine.

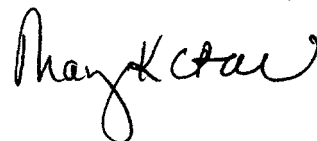
We also collaborate with many other institutions, whether it's through a multicenter, international trial or a partnership. Currently, we have alliances with medical centers in South Korea and Brazil and academic partnerships with institutions in China,

Greece, India and Austria. We exchange ideas and best practices with 20 other centers that span six continents through the International Society of Orthopaedic Centers (ISOC), which was founded by Surgeon-in-Chief Emeritus Thomas P. Sculco, MD, in 2006. Regardless of whether we specialize in orthopaedics or rheumatology, we're all experts in musculoskeletal health, and collaboration is the best way to advance the field.

To meet growing patient demand for our care, we have thoughtfully and carefully expanded our services to several new locations in the tristate area — Stamford, CT and White Plains, NY. We also recently opened the HSS Ambulatory Surgery Center (ASC), which is focused on outpatient surgery, in New York City. Our services have expanded to include not just diagnosis and treatment, but also prevention and wellness. We provide ACL injury prevention programs; a sports concussion program; and sports performance services. Our goal is to care for patients over the course of their lifetime — not just when they're ill or injured.



Todd J. Albert, MD  
Surgeon-in-Chief and Medical Director;  
Korein-Wilson Professor of Orthopaedic Surgery



Mary K. Crow, MD  
Physician-in-Chief; Chair, Department of Medicine; and Chief,  
Rheumatology Division



# Achievements

## #1 in the U.S.

for Orthopaedics for eight consecutive years by *U.S. News & World Report* "Best Hospitals" (2017–2018 rankings)



x 4

Consecutive Magnet® designations

This is the highest award for nursing excellence by the American Nurses Credentialing Center. HSS is the first hospital in New York State and one of only 37 hospitals in the U.S. to achieve the Magnet designation four consecutive times

## 9 Years

the Hospital has scored in the 99th percentile

This is the highest possible rank on "Likelihood to Recommend," a key indicator of customer satisfaction, compared to other Magnet hospitals in the Press Ganey database

## #3 in the nation

for Rheumatology by *U.S. News & World Report* "Best Hospitals" (2017–2018 rankings)



#1

Orthopaedic residency program

in both reputation and research output by the professional healthcare network Doximity



x 5

Consecutive years the Hospital has received the Press Ganey Guardian of Excellence Award®

a nationally recognized symbol of achievement in patient experience

## Best in Manhattan

for Pediatric Orthopaedics and #28 nationally by *U.S. News & World Report* "Best Hospitals" (2017–2018 rankings)



x 3

Consecutive years HSS has received the Healthgrades 2017 Outstanding Patient Experience Award™



# Fast Facts

92%

The Hospital's Net Promoter Score, a measure of customer satisfaction and loyalty

More than 20,000

Medical professionals from 110 countries who choose HSS eAcademy® for continuing medical education

76 countries

Patients traveled for Hospital services in 2016

435

Participants in our Academic Visitor Program in 2016

> 1,800

Patient-submitted stories

> 20

Professional and collegiate organizations HSS cares for and serves as team physicians

> 6.6 million

Unique visitors to our website (hss.edu) in 2016

20

Laboratories

112

Invention submissions at HSS in 2016

47

Active research registries at HSS, with more than 180,000 patients enrolled

\$43.2 million

Value of total federal research grants at the end of 2016

31,424

Surgeries performed in the 2016–2017 academic year

793

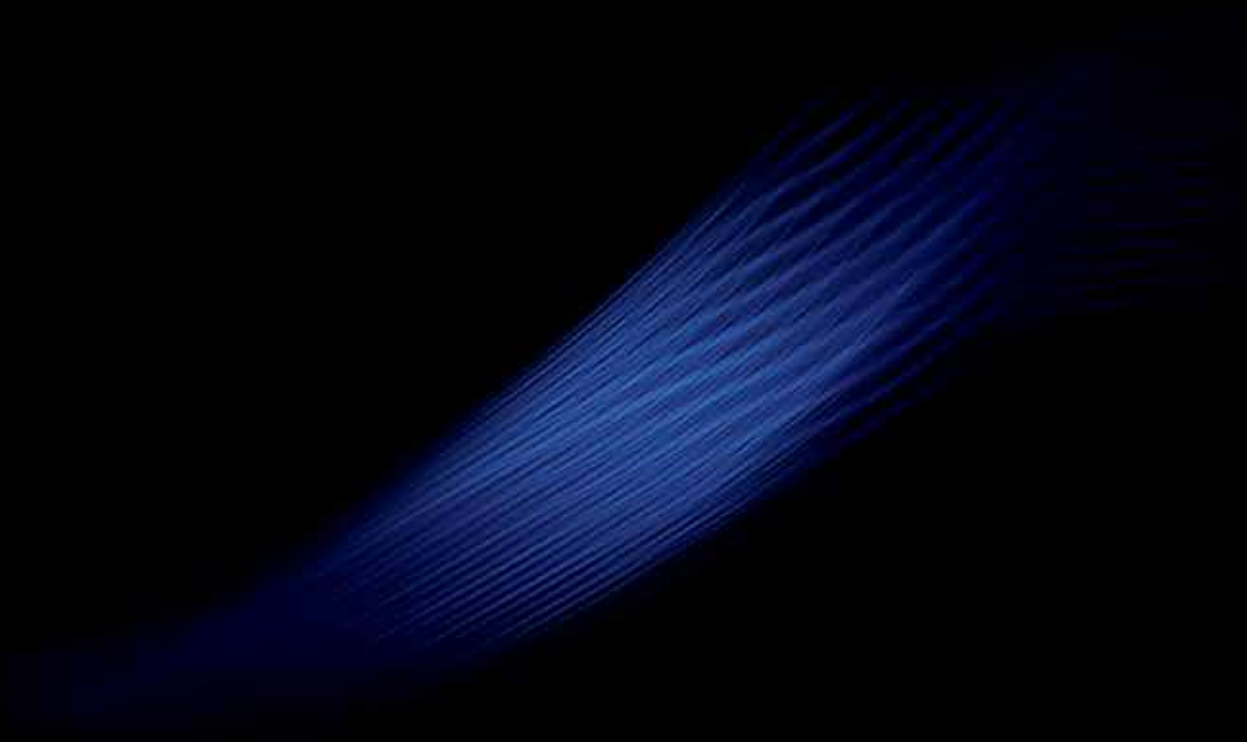
Research papers published in 2016

404,756

Outpatient visits in the 2016–2017 academic year

# Research

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# Predicting surgical success

A few years from now, an office visit might go something like this: A patient comes to see you for a spine issue or joint replacement consultation and wants to know what his chances are of playing 18 holes of golf after a procedure. You confidently tell him his chances are roughly 95 percent, what the potential risks are, and that there are two different surgical options based on patients with a similar history. He picks one of the procedures. He's very satisfied, has no significant complications and returns to playing golf after four months.

This scenario might seem far-fetched, but it may become a reality soon. At HSS, we are using predictive analytics to accurately predict a patient's chance of improvement or complications with different treatment options. We're collecting patient-reported outcomes (PROMs) on all of our patients so we can analyze data that will allow us to predict outcomes for future patients. "A patient will come in, and we'll measure his or her pain and functional status," says Catherine MacLean, MD, PhD, Chief Value Medical Officer. "We'll get a score, and based on that score, we can predict how well he or she will do after a knee or hip replacement." Since December 2016, we've collected about 20,000 preoperative PROMs, and we're in the process of collecting the postoperative ones. We're also starting to collect data on patients' goals. We will find out what goals they want to achieve — and the likelihood of achieving them.

Predictive analytics facilitates shared decision making between physicians and patients, which is especially important for elective surgery. "By more explicitly and

precisely defining the risks and benefits of a therapy or procedure, we can give patients the best treatment options," says Dr. MacLean. In addition, outcomes data enables us to predict complications and identify modifiable risk factors prior to a procedure. "We can much more precisely anticipate the specific risks for a complex patient or complex procedure — and determine the approaches we will take to mitigate those risks and optimize outcomes," says Frank Schwab, MD, Chief of the Spine Service. "I think that's very powerful. You take the power of large groups of patients and apply it to one specific patient and one specific surgeon. It will let us make much better decisions about when and how to treat a patient."

Research is underway to help inform better clinical decision making. Lisa A. Mandl, MD, MPH, Assistant Attending Physician, and colleagues found that total joint arthroplasty patients who were frail were at increased risk of suffering severe adverse events after the procedure. Since frailty is a potentially modifiable risk factor, it may be possible to address the condition prior to surgery to improve outcomes for patients. "You can identify who could potentially benefit from prehab," she says. Currently, Dr. Mandl is conducting a larger study to investigate the long-term effects of frailty.

Predictive analytics can also be used to improve diagnostic accuracy — especially when it comes to rheumatic diseases, which rely heavily on patient reporting of symptoms. Patient registries that contain data on thousands of arthritis patients, for instance, can help physicians better understand the type of arthritis a patient has. "We want to develop a tool that could be used broadly to help make diagnoses efficiently and accurately," says Dr. MacLean. "We're working on developing the right set of questions so we can say to patients, 'based on what you're telling me, here is the likelihood you have this particular condition.'"

**"Predictive analytics will let us make much better decisions about when and how to treat a patient."**

Frank Schwab, MD, Chief of the Spine Service

Currently, we are working with data from the Adult Reconstruction and Joint Replacement registry to build predictive models, which will be shared with our clinicians in the next year. Armed with data-driven information about a patient's diagnosis and treatment options, physicians will be able to more confidently manage patients. Not only will that enhance the physician/patient relationship; it will improve patient satisfaction. "Predictive analytics will help patients achieve their specific health objectives," says Dr. MacLean. "They will get the care they need to achieve their goals and avoid complications — in an efficient way."



# Using precision medicine to customize care

No two patients are exactly alike — even if they have the same injury or disease. As a result, their responses to surgery, medication and other treatments often differ. That's why precision medicine has become an important research focus. By understanding the underlying cause of a particular disease in an individual patient or a group of patients — as well as any predispositions to developing complications or progressing rapidly — physicians can create a personalized treatment plan.

Research is underway, but it's still in its infancy. "Even if we diagnose a patient correctly, we can't match the right treatment with the patient at the start," says Lionel B. Ivashkiv, MD, Chief Scientific Officer. "And that's an important goal, because there is often a time sensitivity with therapy. The sooner we can begin the most effective treatment, the better off the patient is." Take, for example, rheumatoid arthritis (RA). Treatment is primarily trial and error, and it can take months before the most effective medication is found. In the meantime, the disease has progressed, and the patient has suffered additional damage to his or her joints. With precision medicine, you can personalize treatment from the start.

At the Derfner Foundation Precision Medicine Laboratory (PML), which HSS launched in 2015, multidisciplinary teams of surgeons, physicians and scientists investigate molecular drivers of disease and search for new therapeutic targets. "If you can identify the pathway that has gone wrong, you'll know which therapy to use in a patient from the start," says Dr. Ivashkiv. The PML is pioneering the use of precision medicine in orthopaedic surgery. "We have found that patients respond very differently to injury and surgery," says Dr. Ivashkiv. For instance, about 40 percent of people who experience meniscal tears rapidly develop osteoarthritis, but we don't know why. Here, a snapshot of precision medicine research underway at HSS:

## IMPROVING THE SAFETY OF WARFARIN

Over the last decade, the blood thinner warfarin has led to more medication-related emergency room visits among older adults than any other drug. That's because patient responses are often unpredictable. Excessive doses can cause internal bleeding and inadequate doses may fail to prevent blood clots, but doses that are "excessive" or "inadequate" differ from patient to patient. In a multicenter trial published in the *Journal of*

*the American Medical Association* in September 2017, HSS researchers and others found that customizing the prescription to a joint replacement patient's genetic profile helps determine the optimal therapeutic dose, reducing the risks of major bleeding, blood clots and overdose. "We've known about these genetic differences for some time, but the web-based algorithm used in the trial gives practitioners a way to incorporate genetics into warfarin dosing," says Anne R. Bass, MD, Associate Attending Physician. "Now we're having discussions about using genetic testing on a more routine basis for HSS patients on warfarin."

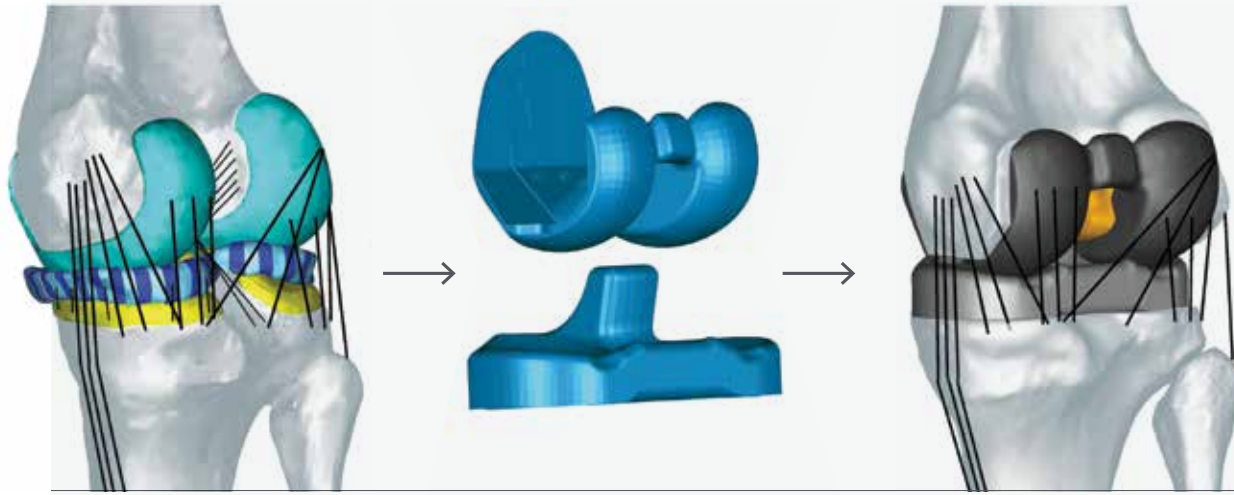
## INVESTIGATING PLATELET RICH PLASMA

There has been plenty of excitement about platelet rich plasma (PRP) — the use of a patient's own blood to promote healing of injured tendons, ligaments, muscles and joints. But much remains to be learned about PRP's mechanism of action. Scott A. Rodeo, MD, Attending Orthopaedic Surgeon and Co-Director of the Orthopedic Soft Tissue Research Program, working with Miguel Otero, PhD, Co-Director of the Precision Medicine Laboratory, has developed cell culture assays to investigate the biologic activity of PRP. "We want to correlate this information with patients' clinical outcomes," explains Dr. Rodeo. "How does PRP affect their symptoms and their function?" In addition, Drs. Rodeo and Otero are investigating formulations. "We're using the same PRP for

Scientists and clinicians at the Derfner Foundation Precision Medicine Laboratory investigate molecular drivers of disease and search for new therapeutic targets. *From left to right:* Lionel Ivashkiv, MD, Chief Scientific Officer; Miguel Otero, PhD, Co-Director of the Precision Medicine Laboratory; and Laura Donlin, PhD, Co-Director of the Precision Medicine Laboratory.







A computer model of the knee enables HSS physicians to customize ACL repairs and total knee replacement surgery. *From left to right: a computer model of an intact knee prior to replacement; a typical total knee replacement design; a computer model of the knee after the implant has been placed in the model of the knee.*

## Personalizing implant and graft procedures

In addition to searching for molecular drivers of disease, we are using innovative technology and certain types of implants to personalize musculoskeletal procedures. For instance, engineers in our Department of Biomechanics have created a computer model of the knee, which could be used to customize ACL repairs and total knee replacement surgery. A patient would have a 3-D scan, then one of our engineers would build a model of his or her knee. Based on the model, our engineers can determine precisely where holes should be drilled for an ACL graft or where components of a knee implant should be placed relative to a person's anatomy. "We're at the beginning of personalizing surgery," says Timothy M. Wright, PhD, Director of the Department of

Biomechanics. "What's fascinating is how little changes in angles and position can make a big difference."

Fracture treatment is also being personalized at HSS. Trauma surgeons are using small, non-locking implants to target each fracture instead of one large, bulky implant. "We look at the patient, his or her bone quality and the injury pattern, and we do fracture-specific reduction and fixation," explains David L. Helfet, MD, Chief of the Orthopaedic Trauma Service. By addressing each patient's injury pattern, surgeons are able to restore the anatomy better and promote healing.

muscle and tendon injuries," points out Dr. Rodeo. "It doesn't make sense, because these are very different anatomic and biologic environments. Our goal is to understand how different formulations might be used to treat specific problems."

### IDENTIFYING BIOMARKERS FOR PEDIATRIC LUPUS

Pediatric rheumatology researchers recently launched a study to identify biomarkers that will differentiate healthy children with a positive antinuclear antibody (ANA) from those at risk for developing systemic lupus erythematosus (SLE) or other pediatric rheumatic diseases. In addition, by using gene expression profiling and flow cytometry to pinpoint differences in patients at a molecular level, investigators hope to be able to tailor and begin necessary treatments earlier in the disease course, says Karen B. Onel, MD, Chief of the Division of Pediatric Rheumatology.

### IMPROVING KNEE REPLACEMENT OUTCOMES

We recently started to investigate a cause of patient dissatisfaction after total knee replacement surgery: arthrofibrosis, a disabling condition in which excessive scar tissue forms inside the joint, causing pain and stiffness that may require additional procedures and possibly revision surgery. A multidisciplinary team is analyzing patients' synovial tissue at the time of revision surgery to determine if a molecular marker exists that could indicate who is at risk for this condition — and

potentially prevent it from developing in the first place. "The ultimate goal is to identify patients at risk of developing an abnormal inflammatory response to surgery leading to pathologic scar tissue formation," explains Peter K. Sculco, MD, Assistant Attending Orthopaedic Surgeon. "Ideally, we would like to use a simple blood test to determine whether the molecular signature associated with arthrofibrosis is present." The next step would be to develop additional pharmacologic interventions that could be given around the time of surgery to prevent the condition. Says Dr. Sculco: "We currently do this with anti-inflammatories, but there are more targeted biologic interventions that could be more effective in high-risk patients."

### DEVELOPING RA PATIENT PROFILES

HSS is one of 16 sites participating in the National Institutes of Health (NIH)-funded Accelerating Medicines Partnership (AMP) study, which aims to identify and validate promising biological targets for therapy. Our Inflammatory Arthritis Center of Excellence (IAC) and Research Institute researchers are currently investigating molecular pathways in RA treatment response. Laura Donlin, PhD, Assistant Scientist and Co-Director of the Precision Medicine Laboratory, is spearheading the use of advanced genomic technologies to study RA patient samples at the single cell level. "If you take 100 patients, you could easily get three or four subgroups of patients who respond differently to treatment," says Vivian P. Bykerk, MD, Director of the IAC. "We want to personalize treatment to patient profiles."

# Realizing the promise of regenerative medicine

There's no shortage of enthusiasm about the field of regenerative medicine, since it offers the hope of curing conditions that can't be managed with traditional therapies. While research is largely focused on growth factors, it has become apparent that inflammation has a negative effect on tissue repair and regeneration because it can compromise the environment necessary for healing. "We are positioned to integrate these two areas of research — inflammation and the optimal environment for repair and regeneration," says Lionel B. Ivashkiv, MD, Chief Scientific Officer. "We are starting to search for ways we can intervene therapeutically to improve the regenerative environment."

HSS scientists are advancing the field by investigating the regeneration of tendon and muscle, as well as bone and spinal discs. We are also studying the potential for stem cells to manipulate the environment in damaged tissue to help normal tissue cells recover and function. "By integrating experts in musculoskeletal research with experts in inflammation research, we hope to create a paradigm shift in how the field approaches regenerative medicine," says Dr. Ivashkiv. Ultimately, physicians and patients around the world may benefit from the following initiatives:

## ACCELERATING RECOVERY FROM SPORTS INJURIES

Christopher Mendias, PhD, Associate Scientist in the Orthopedic Soft Tissue Research Program, is developing novel therapeutic interventions for common sports injuries, including rotator cuff disease and ACL tears. "We want to replace the damaged collagen strands in tendons," says Dr. Mendias. "To do this, we are using growth factors and stem cells to promote tendon repair. The growth factors — in particular, human growth hormone and insulin-like growth factor-1 — act as messengers for the cells in the tendon to produce more mature collagen strands. Because there are few cells in the tendon, we can also use stem cells to serve as a source of new tendon cells."

The hope is that growth factors and stem cells can accelerate the healing process, enabling patients to return to their favorite activities. "Our studies are especially important for professional athletes, who put an exceptional amount of wear and tear on their tendons," says Dr. Mendias. "It takes some time for tendons to heal, and time is important in professional sports. So if we can accelerate the

return to play, that could have a direct impact on these athletes. In addition, we know that tendon damage can lead to long-term weakness and disability after an athlete has retired. If we are better able to treat tendon injuries when they happen, it will likely have an important impact on the long-term health and quality of life of athletes."

## USING INTRINSIC STEM CELLS TO REPAIR TENDONS

Despite the hoopla surrounding stem cell treatment, research is still in its infancy. Using stem cells from bone marrow or fat to treat a musculoskeletal condition is unlikely to be effective, says Scott Rodeo, MD, Attending Orthopaedic Surgeon and Co-Director of the Orthopedic Soft Tissue Research Program. "There are few true stem cells in these tissues, so our ability to use them is limited," he explains. "Also, if you take stem cells out of bone marrow, for instance, and put them in a different environment, such as a tendon, they may behave differently." There is, however, hope for intrinsic stem cells, which are present in all tissues and are likely involved in early tissue formation. Dr. Rodeo discovered that they can be activated by a population of specialized endothelial cells. In ongoing work presented at the 2017 Annual Meeting of the American Orthopaedic Society for Sports Medicine, HSS researchers harvested stem cells from the inner walls of blood vessels in tendons and implanted them in injured tendons. Result? The strength of tendon repair was improved.

## COMBATING EXCESSIVE SCARRING

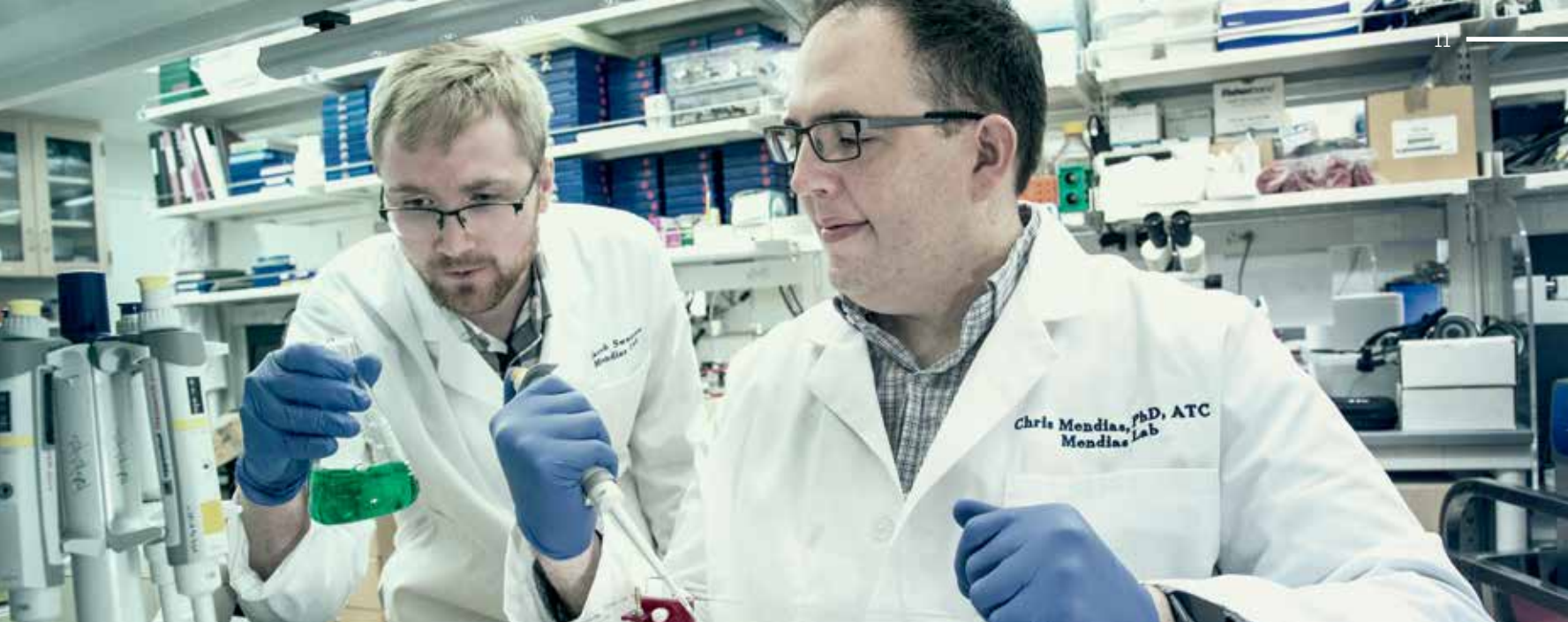
Franck J. Barrat, PhD, Senior Scientist in the Autoimmunity and Inflammation Program, is investigating excessive scarring, or fibrosis, which occurs in patients with certain autoimmune disorders and some who have undergone surgery. His research suggests that inflammation is directly linked to the establishment and maintenance of fibrosis. Dr. Barrat is investigating the role of toll-like receptor (TLR) signaling in inflammation, as well as that of plasmacytoid dendritic cells (pDCs) in autoimmune diseases like scleroderma. He has found that scleroderma patients have an abundance of pDCs in their skin. In laboratory studies, removing pDCs drastically reduced the level of fibrosis in skin — and reversed scarring.

Dr. Barrat's research lays the groundwork for new agents — as well as drugs approved for other

"We are positioned to integrate two areas of research — inflammation and the optimal environment for repair and regeneration — and hope to create a paradigm shift in how the field approaches regenerative medicine."

Lionel B. Ivashkiv, MD, Chief Scientific Officer





conditions — that can combat fibrosis. “One of my objectives is to provide the rationale for companies to test drugs that address these targets,” he says.

### REJUVENATING SPINAL DISCS

Preventing or even reversing spinal disc deterioration would be a boon to the millions who suffer from back pain and disability. A \$1.9 million NIH grant is enabling Chitra Dahia, PhD, Assistant Scientist and Director of the Spine Development and Regeneration Laboratory, to take a step toward that goal. “Our approach to treating disc disorders is to rejuvenate or reactivate them using the molecular pathways that are involved in their formation during embryonic stages and maintenance during neonatal stages,” says Dr. Dahia. Studies of a key cell-signaling pathway, Shh, are promising. “We have shown that Shh signaling is critical for the proliferation of disc cells and production of extracellular matrix by the disc cells,” says Dr. Dahia. “During aging, when Shh signaling is reduced, cell proliferation goes down and levels of the extracellular matrix decline.”

Activating a response to Shh signaling in only a few dormant cells in the disc increases the number of disc cells, extracellular matrix production and disc height. “The entire disc can be rejuvenated so that it resembles a young and healthy disc,” Dr. Dahia says of her research. “We are currently carrying out translational studies to validate our observations in the laboratory. We hope to observe a similar level of reactivation in patient samples.”

### IMPROVING SURGICAL OUTCOMES

Strengthening bone prior to surgery can be beneficial. “People with osteoporosis who are undergoing spine surgery don’t do as well,” says Richard S. Bockman, MD, PhD, Senior Scientist, Attending Physician and Chief of the Endocrine Service. The problem is that the hardware used in fusion or stabilization procedures is less likely to osseointegrate with osteoporotic bone.

The laboratory of Mathias P. Bostrom, MD, Senior Scientist, Attending Orthopaedic Surgeon and Chief of the Hip Service, has developed a preclinical model for investigating osseointegration and has shown that parathyroid hormone (related to the anabolic agent teriparatide) improves the integration of bone with orthopaedic implants. Our

physicians are experienced in using teriparatide, which inhibits osteoclasts, the cells responsible for bone breakdown, and preferentially promotes osteoblasts, which form new bone. Currently, the team, which includes newly recruited Assistant Scientist and Associate Attending Physician Emily M. Stein, MD, is culling outcomes data from HSS patient registries to determine how people on the drug fare after spine surgery. They plan to conduct studies of patients with osteoporosis who experience a fracture or need an orthopaedic procedure with the hope of improving healing and the osseointegration of hardware and implants. “There’s a place for these medications in a number of orthopaedic procedures,” says Dr. Bockman. Meanwhile, Dr. Bostrom’s laboratory is testing novel and improved therapeutic strategies using his preclinical model.

### INHIBITING BONE EROSION

The chronic inflammation that characterizes rheumatoid arthritis (RA), combined with estrogen loss and aging, doubles the risk of fractures and bone loss. Kyung-Hyun Park-Min, PhD, Assistant Scientist and Director of the Laboratory of Inflammatory Bone Destruction, is investigating the physiologic underpinnings of this process and identifying potential targets for treatment.

Dr. Park-Min’s laboratory focuses on the development of osteoclasts. Her team has identified two critical pathways in the process of osteoclast formation and used a pharmacologic inhibitor to successfully inhibit bone erosion in preclinical models. Recently, the team uncovered a new pathway called MYC/ERR $\alpha$ , which regulates the development of osteoclasts. In the study, which was published in the *Journal of Clinical Investigation* in July 2017, HSS scientists showed that targeting the pathway in a model of osteoporosis attenuated bone loss. Her team has also discovered another pathway, called MPMR, that controls both osteoclasts and osteoblasts. “We have found that this pathway suppresses bone erosion and promotes bone formation, too,” says Dr. Park-Min.

The research opens up an entirely new line of investigation in the quest to stop bone erosion and promote bone repair, which could greatly benefit people with RA. “We will identify a molecule to target and develop an inhibitor,” says Dr. Park-Min.

Christopher Mendias, PhD, Associate Scientist in the Orthopedic Soft Tissue Research Program, studies growth factors to promote tendon repair. Here, he and Jacob Swanson, Research Associate, prepare fragments of growth factor DNA for genetic sequencing analysis.



# Investigating health disparities to improve outcomes for all patients

As physicians, we always want the best possible outcomes for our patients. But certain nonclinical factors can have a surprisingly powerful effect on how patients fare after a procedure. In an effort to improve outcomes, surgeons and physicians at HSS are investigating health disparities.

Studies have shown that African American patients who have joint replacement surgery don't fare as well as Caucasian patients. In a review of the literature published in the *Journal of Rheumatology* in December 2016, HSS researchers found that African Americans experience more pain, less function, less satisfaction and a worse quality of life than Caucasians after total knee replacement surgery. But it wasn't until recently that clues to the disparities began to emerge. HSS researchers developed a novel method of linking outcomes from our arthroplasty registry to census tract data, enabling them to study variables such as race and education against a gradient of community poverty or foreign-born population. "This enabled us to separate the socioeconomic factors from the individual ones," says Susan M. Goodman, MD, Director of the Integrative Rheumatology and Orthopedic Center of Excellence.

In a new study presented at the American College of Rheumatology meeting in November 2017, HSS researchers used data from our total hip replacement registry of more than 4,000 patients to compare pain and function in African American and Caucasian patients two years after surgery. They found that African American patients living in areas of economic deprivation — as indicated by a large percentage of patients with Medicaid coverage — fared worse in terms of physical function than Caucasians in those neighborhoods. On the other hand, "the African Americans in wealthy neighborhoods had identical outcomes to those of Caucasians in the same neighborhoods," says Dr. Goodman.

Census data has allowed HSS researchers to delve further. In a recently published study in *Arthritis Care & Research*, we found that education levels mitigate the risk of poor outcomes. Our studies have shown that educated people living in impoverished communities fare well after surgery, but poorly educated people do not. "Having a college degree or higher level of education seems to compensate for the effects of community impoverishment," says Dr. Goodman.

The bottom line: Poverty interacts strongly with both race and education when it comes to joint replacement outcomes. "The goal is to come up with targeted interventions that will lead to more equitable outcomes," says Michael L. Parks, MD, Clinical Director of Orthopaedic Surgery and Associate Attending Orthopaedic Surgeon.

Another area of disparities research at HSS is pregnancy outcomes in lupus patients. A team led by Jane E. Salmon, MD, Director of the Lupus and Antiphospholipid Syndrome Center of Excellence, has examined rates of adverse pregnancy outcomes, including fetal death, preterm delivery due to preeclampsia, and fetal growth restriction. In a study published in *Arthritis Care & Research* in May 2017, the researchers found that poor outcomes were twice as common among African American and Hispanic women as Caucasian women. They also discovered that factors such as education level and median community income were important contributors to the disparities. The study was the first to show that socioeconomic status is a key driver of the differences in adverse pregnancy outcomes between African American and Caucasian women, says Dr. Salmon. "The next step is to unravel the impact of poverty and low levels of education on possible environmental triggers like stress," she says.

We are also studying disparities in patient expectations of surgery. The Foot and Ankle Service recently surveyed 352 patients undergoing a

HSS surgeons and physicians are conducting a wide range of studies on health disparities. From left to right: Jane E. Salmon, MD, Director of the Lupus and APS Center of Excellence; Bella Mehta, MBBS, Fellow, Rheumatology; Lisa Mandl, MD, Assistant Attending Physician; Susan M. Goodman, MD, Director of the Integrative Rheumatology and Orthopedic Center of Excellence; and Michael L. Parks, MD, Clinical Director of Orthopaedic Surgery and Associate Attending Orthopaedic Surgeon.





New York City TKA Study Participants with % Census Tract Foreign Born

Total # TKA participants per Tract (max 26)

- 1
- 5
- 10

Census Tract % Foreign Born

- 0% – 10%
- >10% – 20%
- >20% – 30%
- >30% – 40%
- >40% – 50%

Using census tract data, a team of HSS researchers found that living in an immigrant community has no impact on total knee replacement outcomes. The study was presented at the American College of Rheumatology Annual Meeting in 2017.

variety of procedures and found that those who were female and non-Caucasian were more likely to expect a complete improvement. There was no interaction between race and community poverty. This finding may help surgeons better counsel patients about the outcome they expect — and potentially influence patient satisfaction.

HSS researchers are also investigating barriers to care, including why some people cancel a scheduled joint replacement surgery. “These are patients who have come here, met the surgeon, and booked surgery,” says Lisa A. Mandl, MD, MPH, Assistant Attending Physician, who is leading the study. “We’re comparing them to patients who saw the same surgeon on the same day and did not cancel surgery.” The team will try to ferret out if there is a common underlying factor, such as a lack of transportation or perceived racism.

In another project, HSS scientists are studying outcomes in rheumatoid arthritis (RA) patients in New York City’s Chinatown neighborhood. “Some Asian patients tend to have more severe

lupus and RA than non-Asians,” says Dr. Mandl. “We wondered if there was any connection with using traditional Chinese medicine in place of Western medicine.”

The research actually showed the opposite was true: Patients who used Chinese medicine were actually *more* likely to take their Western medications. The next question is whether Chinese medications may interfere with patients’ prescribed medications. The findings underscore the need for rheumatologists to ask their Asian patients about the use of Chinese medicine.

“We aren’t simply trying to document that there are differences in outcomes,” says Dr. Parks. “Ultimately, we want to come up with solutions. This research allows us to determine if there are interventions that we can put in place to improve our outcomes.”

“The goal [of our disparities research] is to come up with targeted interventions that will lead to more equitable outcomes.”

Michael L. Parks, MD, Clinical Director of Orthopaedic Surgery and Associate Attending Orthopaedic Surgeon



# Striving for less invasive procedures

Over the past decade, there has been a growing demand for minimally invasive procedures — and the field has been moving in that direction. Of course, some question whether the outcomes justify the additional training and equipment. At HSS, we are finding that in many cases, improved outcomes make the investment worthwhile.

“We are marrying less destructive techniques with radiologic, robotic and computer-assisted techniques to make procedures less invasive, less injurious and, ultimately, higher performance,” says Todd J. Albert, MD, Surgeon-in-Chief and Medical Director. “We feel it’s our obligation to not just do the new thing but also to test the new thing and make sure it’s viable — and then maximize the capabilities if we can improve upon them.”

## IMPROVING OUTCOMES WITH LESS INVASIVE SURGERY

In the early 2000s, Steven B. Haas, MD, Attending Orthopaedic Surgeon and Chief of the Knee Service, pioneered small-incision total knee replacement, which uses incisions half the size of the traditional approach and preserves the quadriceps tendon, helping to speed recovery. The knee is bent less than usual during the operation, allowing the soft tissues to relax and exposing more of the joint without having to cut additional tissue. “If we cut less of the patient and perform less dissection, then there is less tissue trauma,” says Dr. Haas, who received a patent for the procedure in 2009. “That improves recovery.”

Research showed that patients who had the less invasive procedure fared as well at six weeks postoperatively as patients who had the traditional operation at 12 weeks postoperatively. These patients also used less pain medication, according to a study published in *Clinical Orthopaedics and Related Research*.

Flexion is also better among patients who have the small-incision knee arthroplasty. In research published in *Clinical Orthopaedics and Related Research*, we found that patients who received the less invasive procedure had a mean flexion of 114 and 122 degrees at six and 12 weeks, respectively, compared with 95 and 110 degrees at the same time periods in a control group of patients who had the traditional procedure. The average range of motion at one year postoperatively in the minimally invasive total knee replacement group was 125 degrees, compared to 116 degrees in the control group. More than 5,000 minimally invasive knee replacements have been performed at HSS since 2001, and other surgeons around the country have adopted the technique.

We have also found success with minimally invasive spine surgery. “Our results show that we can address anything in the spine minimally invasively and with outcomes as good as open surgery,” says Sheeraz Qureshi, MD, MBA, Associate Attending Orthopaedic Surgeon. “It’s really a paradigm shift.”

Dr. Qureshi performs nearly 300 minimally invasive spine procedures each year, including lumbar fusion as well as motion-sparing non-fusion procedures. Such procedures entail shorter hospital stays, less immediate and short-term postoperative pain, and a lower risk of infection and need for blood transfusions.

Taking a less invasive approach to spinal surgery may allow some patients to avoid fusion, which increases the risk of creating new problems. “Traditional open fusion comes with a significant amount of what I call collateral damage,” since accessing the spine itself can create instability, Dr. Qureshi says. “With minimally invasive surgery, there are cases where we can address the same pathology but without fusion and without creating instability.”

If a patient has a disc problem, he or she may be able to avoid fusion and instead opt for disc replacement surgery, another example of motion-sparing technology. “This is an increasingly popular option for the cervical spine,” says Dr. Qureshi. “My motion-sparing disc replacement patients are some of my happiest patients. They are less likely to have adjacent segment issues.”

Our surgeons are also using leading-edge techniques such as XLIF, a method of implanting a fusion cage through a small side incision. Another procedure, minimally invasive lumbar decompression, relieves nerve compression through small incisions in the back. With minimally invasive posterior fusion, surgeons aim to decompress nerves and place titanium stabilization implants through small incisions. “These techniques are ways of achieving traditional surgical goals in spine surgery,” says Russel C. Huang, MD, Associate Attending Orthopaedic Surgeon and Director of the Spine Surgery Clinic. “We’re able to achieve similar work on the inside but with smaller incisions on the outside and less immediate postop pain and less trauma to the paraspinal muscles.”

In some cases, portions of traditionally open procedures can be done less invasively. “We are finding ways to perform parts of open adult scoliosis surgery percutaneously,” says Dr. Albert. “We can open a smaller part of the incision to do the work that has to be done in an open way and then do the rest percutaneously. I think this will be done more and more in the future.”

David J. Mayman, MD, Associate Attending Orthopaedic Surgeon and Clinical Co-Director of the Computer-Assisted Surgery Center, performs a computer-assisted total knee replacement using a device called OrthAlign to improve the accuracy of cuts in the bone, which can lead to better overall alignment of the leg. He is assisted by Ronald Huang, MD, Fellow, Orthopaedic Surgery.



While long-term outcomes of minimally invasive spine procedures are being studied, Dr. Qureshi is confident that they will be positive. “I think we’re going to show that minimally invasive outcomes are actually better than those associated with traditional surgery because we’re less disruptive to those collateral areas in the spine,” he says. “I’m starting to notice that we are having fewer long-term problems in a lot of our patients.”

A team of anesthesiologists, surgeons and other medical professionals have launched a new initiative to define best practices for minimally invasive spine surgery and devise first-ever, evidence-based protocols to improve the surgical and post-surgical experience, including analgesic relief. To create the Enhanced Recovery After Minimally Invasive Spine Surgery Pathway, the team is mining patient data. “We’re hoping to have the prospectively defined pathway by the end of next year,” says Dr. Qureshi. In the future, other institutions may be able to use the protocol with their patients.

### USING TECHNOLOGY TO ADVANCE PERFORMANCE AND LONGEVITY

In the end, results are what really matter to patients. “There is now some data showing that robotic placement — especially in unicompartmental knee surgery — and computer-assisted technology can improve positioning and thereby improve the longevity and performance of a joint replacement,” says Dr. Albert. “Similarly, in spine surgery, there is now some evidence that robotic surgery can decrease the chance of injuring a nerve or neural elements when placing devices.”

HSS surgeons perform more than 1,000 robotic and computer-assisted procedures every year. “We encouraged the adoption and evaluation of some of these technologies that are now in widespread use,” says Andrew D. Pearle, MD, Associate Attending Orthopaedic Surgeon and Director of the Computer-Assisted Surgery Center. The technology is aimed at improving implant positioning. “For the 50 years we’ve been doing joint replacements, we’ve been using mechanical guides where we look at the bone, we use our eyes and we get things pretty close,” says David J. Mayman, MD, Associate Attending Orthopaedic Surgeon and Clinical Co-Director of the Computer-Assisted Surgery Center. Dr. Mayman performs more than 700 computer-navigated hip and knee replacement surgeries annually. “But we know that somewhere in the neighborhood of 30 percent of the time, we don’t get the implants exactly where we want to put them. We know that when we use computerized tools, we can achieve accuracy rates well over 95 percent.”

Some of the technology is image-based, so it allows us to use CT scans, which generate three-dimensional images on a computer, to plan where we want to place an implant. Like a car’s GPS system, the technology gives surgeons a “road map” to guide them in making precise incisions. There is also an execution tool, which helps to actualize the surgical plan in the OR. That tool could be a robotic arm, which we use for cutting bone. “The one I use has haptic guidance, so it enables me



to cut the bone I want to remove but prevents me from cutting bone outside the boundary,” says Dr. Pearle. “So I always remove the bone I intend to remove based on my preop plan.”

Sheeraz Qureshi, MD, MBA, Associate Attending Orthopaedic Surgeon, uses three-dimensional navigation to perform a minimally invasive lumbar fusion.

The biggest impact we are seeing in terms of clinical outcomes is the partial knee replacement, a minimally invasive but technically challenging procedure, says Dr. Pearle. In a study published in *Knee* in March 2017, we showed that using a robot for partial knee replacement is linked to lower failure rates. “Our multicenter study showed that our survivorship was 99 percent at two and a half years, which is a dramatic improvement compared to that of manual techniques,” says Dr. Pearle. “We got a 50 to 70 percent drop in the failure rate. Also, patients consistently feel better after a robotic-assisted partial knee replacement. It’s a safer operation, with one-third of the complications. Patients end up with a more natural feeling knee, and they experience a shorter recovery and a faster return to work.”

Another study, which was published in *Knee Surgery, Sports Traumatology, Arthroscopy* in November 2016, showed that soft tissue balancing improved when computer-assisted systems were used compared to traditional knee arthroplasty. We also found that lower leg alignment, component positioning and soft tissue balancing were better when patients had robotic-assisted surgery compared to traditional surgery.

Ultimately, we want to know the long-term outcomes of the procedures, so we are using our patient registry to follow patients over time. The registry contains information such as the type of implant a patient received; the surgical technique that was used; and the type of instruments used. “We are starting to get some answers, but we need 20-year outcomes data,” says Dr. Mayman.

In addition to studying the accuracy of robotic arms and computers, we will, in the future, use a more objective way to determine how patients fare after surgery: wearable devices. “We will use these technologies to prove that patients are more functional, that their range of motion is better, and they’re doing more things,” says Dr. Albert. “We could implant these devices at the time of surgery so we can determine whether a technology really works in a patient.”



# The brave new world of musculoskeletal health

These days, there are enormous opportunities for the field to innovate, given the introduction of machine learning/robotics, advanced imaging, computational modeling and additive manufacturing. “When new technologies like these converge in a fortuitous fashion, our opportunity is to find a way to combine them,” says Robert N. Hotchkiss, MD, Medical Director, Innovation. “Fortunately, at HSS, we have engineering and computational talent — and clinical insight from experience.”

Although we often try to tackle uncommon disorders, those fringe cases inform how we manage more common problems. Case in point: a new elbow replacement we’ve been designing, which takes advantage of additive manufacturing. This technology has allowed us to rethink design and fit in novel and previously impossible ways. “Now we are looking at other joints that we thought we could never build implants for,” says Dr. Hotchkiss. “With additive manufacturing, we can create shapes, surfaces, stiffnesses and flexibilities that were impossible to manufacture in a subtractive environment.” That, of course, is just the tip of the iceberg. The advances below are already making — or will soon make — a difference for many patients.

## THE MICROBIOME AND INFECTION RISK

Periprosthetic joint infections are among the most devastating complications of total joint replacement, and they often lead to costly revision arthroplasty. There may be a novel way to prevent or reduce their incidence, though. For the first time ever, HSS researchers and Ithaca, NY-based Cornell University collaborators have shown that altering the microbiome has an effect on infection rates in preclinical models. In a study funded by the National Institutes of Health (NIH), Mathias P. Bostrom, MD, Attending Orthopaedic Surgeon and Chief of the Hip Service, and his collaborators, Christopher J. Hernandez, PhD, and Marjolein van der Meulen, PhD, found that disturbing the gut flora significantly increased the risk of infection. In an experimental model, infection rates climbed from 50 percent to 80 percent, indicating that the microbiome has an effect on immune capacity. “This has direct clinical implications for patients with gastrointestinal issues and those who have been on an antibiotic,” explains Dr. Bostrom, who speculates that probiotics that improve gut health may protect from joint infection. “Just like we make sure that patients with diabetes have their blood sugar under good control before surgery, it may be that we should optimize patients’ gastrointestinal tracts with probiotics before joint replacement surgery.” Plans are underway to study the impact of probiotics on infection rates.

## MACHINE LEARNING

If a fracture is discovered late, it may require surgery. To reduce the chances of diagnostic error, we are developing machine learning to study fractures on X-rays. With this new technology, a computer is trained to read and interpret X-rays. It’s like having a virtual expert radiologist who can increase the efficiency and accuracy of the diagnosis. Aaron A. Daluiski, MD, Associate Attending Orthopaedic Surgeon, and Dr. Hotchkiss recently conducted a study on a convolutional neural network and found that it is fast and accurate and improves fracture detection by clinicians. “I’m very excited about it — I think it’s the future,” says Hollis G. Potter, MD, Chairman of the Department of Radiology and Imaging. “We hope to begin using the technology in the next year. This will enhance the efficiency of our expert team of radiologists.”

## LUPUS BIOMARKERS

Lupus is notoriously difficult to manage because it tends to have periods of stability followed by symptom flares. “One of the challenges is to control disease activity when a patient has a flare,” says Mary K. Crow, MD, Physician-in-Chief and Chair of the Department of Medicine. “Ideally, we would be able to anticipate when someone is going to have a flare and intervene therapeutically.” Using RNA sequencing technology, Dr. Crow’s lab has been studying the blood of lupus patients over time. Her team was able to identify several molecular pathways that are activated in patients during peak disease activity. She recently received a patent for a composite biomarker that includes both RNA transcripts as well as a plasma protein to measure disease activity. “Now we are validating the utility of the biomarker panel in additional patients,” says Dr. Crow. “We think the panel might not only be able to show an association with current disease activity but also future disease flares.”

## “SMART” SENSORS

To improve outcomes for patients undergoing meniscus and cartilage transplantation, we have started to investigate the use of sensor technology. These devices provide engineering information in real time in the OR, helping surgeons make better decisions. The sensors are currently being used in a study of patients who are undergoing meniscal allograft transplantation. A device applies a load to the knee, and the sensor measures the pressure. Scott A. Rodeo, MD, Senior Scientist and Attending Orthopaedic Surgeon, and Suzanne A. Maher, PhD,

HSS physicians recently developed a new total elbow implant, which enables a surgeon to use linked or unlinked versions, increasing the potential for greater durability and longevity.





Associate Scientist and Associate Director of the Department of Biomechanics, will relate those pressures to patient outcomes. "This is our first foray into technology that enables surgeons to do something differently in the OR based on the data received from the sensor," says Timothy M. Wright, PhD, Director of the Department of Biomechanics. "Ultimately, it will allow us to establish that the improvement achieved in the OR led to better outcomes." Next year, we will start to study the use of sensors in the far more common procedure of partial meniscectomy.

### A NEW AND IMPROVED TOTAL ELBOW IMPLANT

We recently developed what we're calling a Modular Total Elbow System in collaboration with Lima Corporate, an Italian medical device company. It integrates new design concepts and improved surgical techniques. We have optimized the bearing surfaces to enhance the transfer of load across the elbow and be more wear-resistant. Three-dimensional surfaces are intended to improve the way the implant becomes affixed to the surrounding bone. In addition, unlike previous implants, which were linked, "the modular connections between the bearing and stem portions of the components give the surgeon the opportunity to use linked or unlinked versions," says Dr. Wright. That increases the potential for greater durability and longevity, says Dr. Hotchkiss.

Meanwhile, enhanced surgical techniques allow the modular components to be implanted without having to remove the triceps muscle. "Maintaining attachment of the triceps should speed rehabilitation considerably and provide the patient with more normal function," says Dr. Wright. We plan to submit the implant to the FDA for approval and are hoping it will be sold worldwide in 2018.

### GAIT SIMULATOR

To develop better treatments for foot and ankle conditions, Jonathan T. Deland, MD, Attending Orthopaedic Surgeon and Chief Emeritus, Foot and Ankle Service,

created an advanced gait simulator that uses robotic technology to replicate the act of walking. "The gait simulator will allow us to understand how different surgical treatments affect foot and ankle function so that we maximize outcomes before we even go to the operating room," says Scott Ellis, MD, Associate Attending Orthopaedic Surgeon. "It will also help us determine which implants, particularly total ankles, best restore normal ankle and foot motion and mechanics. There is currently no other or better way to simulate real-life scenarios." We have confirmed that the simulator reproduces human foot and ankle motion and emulates real-life walking, according to a study published in the *Journal of Orthopedic Research* in September 2016. Currently, we are using it to compare ankle replacement to ankle fusion procedures. We recently discovered that ankle fusion causes increased



motion and, ultimately, stress in the foot joints, which may lead to arthritis, according to a study published in *Foot & Ankle International* in 2017.

### 3-D SURGICAL NAVIGATION

This game-changing tool allows surgeons to view where they are within the patient's body in three dimensions, in real time. In addition to enabling surgeons to make smaller incisions, the technology helps to increase the safety of a procedure. With spine surgery, for example, "we're putting screws in deformed spines at multiple levels," explains Roger Widmann, MD, Attending Orthopaedic Surgeon and Chief of the Pediatric Orthopaedic Service. While surgeons have traditionally performed procedures like this using their anatomical knowledge and surgical expertise, 3-D navigation "allows us to ascertain that we've got the appropriate trajectory for the implants, so we can avoid vital structures before we put them in," says Dr. Widmann. While the tool does not replace surgical expertise, "it provides you with incredible expertise in the OR in real time, which is when you need it."

### THERAPIES FOR OSSEointegration

When performing joint replacement, one of the challenges is to integrate the bone with the implant and prevent loosening over time. Previously, we found that loading the implant and treating a patient with parathyroid hormone (teriparatide) was effective in promoting osseointegration. Now we're building on that work by exploring novel molecular pathways involved in the biology of bone growth in an effort to develop new therapies to promote osseointegration during spine surgery and arthroplasty. "Dr. Bostrom and Emily Stein, MD, at HSS, working with their engineering and biology colleagues Drs. Hernandez and Van der Meulen and Adjunct Senior Scientist Paddy Ross, PhD, are pioneering this," says Lionel B. Ivashkiv, MD, Chief Scientific Officer. "The goal is to facilitate healing and enhance the longevity and functionality of these implants."

We are using our gait simulator to compare ankle replacement to ankle fusion procedures. *From left to right:* Scott Ellis, MD, Associate Attending Orthopaedic Surgeon; the simulator's creator, Jonathan Deland, MD, Attending Orthopaedic Surgeon; and Constantine A. Demetracopoulos, MD, Assistant Attending Surgeon.

"When new technologies converge in a fortuitous fashion, our opportunity is to find a way to combine them."

Robert N. Hotchkiss, MD, Medical Director, Innovation

# Patient Care

## Pioneering best practices

Today, musculoskeletal healthcare providers are treating a growing number of sports-related injuries in children and performing more joint replacements in active, middle-aged people. In the coming years, we will be seeing an explosion in the geriatric population. "We already see a large number of geriatric fracture patients, and we want to be pioneers with regard to multidisciplinary patient care pathways that include orthopaedic surgery, anesthesiology, internal medicine and geriatrics," says William M. Ricci, MD, the new Chief of the Orthopaedic Trauma Service as of September 2017.

At HSS, our focus is not just on treating injuries or rheumatic conditions at a single point in time; it's on caring for patients throughout their lives. To that end, HSS clinicians and scientists are partnering to develop innovative ways to diagnose, treat and prevent musculoskeletal injuries and diseases and, ultimately, advance the field.

### PREVENTING PREGNANCY LOSS IN PATIENTS WITH ANTIPHOSPHOLIPID SYNDROME (APS)

Pregnant women with antiphospholipid syndrome (APS) who test positive for lupus anticoagulant (LAC) are at high risk of miscarriage or premature delivery due to poor placental development and preeclampsia. There is no effective treatment for these patients, so Jane Salmon, MD, Director of the Lupus and Antiphospholipid Syndrome Center of Excellence, has investigated the condition in experimental models and found that blocking TNF- $\alpha$ , a mediator of inflammation, prevents adverse outcomes in laboratory studies. She identified a drug, certolizumab, which is approved for the treatment of rheumatoid arthritis (RA), psoriasis and Crohn's disease that does not cross the placenta and has been safely used by hundreds of patients with these conditions throughout pregnancy. Dr. Salmon is now recruiting patients for a multicenter trial called the IMPACT study (Improve Pregnancy in APS with Certolizumab Therapy). "We're going to give this drug to high-risk patients at the beginning of their pregnancies and try to cut their risk of miscarriage and preterm delivery by 50 percent," she says. "This is the first trial of a biologic therapy to prevent pregnancy complications."

### AVERTING LIFE-THREATENING INFECTIONS IN PEDIATRIC SPINE PATIENTS

In February 2017, we published one of the largest studies of infection rates in pediatric spine surgery in *Spine*. We reviewed all the clinical and microbiology records of more than 1,000 pediatric patients who underwent spinal fusions for deformity at HSS between 2000 and 2012. Two-thirds of the patients in the study underwent spinal fusion for idiopathic scoliosis, and in this population, the overall incidence of deep surgical site infection was 1 percent. The incidence of deep surgical site infection varied by diagnosis and associated co-morbidities, and the highest rate occurred in patients with neuromuscular conditions. The most common pathogens were *Staphylococcus epidermidis* and methicillin-sensitive *Staphylococcus aureus* (MSSA). "This information is educational for patients because you can tell them what their risk is — not based on a handful of patients, but based



Robert F. Spiera, MD, Director of the Scleroderma, Vasculitis & Myositis Center of Excellence, examines patient Carolyn Ouderkirk, who participated in a clinical trial of a new treatment for giant-cell arteritis.



on 1,000 patients," says Roger F. Widmann, MD, Attending Orthopaedic Surgeon and Chief of the Pediatric Orthopaedic Service. "We can take specific precautions — such as giving prophylactic antibiotics — in patients at high risk of infection. This has, in our experience, decreased the rate of infection, most notably in the neuromuscular population."

### DEVELOPING A NEW STANDARD OF CARE FOR GIANT-CELL ARTERITIS PATIENTS

In May 2017, the U.S. Food & Drug Administration (FDA) approved tocilizumab, a monoclonal antibody that blocks the interleukin-6 receptor, for giant-cell arteritis (GCA). It is the first FDA-approved drug for the condition. Robert F. Spiera, MD, Director of the Scleroderma, Vasculitis & Myositis Center of Excellence, was involved in the design of the GiACTA clinical trial, which led to its approval for GCA. The process of designing the trial was complex, since ensuring blinding of investigators to the biomarkers that are used to help assess the activity of the disease posed a major challenge

in terms of patient safety.

It resulted in a separate publication regarding trial design. HSS also served as a study site for the GiACTA trial, which was published in July 2017 in *The New England Journal of Medicine*.

Researchers found that more than half of patients who received weekly or biweekly tocilizumab injections in addition to a 26-week prednisone taper experienced sustained remission, compared to only 14 percent of a placebo group that underwent a 26-week prednisone taper, and 18 percent of the placebo group that underwent a 52-week prednisone taper.



### IMPROVING OUTCOMES IN GERIATRIC PATIENTS WITH HIP FRACTURES

One-year mortality after a hip fracture can be as high as 50 percent, and there are few modifiable risk factors. There is evidence, however, that a large percentage of these patients are socially isolated. Lisa A. Mandl, MD, MPH, Assistant Attending Physician, and colleagues are conducting a study of geriatric patients being treated for low-trauma hip fractures to evaluate the association between preoperative social isolation and death, short-term complications and patient-reported functional recovery. This study, presented at the American College of Rheumatology meeting in 2017, has identified a trend toward increased mortality among the socially isolated (meaning how integrated a patient is in his or her community). There was a 9.5 percent mortality rate among socially isolated patients after three months compared to a 1.5 percent mortality rate for non-socially isolated patients. Dr. Mandl and her team are continuing to recruit and follow patients to determine whether social isolation

or changes in social isolation are associated with longer term functional outcomes or mortality. If she is able to confirm an association between social isolation and mortality in these patients, the next step will be to develop an intervention to give these patients regular human contact and support. The intervention could take the form of phone calls or in-person visits.

### SEARCHING FOR BETTER MEDICATIONS FOR LUPUS

We are constantly looking for ways to decrease lupus patients' reliance on steroids, which are effective but can be damaging. Over the last 15 years, our research has helped to set the stage for Phase III clinical trials of a groundbreaking new medication. In an effort to understand the immunologic basis of lupus, Mary K. Crow, MD, Physician-in-Chief and Chief, Rheumatology Division, and two other groups around the country discovered that lupus patients produce an increased amount of type I interferon, an immune system product typically expressed in a viral infection. They hypothesized that if you block type I interferon or the receptor that recognizes interferon, you might be able to bring lupus patients' immune systems under better control and improve the clinical manifestations of disease. A Phase II clinical trial of an anti-type I interferon receptor monoclonal antibody in lupus patients showed the drug was having some efficacy and was reasonably safe, according to a study published in *Arthritis and Rheumatology* in February 2017. "Most lupus investigators would agree that the Phase II clinical trial had the most successful data to date in a lupus clinical trial," says Dr. Crow. "If this drug becomes available, it's possible that lupus patients will feel better, experience less severe complications, and reduce their reliance on potentially damaging drugs." The next step is a randomized, double-blind, placebo-controlled Phase III trial, which had just completed enrolling patients in multiple centers around the world at press time. "The drug is very promising, and we hope it will be successful," says Dr. Crow. "If it is, it will be an important step on the way to FDA approval for lupus patients."

### PRESERVING HIPs IN YOUNG PEOPLE

In addition to repairing a patient's anatomy through hip arthroscopy, pelvic and femoral osteotomies and surgical hip dislocation, we hope to further improve patient outcomes by replacing or regenerating missing articular cartilage. There are a growing number of restorative cartilage products available that may be used in the hip. In a procedure called an osteochondral allograft, we can replace damaged cartilage. For example, if a patient has a defect on the femoral head, it is possible to dislocate the hip, drill out the defect and then plug in a "dowel" made of living bone and cartilage obtained from a donor. "Quite a few have been done in patients' knees but a fewer number in the hips," says Robert L. Buly, MD, Chief of the Hip Preservation Service. Eventually, the hope is that we will be able to inject the patient's own cartilage cells or apply cell-laden membranes onto the affected area. "As we continue to advance research in cartilage regeneration, we will look for additional ways to prevent more hips from going on to replacement," says Dr. Buly.

HSS clinicians and scientists are partnering to develop innovative ways to diagnose, treat and prevent musculoskeletal injuries and diseases and, ultimately, advance the field.

# Our partners in patient care

## Department of Anesthesiology

Anesthesiology can make a big difference for a patient when it comes to successful joint replacement surgery. As a field, we are recognizing that the type of anesthesia a patient receives can affect his or her outcome. "Recent studies performed at HSS show that if you use regional anesthesia when you have your knee or hip replaced, you can lower your risk of developing a variety of medical complications, including death," says Gregory A. Liguori, MD, Anesthesiologist-in-Chief and Director. As a result, 98 percent of our hip and knee replacement surgeries are performed using spinal or epidural anesthesia, compared to only 25 percent nationwide. In addition, the use of regional anesthesia may reduce the risk of a surgical site infection. "The theory is that a spinal or epidural increases blood flow to the lower part of the body, which ensures more oxygen delivery," says Dr. Liguori.

"That, in turn, lowers the risk of infection." One study quantified the risk reduction as the same order of magnitude as using prophylactic antibiotics prior to surgery.

In light of recent concerns about the effects of some general anesthetics on cognitive development in young children, our anesthesiologists minimize their use in our pediatric surgical patients. This is accomplished, with the cooperation of our pediatric surgeons, by performing peripheral nerve blocks and mild sedation whenever possible on young children.

In addition, our anesthesiologists, mindful of the nation's opioid epidemic, have adopted a cutting-edge technique called multimodal analgesia to treat postoperative pain. "We administer several different analgesic medications, such as acetaminophen, non-steroidal inflammatory drugs and ketamine," explains Dr. Liguori. These medications, when combined with peripheral nerve blocks and local infiltration, enable our anesthesiologists to dramatically reduce the amount of opioids prescribed and administered to patients. This reduction in opioid use has led

to a reduction in opioid-induced side effects, such as nausea, vomiting and respiratory depression. "Opioids are there if a patient needs them, but we only use them as a last resort," says Dr. Liguori.

## Department of Nursing

Improving patient outcomes and reducing complications are key goals in Nursing practice. During this past year, we increased our efforts to prevent and mitigate skin injuries. "Skin injuries can be painful for patients and may lead to additional complications and longer length of stay," says Stephanie J. Goldberg, RN, MSN, NEA-BC, Chief Nursing Officer and Senior Vice President, Patient Care Services. "Our goal is to try to prevent them." This year, we hired a Nurse Practitioner (NP) with specialized certification in wound care management. His expertise and prescribing capabilities allow for greater accuracy in wound classification and appropriate treatment and serve as an educational resource. To further support the NP role, 20 of our nurses completed a Wound Treatment Associate (WTA) certification course that prepares them to collaborate with the NP as clinical extenders to provide continuous surveillance and education at the unit level. These resources support HSS nurses and increase their skill set to apply prevention methods, such as additional padding or pressure off-loading while on the operating room table or in bed. HSS nurses are also working closely with our surgeons to identify and trial dressings and adhesives that are less irritating to patients' skin.



Stephanie J. Goldberg, RN, MSN, NEA-BC, Chief Nursing Officer and Senior Vice President, Patient Care Services

help identify patients who, for example, are obese or have a health condition such as Type 2 diabetes or severe depression before they come in for surgery," she says. "This will help us to proactively work with the surgeons and other providers to anticipate patient

needs and to design a patient-centered treatment plan, in which we provide the best possible, cost-effective quality care."

## Department of Pathology and Laboratory Medicine

Pathology plays a key role in musculoskeletal care, whether it's diagnosing a rare disease, perfecting implants or reporting accurate results of blood tests. For example, as we move toward more personalized medicine, Pathology is helping to refine implants, bone grafts and biomarkers. "We are very familiar with bone graft substitutes, so we can recognize the advantages and disadvantages of certain materials and biologics," says Thomas W. Bauer, MD, PhD, Pathologist-in-Chief. "Working with the Department of Biomechanics, we can also help investigate the mechanisms of success and failure of different hip and knee procedures. If we are able to identify complications associated with one type of implant, we can help patients, the surgeons and the Hospital."

At HSS, pathologists work closely with our Departments of Orthopaedic Surgery and Radiology and Imaging to deliver best-in-class patient care. "If a patient already has a hip arthroplasty but there is a question about whether it's working optimally, he or she may have an MRI scan, followed by a biopsy or revision arthroplasty," explains Dr. Bauer. "Then we can compare the results of blood tests, imaging studies, intraoperative observations, histology of peri-prosthetic tissues, and evaluation of the implants. Few other hospitals in the world can offer orthopaedic patients such integrated care."



Thomas W. Bauer, MD, PhD, Pathologist-in-Chief

It is sometimes difficult to determine if an implant has become loose or is associated with an infection. Our Pathology team is working with infectious disease physicians to investigate new and existing biological markers that will help diagnose or exclude infection. They also routinely collaborate with our rheumatologists to determine if certain markers or histologic findings suggest an underlying inflammatory condition, such as rheumatoid arthritis.

Digital technology is starting to emerge in pathology departments around the world, and ours is no exception. Dr. Bauer is continuing the Department's history of innovation by developing its digital capabilities. "There are now high-resolution scanners that can scan an entire microscope slide and software that lets you navigate an image like Google Earth," says Dr. Bauer. "The quality is just as good as microscope slides, and you can view these slides from anywhere, which is extremely useful for consultation diagnoses and multicenter research projects."

The Department of Pathology and Laboratory Medicine also works closely with the HSS Research Institute to help identify mechanisms of musculoskeletal disease and document the efficacy of new treatments. Performing nearly 2 million laboratory tests per year, the Department of Pathology touches virtually every patient at HSS.

## Department of Physiatry

Providing efficient, value-based patient care is a top priority for the field, and a recent pilot program in the Department of Physiatry is a great example of it. To provide better access to spine care, we developed a triage system to refer patients to the appropriate provider — whether a surgeon or physical therapist — quickly. "Many patients who call us don't need to see a surgeon," says Joel M. Press, MD, Physiatrist-in-Chief. "For example, someone who presents with back pain but no red or yellow flags can be seen and treated within 48 to 72 hours by an appropriately trained spine clinician, such as a nurse practitioner or physical therapist. The goal is to identify and treat these patients with acute pain early so they don't develop chronic problems." So far, about 100 patients have been evaluated through the program, and more than half have been appropriately managed and treated by a physical therapist or nurse practitioner.

Plans are now in the works to expand the program to knee patients.

The Department is also working collaboratively with the Department of Neurology and Sports Medicine and Primary Care Sports



Joel M. Press, MD,  
Physiatrist-in-Chief

Medicine to develop a comprehensive Youth Sports Concussion Program for the main campus and HSS Westchester in White Plains, NY. Our goal is to extend the full continuum of services around prevention, wellness and performance for our patients.

## Department of Radiology and Imaging

Technology is revolutionizing the field of musculoskeletal radiology and imaging. At HSS, we are constantly evaluating new imaging techniques to bring precision to patient care. "We take our unique research techniques, validate them with grant funding, and bring them from bench to bedside," says Hollis G. Potter, MD, Chairman of the Department of Radiology and Imaging.

Recently, the Department has begun using MRIs and CT scans to create 3-D models of tissue. "If a patient has a hole or lesion in his or her joint, for example, we can use digital imaging to help with tissue transfer," says Dr. Potter. "If we create a 3-D model, it takes the guesswork away from surgeons. They know exactly where to harvest the tissue."

Dr. Potter is especially passionate about using machine learning in imaging. Although still in its infancy, it is likely to become a crucial tool for enhancing diagnosis. "We're collaborating with surgeons and machine learning to strategize ways to apply these types of algorithms to MRI in an effort to speed up the imaging process and make it even more accurate," she says.

Imaging plays a crucial role in enhancing musculoskeletal care. "The whole concept of personalized medicine starts with an appropriate diagnosis," says Dr. Potter. Oftentimes, simply adding pulse sequences to an MRI can help make a definitive diagnosis since the area in question can be viewed from different planes and contrast. "In two recent cases, by adding extra sequences, we were able to make findings not suspected, which can have a crucial impact on patient management," notes Dr. Potter.



Hollis G. Potter, MD, Chairman  
of the Department of Radiology  
and Imaging

## Department of Rehabilitation Medicine

The field of rehabilitation is moving in the direction of pre- and virtual rehab. Research indicates that pre-surgical rehabilitation training, also called "prehab," cuts down on the number of rehab sessions needed postoperatively. In a 2016 pilot project in which joint replacement patients underwent a one-on-one prehab session with a physical therapist in addition to receiving educational materials and exercises using our new digital microsite platforms (<https://www.hss.edu/LATHR/> and <https://www.hss.edu/RATHR/>), we discovered that we were able to decrease their length of stay by half a day.

In addition, patients undergoing rehabilitation may soon be doing their exercises at home. They will use wearable devices, such as accelerometers, that attach to limbs and can record data on a patient's progress. The data can be downloaded and shared with a patient's physical therapist. "Instead of someone having to travel two or three times a week for physical therapy, the patient would be able to augment their therapy sessions by doing a greater proportion of them at home using an iPhone or computer with a built-in accelerometer," says JeMe Cioppa-Mosca, Senior Vice President, Rehabilitation. "We'll be able to prescribe standardized procedures patients can follow on their own — and ensure they are performing the exercises correctly."

The Hospital recently purchased a portable gait lab, which can analyze a patient's walking patterns in the first few weeks after

surgery. One way it's being used is to compare the early outcomes of surgical procedures. "We can find out, for instance, if patients who had an anterior surgical approach walk differently from those who had the standard posterior approach and



JeMe Cioppa-Mosca, Senior  
Vice President, Rehabilitation

adjust rehab protocols accordingly," says Michael M. Alexiades, MD, Director and Chief of the Department of Rehabilitation Medicine.



# Education

## Serving professionals and patients

Technology is transforming medical education in musculoskeletal health, and it's no wonder: Physicians must stay abreast of the latest advances in the field in order to deliver the best patient care. Yet they have limited time to travel to conferences and pore over medical journals. One way to supplement traditional learning is through digital platforms and novel approaches to training residents.

### A DIGITAL APPROACH TO KNOWLEDGE TRANSFER

In order to deliver educational information to professionals around the world in the most succinct ways, we created HSS eAcademy®, a digital learning platform. We offer live-streaming webinars, on-demand modules and a surgical techniques video library. Currently, more than 20,000 professionals have access to 600-plus HSS eAcademy® modules. There are more than 200 modules in development. "Our platform has moved from onsite-only to a combination of in-person and digital training," says Laura Robbins, DSW, Senior Vice President of Global and Academic Affairs. "It's about reach, access and impact, since surgeons' time is limited."



Technology is also shaping the way HSS residents learn. We recently launched the new “flipped classroom” curriculum for all residents, in which residents first watch a pre-lecture online, at their own pace, then use in-person meetings to focus on areas to learn in depth. “We’re getting good results,” says Robbins. “When everyone is in the room together, residents can focus on what they need to learn more about. It’s a more interactive and self-directed program, teaching to the needs of the group.” In keeping with our evidence-based approach to education, we are collecting data to measure resident satisfaction with the program and refining the curriculum. Our goal is to make the flipped classroom approach to orthopaedic learning available to other residency programs in the U.S.

Although the digital component of medical education is here to stay, it is not meant to replace face-to-face learning. “We need to make sure that we’re educating our residents effectively,” says Robbins. “Part of that is investing in the infrastructure, doing outcomes studies and making sure that we are tailoring our courses to residents’ learning needs. If a resident needs to know how to do an ACL repair, it’s important that he or she be able to get individual attention, either through the video library or hands-on training in our Bioskills Education Laboratory. That’s the kind of self-directed learning that technology makes possible.”

Increasingly, digital platforms are also enriching patient education. We provide educational Facebook chats with our physicians and webinars on topics ranging from bone health to meniscus tears. These programs supplement our educational newsletters; support programs for people with lupus, myositis, rheumatoid arthritis (RA), osteoporosis and scleroderma; educational forums, such as classes on pain management; and pre-surgical education classes.

**OBJECTIVELY  
EVALUATING  
RESIDENTS**

To attract the highest quality residents, we must be at the cutting edge of musculoskeletal education. Our newly renovated Bioskills Education Laboratory (BSEL), our accredited surgical training facility, features state-of-the-art arthroscopy simulators, which enable residents to practice procedures prior to going into the OR. Our newest surgical simulators have improved haptic technology, which simulates the sense of

touch. “Aside from training opportunities, the simulators also provide objective metrics the resident can measure over time,” says Duretti T. Fufa, MD, Assistant Attending Orthopaedic Surgeon and Associate Director of the HSS Residency Program.

Another innovative way we are training our residents is through a new initiative called the Surgical Games. Teams of residents rotate through four different stations, competing to perform procedures like carpal tunnel release surgery, knee arthroplasty and arthroscopy. Residents are observed and graded by faculty to evaluate trainees’ skills in real time. This is an advantage because it allows us to intervene quickly, and we can provide more accurate assessments of their skills because we aren’t relying on the attendings’ recall. The inaugural games took place in October 2017.

To ensure that our educational approaches are effective, we evaluate them through peer-reviewed studies. We recently investigated the impact of the arthroscopy simulators on the acquisition of surgical skills. In a prospective randomized study published in the *The American Journal of Sports Medicine*, we found that training with a surgical simulator translated into improved performance in diagnostic shoulder arthroscopy in junior residents compared to those who did not receive the training.

**TAKING THE LEAD IN OPIOID EDUCATION**

To address the opioid crisis, we are developing and distributing educational information on opioid prescribing and pain management for healthcare professionals, patients and the general public. We are using multiple digital platforms to reach these groups. For a professional audience, we have developed an opioid-related curriculum; created an interactive webinar series called “Best Practices in Opioid Management”; and are increasing HSS leadership participation at national meetings on the topic. HSS was one of the first institutions in the U.S. to create an online module for orthopaedic physicians and all prescribers, developing guidelines for appropriate dosages, according to Robbins. “It’s a great example of us leading in a new area — and using digital platforms to do so,” she says.

For consumers, we are expanding our pain management program to the pre-surgical screening population and developing meditation and yoga videos for pain management. We are also planning to design and implement a program called “How to develop a pain management outreach program” for local community hospitals, health educators and those supporting community benefit plans.

It’s a great example of not just putting out a mission statement to be a leader in education, but devoting all the necessary resources to that mission. “We have created an environment that’s incredibly rich in terms of education,” says Mathias P. Bostrom, MD, Academic Director of Orthopaedic Surgery and Vice Chair of Education and Academic Affairs. “Education is in our DNA.”

Below, far left:

Duretti T. Fufa, MD, Assistant Attending Orthopaedic Surgeon and Associate Director of the HSS Residency Program, supervises resident Cynthia Kahlenberg, MD, who is performing a carpal tunnel release, in the newly renovated Bioskills Education Laboratory. Julie Friedman (center) assists Dr. Fufa.

Below, right:

Resident Jeffrey Stepan, MD, uses a state-of-the-art arthroscopy simulator to gain experience before going into the OR.



# Advocacy

## Giving our patients a voice

Every day, physicians in the field of musculoskeletal medicine counsel patients who aren't getting relief from their medications or don't have access to expensive therapies. They also treat injuries they know could have been prevented with adequate education. Those are just a few of the reasons many HSS physicians are moved to advocate for their patients, whether it's pushing for new treatments or patient education programs. Their efforts are having a meaningful impact on the field.







### IMPROVING THE HEALTH OF 9/11 FIREFIGHTERS

In 2005, Jessica R. Berman, MD, Associate Attending Physician and Associate Director of the Academy of Rheumatology Medical Educators, received a phone call from David J. Prezant, MD, Chief Medical Officer for the Fire Department of the City of New York and Co-Director of the FDNY World Trade Center (WTC) Health Program. “He wanted me to see if treatment might help firefighters who had been 9/11 first responders and had bad inflammatory arthritis,” she says. Dr. Prezant began referring patients to Dr. Berman and, over the past decade, she has seen more than 50 firefighters with a variety of autoimmune diseases, including systemic arthritis and chronic sarcoid arthritis. She discovered that they were resistant to traditional treatments, such as disease-modifying antirheumatic drugs, and needed biologic anti-tumor necrosis factor medications. But biologic medications, which can cost around \$20,000 per year per patient, were not on the approved list of drugs covered by the federal WTC Health Program. “These men were suffering, but we had to prove that their illnesses were related to 9/11,” says Dr. Berman. She told Dr. Prezant that, in her medical opinion, biologic medications were the next step in treatment. “Dr. Berman was responsible for providing expert evidence that biologics were required for treatment efficacy in these patients,” says Dr. Prezant.

Based on Dr. Berman’s expert opinion, the WTC Health Program soon approved these drugs for patients with WTC-related sarcoidosis. Many firefighters are finally starting to feel better. Ray Reilly, 56, who had experienced wrist pain so intense that he thought the joint was broken and granulomas in his shins that hurt even when he stood in water, says he feels almost back to normal now that he has been taking adalimumab combined with hydroxychloroquine over the past four years. “I’m playing golf again, and I haven’t needed to take a steroid in almost a year,” says

Reilly of Lake Luzerne, NY. “I feel like my symptoms are starting to stabilize. I’m very thankful to Dr. Berman and HSS.”

Dr. Berman is still seeing her firefighter patients, and she was author of a paper published in the *Journal of Clinical Rheumatology* that described the cases of 11 WTC-exposed FDNY firefighters who were diagnosed with chronic sarcoid arthritis. “To be able to give back to people who gave their lives is amazing,” she says. Of course, the firefighters are extremely grateful to Dr. Berman. “I travel two and a half hours from Staten Island to see her,” says John Mahon, 54, who is now retired and comes to HSS for infusions every month. “I could see a physician 10 minutes down the road, but she is so caring and knowledgeable.”

Today, Dr. Prezant has petitioned the government to expand WTC Health Program coverage of biologic medications for firefighters with other autoimmune diseases, such as rheumatoid arthritis. Dr. Berman has joined the research team, whose role is to review medical records and evaluate patients. “She provides a unique mixture of clinical expertise and experience along with compassionate care and, as such, clearly fits in with our data-driven approach to patient advocacy,” says Dr. Prezant.

### LOBBYING FOR SCOLIOSIS SCREENING

Many of our physicians are leaders in professional organizations, giving them the ability to influence healthcare guidelines and policymaking. For example, Todd J. Albert, MD, Surgeon-in-Chief and Medical Director, is President of the Scoliosis Research Society (SRS), and Frank Schwab, MD, Chief of the Spine Service, is on the board of the SRS. “We have been heavily involved in lobbying to modify government recommendations and approaches to the care of children with scoliosis,” says Dr. Schwab. In June 2017, Dr. Schwab was one of several physicians who helped craft a response to the U.S. Preventive Services Task Force, which

Jessica R. Berman, MD, Associate Attending Physician, discusses symptoms with 9/11 firefighter John Mahon during an office visit.



recently upgraded the evidence for routine scoliosis screening of asymptomatic children and adolescents from “D”, which means “discourage” screening, to a rating of “I”, which means the current evidence is “insufficient” for screening. Dr. Schwab was in favor of screening because it can lead to brace treatment in children who need it. “We looked at all of the data, and there is strong evidence that bracing is effective in growing children with idiopathic scoliosis, so we should screen them,” says Dr. Schwab. The guidelines are still under review.

#### IN SEARCH OF BETTER MEDICATIONS FOR LUPUS PATIENTS

Mary K. Crow, MD, Physician-in-Chief and Chief, Rheumatology Division, has spent the better part of her career searching for alternatives to potentially harmful steroid medications for lupus patients. As Co-Chair of the Scientific Advisory Board for the Lupus Research Alliance, she and other board members formed the Lupus Clinical Investigators Network (LuCIN), a lupus clinical trials network. The goal of the network, which consists of 59 academic medical centers in North America, is to accelerate the development of new lupus treatments. The Alliance provides support for centers that are qualified to be involved in

lupus clinical trials. “With the help of the Alliance, the network has developed an infrastructure to identify potential new therapies for lupus patients,” says Dr. Crow.

Several years ago, Dr. Crow and other physicians involved in the Alliance met with Janssen, a pharmaceutical company, to find out whether any of their drugs might be useful for lupus patients. One medication that was developed for psoriasis, ustekinumab (Stelara®), seemed to have potential. “We encouraged them to think about testing the drug in lupus patients, and they conducted a clinical trial,” says Dr. Crow. The results of the Phase II trial were presented as a late-breaking abstract at the American College of Rheumatology meeting in November 2017. Sixty percent of patients receiving the drug showed significant reductions in lupus disease activity, compared to 31 percent of the patients who took a placebo. The company now plans to advance the drug to a Phase III clinical trial. “Advocating for the community and for more active drug development can pay off,” says Dr. Crow. “We feel that encouraging the company was very helpful.”

HSS has partnered with the Aspen Institute, an educational and policy studies organization, on Project Play, which aims to increase national sport participation rates. We are working with the Institute to develop standardized education for coaches and to teach kids how to play sports safely.





## TEACHING KIDS TO PLAY SPORTS SAFELY

In addition to identifying more effective treatments for patients, we are committed to wellness and injury prevention. We recently partnered with the Aspen Institute, an educational and policy studies organization based in Washington, DC, on Project Play, an effort that aims to increase national sport participation rates. While many kids choose to play sports, in general “we have a generation of kids who are not participating in any activities,” says Laura Robbins, DSW, Senior Vice President, Global and Academic Affairs. “Their parents want them to get involved, and when they do, they sometimes get injured. Every year, there are hundreds of thousands of ACL injuries.” Part of the problem is that kids are not being taught how to play sports safely. There are no

national standards for coach education, and “parents don’t have much information about the training of their children’s coaches,” points out Robbins. She is working with the Institute to develop standardized education for coaches. In addition, the Hospital is sponsoring the development of a tool that will help guide parents about safe sports for kids.

Simultaneously, HSS is providing training and education for coaches, children and parents on how to prevent injuries and play sports safely through the HSS Sports Safety ACL Program. “We want to make sports fun and encourage kids to play more than one sport, but we want them to do it safely,” says Robbins.



“We want to make sports fun and encourage kids to play more than one sport, but we want them to do it safely.”

Laura Robbins,  
DSW, Senior Vice President,  
Global and Academic Affairs

# Value-Based Care

On October 26, 2017, we held a roundtable discussion on value in musculoskeletal care. The participants were Todd J. Albert, MD, Surgeon-in-Chief and Medical Director; Mary (Peggy) K. Crow, MD, Physician-in-Chief; Chair, Department of Medicine; and Chief, Rheumatology Division; and Catherine H. MacLean, MD, PhD, Chief Value Medical Officer. Matthew Titmuss, Senior Director, Center for the Advancement of Value in Musculoskeletal Care, was the moderator.

## **WHAT DOES IT MEAN FOR A HOSPITAL OR A PHYSICIAN TO DELIVER VALUE, AND HOW IS THAT DIFFERENT FROM DELIVERING EXCELLENT CARE?**

Dr. Crow: I think of high-value care as care that can be measured and meets a patient's expectations. Excellent care is a bit of a vague term, so I would distinguish excellent care from high-value care in terms of the capacity to measure high-value care.

Dr. Albert: I think that's beautifully said, but if you think about what high-value care is, it's what you or anybody would want if it were them or their family receiving care. That's the aspiration. But high-value care is exactly what Peggy said. It's measuring. How do we measure it? If you measure it and constantly look at what you're measuring, you'll constantly improve.

Dr. MacLean: I'm going to put more of an equation to it. I think about high-value care in terms of the relationship between quality and cost, and both of those things can be measured. We have a lot of standard metrics that are used to measure quality. It's really easy to measure cost, but I think it's important to get beyond the metrics that focus on complications and get to the things that Peggy and Todd were referencing, which are making people better; helping people achieve their goals; and helping them to get what they want out of healthcare.

## **HOW IS HSS DELIVERING VALUE DIFFERENTLY FROM OTHER HOSPITALS?**

Dr. Albert: People underestimate the power of focus. Since 1853, HSS has only been focused on taking care of patients with musculoskeletal disorders, rheumatologic disorders and orthopaedic

surgical disorders. There's no confusion worrying about patients because we take care of them. But there's no competition for intellectual curiosity, power or determination to get those patients better. When you can focus on a single disease process, it's hugely advantageous.

Dr. Crow: I think we have an extraordinary history of collaboration among our specialties, too. We have a clinic that we call the Combined Arthritis Program, the CAP program, which goes back decades. Orthopaedic surgeons have been collaborating with rheumatologists to plan for care and surgery for the most complicated patients. It is a unique program at HSS, and it demonstrates how working together can provide high value and terrific care for patients.

Dr. Albert: The results of that program are amazing. The stories of the patients with these complex disorders are incredible.

## **WE RECENTLY LAUNCHED THE CENTER FOR THE ADVANCEMENT OF VALUE IN MUSCULOSKELETAL CARE. HOW DO YOU THINK THE CENTER IS GOING TO HELP IMPROVE CARE AT HSS — AND PERHAPS HEALTHCARE AS A WHOLE?**

Dr. Albert: HSS has historically been known as this top level institution, at least for musculoskeletal care, but I believe the idea of the Center is to put together groups that have been measuring what they are doing in different ways and use unified metrics to say, what are we doing? How are we doing it so well? And, can we do it better?

Dr. Crow: I think Cathy is a tremendous addition to HSS leadership. I think you're helping us to look at specific categories of disease or problems patients have in our musculoskeletal disease areas and to define risks for particular outcomes and surgeries. You're also helping us to assess what we can do to optimize the outcomes, given a particular patient's situation. So, you help to organize us and think through plans in specific disease areas.



Dr. MacLean: When I got to HSS, I was really struck by the commitment to quality. So, as a person who spent her life in the quality trenches, it is refreshing to be at a place where everyone is so interested in quality. We started out with the Value Office, and it didn't take too long before it was apparent that people across the organization were really interested in what we were doing in Value. Starting the Center has allowed us to pull more people in from across the organization. It serves as a forum where we can exchange ideas and work together more effectively and efficiently to promote value. Additionally, one of our objectives for the Center is to share our learnings with other organizations, be they other healthcare delivery systems, academic endeavors, policy makers, employers, insurers. At the same time, it can be a forum where we can learn from others. We are really excited about the Center and the opportunities to grow value — not just here, but more broadly.

Dr. Crow: At HSS, we always try to have an impact beyond what we do here. Having a Value Office and a new focus on value and measurement and thinking through how we deliver value-based care is going to have an impact beyond us. I hope we can disseminate what we have learned.

Dr. Albert: That's the plan.

#### **CAN YOU EXPLAIN THE GOALS OF THE CENTER AND WHY IT'S IMPORTANT TO HAVE THIS FOCUS ON VALUE CENTRALIZED AT HSS?**

Dr. MacLean: There are three goals: One is to advance value at HSS. In addition, we want to share our learnings on value with the outside world. Third, it is a forum through which we can learn about value from other organizations as well.

#### **THE WAY PEOPLE TRADITIONALLY LOOK AT VALUE IS VALUE EQUALS QUALITY OVER COST. IS THAT THE RIGHT WAY TO LOOK AT VALUE IN MUSCULOSKELETAL HEALTH?**

Dr. Crow: The cost aspect is interesting, and the equation you laid out is the classic definition of value. Physicians have probably not paid as much attention to cost as we should have in the past. It is very difficult to get a grip on. We don't always know what the care we are delivering costs, but I think this new emphasis on value will help us to deliver cost-effective and cost-efficient care.

Dr. Albert: I think it's the correct starting point. But once you start peeling the onion and asking what quality is and what the right measurement is for musculoskeletal quality versus other types of quality, and when you start looking at cost — direct and indirect cost — it's incredibly complicated. So, by having the Center and saying well, that's the right measure, generally, but let's start picking apart the interiors of that measure, I think that's really getting to the point.

Dr. Crow: There's short-term cost and value and long-term, and one of the features of the rheumatic diseases as opposed to the orthopaedic indications for surgery is that some of our diseases go on for decades. Rheumatoid arthritis and lupus patients will probably have their diseases for the rest of their lives. The disease activity waxes

and wanes, and the kind of care we deliver will differ from one month or year to another. It's very challenging to measure and determine how to optimize value in that kind of situation.

Dr. Albert: That's a really important point and, as orthopaedists, we used to measure our quality by the X-ray. We were happy that the X-ray looked good. Now we want to know how the patient is doing five years later and 10 years later. Does he or she need revision surgery? What's the durability of our interventions as opposed to a lifetime disease?

Dr. Crow: And what does the patient think of his or her surgical outcome? Not only what does the X-ray look like or how much mobility he or she has, but how does it relate to his or her life?

Dr. MacLean: I'd like to follow up on a comment Peggy made about the rheumatic diseases. The long-term horizon matters for patients with chronic diseases. One of the challenges in our current measurement system is that payors are often focused on the one- to two-year timeframe. The reason is members churn in and out of health

**“The new Center for the Advancement of Value in Musculoskeletal Care will advance value at HSS and will enable us to share our learnings.”**

Catherine H. MacLean, MD, PhD, Chief Value Medical Officer

plans, and many health plans have to meet expectations of investors and others who are looking at that one-year timeframe. That doesn't fit so well for diseases like rheumatoid arthritis. You know, when I think back to when I was a fellow, there were a lot of wheelchairs in the waiting room. There aren't many wheelchairs in the waiting room in rheumatology offices now. That is the result of the significant advances that we, as a field, have made in the management, particularly, of rheumatoid arthritis. That's very high-value care.

Dr. Albert: There are surgeries we used to do that we don't do anymore because of the drug interventions that have been created.

Dr. MacLean: But I think we still have opportunities. I think we've learned that early treatment with effective medications will lead to better outcomes in the end. So I think we can still focus more on collecting structured data from patients, including patient-reported outcomes, and using those data to guide our initiation of care as early as possible.

#### **DR. MACLEAN, COULD YOU DISCUSS THE RECENT PATIENT-REPORTED OUTCOME INITIATIVE AND HOW THAT'S GOING TO ADVANCE OUR CARE OF PATIENTS?**

Dr. MacLean: We've collected patient-reported outcome measures (PROMs) as part of a very extensive research registry program at HSS. More than 100,000 patients are in our registries, and many of them have patient-reported outcome measures that have been collected five or 10 years longitudinally. We've used those registries largely



to drive clinical care in understanding what interventions work better and what risk factors will affect how well different interventions work. What we've learned is that those PROMs have potentially great benefit in the care delivery arena, and several of our surgeons and rheumatologists are effectively using them in care delivery. Given the huge clinical upside to understanding PROM scores when making clinical decisions, we are going to be collecting PROMs as a standard of care at this institution. What that means is they are going to be like a vital sign. Patients will come to HSS and have their PROMs collected, and we will collect them longitudinally—including a year or two later, even if they don't need to be seen in person. Everyone is excited about it. It's a lot of work operationally to make this work, to get this into the electronic medical record. Every patient is going to have the same global health assessment. We have chosen the PROMIS-10, and additionally we will have a disease-specific measure relevant to their disease. I think an important aspect of our PROMs initiative is that we've worked across all of the service lines, divisions and clinical areas to determine a common set of PROMs for a common condition. So, for example, for lumbar spine disease, we've chosen the Oswestry Disability Index. But no matter who sees the patient with that lumbar spine problem, whether it's a surgeon, rheumatologist, physical therapist or physiatrist, they are all going to collect the same information, so we will have meaningful longitudinal data over time.

Dr. Albert: It's a validated measure of how are you doing, as opposed to saying how are you doing.

Dr. Crow: Of course, the patients have to be willing and able to participate in providing the patient-reported outcomes. One of our rheumatology fellows completed a study in lupus patients here at the Hospital to try to get a sense of their acceptance of performing the PROMIS measure, and they were very accepting of it. We've learned some very important facts about what they view as important. For example, the patients were reporting the importance of fatigue and impaired cognitive function, thinking problems. I think the FDA, in their future assessment of new drugs, is going to be considering the importance of such functions as fatigue and cognitive function. So the patient-reported outcomes are going to be terribly important not only in care, but also in drug development.

#### **HISTORICALLY, PROMS HAVE BEEN USED FOR RESEARCH. DO YOU THINK YOU WILL BE ABLE TO USE A TOOL LIKE THAT DURING THE ACTUAL VISIT?**

Dr. Crow: Well, I think that's the goal, and obviously it has to be a practical tool rather than an imposition on the patient. I think that's why the shorter sets of questions are going to be very useful and applied across the Hospital.

Dr. Albert: I think it's enormously helpful. I've been doing this for years, mostly disease-specific. I see a lot of neck patients. I know their Neck Disability Index, and if it goes down, I can share it with them and it's very useful. It's quantitative and it's useful.



#### **DR. ALBERT, YOU'VE BEEN WORKING WITH SOME OF THE RESEARCHERS AND DATA SCIENTISTS ON PRESENTEEISM. COULD YOU EXPLAIN WHAT PRESENTEEISM IS AND HOW YOU THINK IT WILL HELP HSS TO DELIVER HIGH-VALUE CARE?**

Dr. Albert: Presenteeism is another measure of how people are functioning, in a sense. Everybody, I think, knows about absenteeism. If somebody's a worker and they miss work, they are absent from work. That is absenteeism. But many people who are going to be reading this have had a bad cold and show up at work. They don't work as well when they have a bad cold or don't feel well or their back, neck or hip is killing them. Presenteeism measures how they function while they're at work—how present they are and able to do their work. So, we are trying to measure that, put data to that and see how our interventions change that. I think it's going to be enormously helpful for employers and large employee groups who pay for healthcare for their patients.

Dr. MacLean: I agree. Some studies quantitate the amount of money that's spent directly on healthcare, absenteeism, long-term disability, short-term disability and presenteeism. It's an evolving literature. One study found that the cost of presenteeism was greater than the direct medical costs. This particular study was done in the financial services industry, so I am not sure how generalizable it is. That being said, it looks like there's something there and we are exploring it further.

#### **THE WAY HOSPITALS ARE BEING PAID IS CHANGING. DO YOU THINK BUNDLED PAYMENT PROGRAMS WORK?**

Dr. Albert: I'll give you my cynical view and then the optimistic view. My cynical view is they are going to drive down cost. The reason they are going to drive

*From left to right: Catherine H. MacLean, MD, PhD, Chief Value Medical Officer; Todd J. Albert, MD, Surgeon-in-Chief and Medical Director; and Mary K. Crow, MD, Physician-in-Chief; Chair, Department of Medicine; and Chief, Rheumatology Division, discuss the importance of value in musculoskeletal care. At far right, Matthew Titmuss, Senior Director, Center for the Advancement of Value in Musculoskeletal Care, moderates the conversation.*



metrics is that, honestly, we as a medical profession haven't done the best job in making sure that those quality metrics are available or the right quality metrics are available. That's one of the things we are working on in the Center. We want to promote the measurement of clinically meaningful measures and are exploring how presenteeism and patient-reported outcome measures can be used validly to drive forward the value and the quality. So, even though we're measuring the PROMs now, the science isn't there yet to say whether certain PROM scores or differences in scores before and after treatment denote high quality care.

Dr. Albert: Substantial clinical benefit, minimal clinically important difference.

Dr. MacLean: Right, so how do you measure that? I'm pretty sure it's not simply a delta and

down cost is they are going to say, here's the bundle, here's what it costs today, you own it now and when you own it, the only way to survive, to make any net profit, is to drive down the costs inside all the different parts of that bundle. But many times, we try to make them more efficient and, at the same time, not compromise care in the least. So it can end up improving our quality because to do a bundle, you have to know what your costs are and you have to be able to measure them. And you have to be able to measure quality simultaneously to make sure you aren't compromising it.

Dr. Crow: We have to recognize, though, that every patient is different. We have high-risk patients and low-risk patients, and I think HSS does an excellent job of preparing patients for surgery and getting an assessment of their risk. But some are going to be more complicated than others. Some are going to require more expensive care than others. So, I imagine bundling care puts the pressure on all of us to deliver care as efficiently as possible. But we have to recognize that it's not cookie cutter; everyone is different.

Dr. Albert: And we can't deny care to people who need the extra amount.

Dr. MacLean: That's an interesting point, and I think we, as a health system, recognize our responsibility to be a responsible steward of our healthcare dollars. So we ought not to be doing unnecessary or duplicative care. There is a big emphasis on providing care safely so there aren't complications. I think that the bundled payment mechanism is a good one, in terms of coordinating care across a number of different providers so that care is delivered in a more efficient way. I would say one of the shortcomings of many of the bundled programs out there right now is that there's not a parallel or concomitant emphasis on quality metrics. I think the challenge around quality

that the doctor or health system that gets the biggest delta is the best. I'm pretty sure that's not what it is, but that's the hypothesis and again that's the sort of stuff that we are looking at in the Center.

Dr. Crow: I wonder what you think about the role of the patient in defining his or her ideal outcome. We might think of the ideal outcome of a total hip replacement as so much function or a particular score on a particular measurement tool, but maybe that's not what's important to the patient. Should we be giving the patient more of a role in defining what he or she would like to achieve?

Dr. MacLean: It's funny you should ask that, Peggy, because that's actually another area of active research. We have had research assistants shadowing our clinicians and talking to our patients and collecting information on their goals. We've been collecting information on goals in three domains: recreation, work and daily living. For example, if a patient comes in with neck pain, we understand that his or her neck hurts. What we may not understand is what the patient wants to be able to do after this gets fixed. We've done a lot

**“We are trying to measure presenteeism — which measures how well a person functions while he or she is at work — to see how our interventions change that. I think it's going to be enormously helpful for employers and large employee groups who pay for healthcare for their patients.”**

Todd J. Albert, MD, Surgeon-in-Chief and Medical Director



of work on this, quantifying the different types of goals. Our objective is to be able to predict whether a patient will be able to achieve his or her goal. I want to be in a place where we routinely measure patient goals and our clinicians know those goals. That is job one — find out what the patient's goal is and make sure the treating doctor knows what that patient's goal is. Two, have the patient and the doctor agree upon a reasonable goal. Some of the goals we have collected from patients have not been reasonable goals.

Dr. Crow: So we have to manage expectations.

Dr. MacLean: Absolutely.

Dr. Albert: There is some great research being done by Dr. Carol Mancuso and others on the team looking at patient expectations as well. Can they be achieved?

Dr. Crow: It is important to recognize what is important to patients — and whether we can help them as best we can achieve their goals.

#### **THE CENTER IS WORKING ON PREDICTIVE ANALYTICS USING SOME LARGE DATA SETS. HOW DO YOU THINK THAT'S GOING TO BENEFIT PATIENTS?**

Dr. MacLean: I think that's going to have a huge benefit for patients. Our objective is that when a patient comes in, we will collect the appropriate information. Building on these large data sets that we have with decades of PROMs and eventually patients' goal information, our goal is to say to a knee replacement patient: Here are the four or five different treatment options for your knee and here's how likely you would improve — given your personal characteristics — to achieve your goal. Also, here's how likely you would be to have a complication with each of those. That information should be available to patients and should inform their decisions in consultation with their treating physician so they can come to a shared decision about the best option. Peggy, one of the things that is exciting to me about this whole thing is what we can do with genomic data. Maybe you can comment on that.

Dr. Crow: HSS has a very active research program with a number of physician-scientists working with PhDs in the lab to study blood or tissue from patients we follow at the Hospital. We have tremendous opportunities and have actually made a lot of progress in looking at blood gene expression or tissue gene expression, the different molecular programs and pathways that are associated with particular patient manifestations, as well as outcomes. I think this can involve gene expression, it can involve genetic variance. The registries we've put together at the Hospital over many years feed this kind of data. So, we have very well-established patient cohorts, and we learn a lot from them. I think you're right, we can incorporate that biologic data into clinical data and gain new insights into how we can predict who is going to have better outcomes and who needs additional management. Hopefully, this will also guide us to which particular therapies we should be using for individual patients.

Dr. Albert: We aspire to be able to do it at least in spine surgery — to be able to predict who will do well with spine surgery, who won't and who maybe shouldn't have surgery and do alternative methodologies.

#### **DO YOU SEE THIS AS A TOOL THAT YOU WILL BE ABLE TO USE WITH A PATIENT?**

Dr. Albert: Absolutely.

Dr. Crow: Cathy, what are your plans and hopes for taking some of these tools that you are developing and communicating them to the broader medical community through publications or in other ways?

Dr. MacLean: There is a lot of work going on. I think the initial way we will be able to share this more broadly will be through publications. We have some really promising work going on right now with predictive modeling, particularly around patient-reported outcomes for hip and knee arthroplasty. Beyond that, we are developing an electronic platform that we are calling personalized health medicine. We have a beta version that is going to launch in January 2018, and I think there's a lot of opportunity for that tool. There are so many things that we're doing with it. Beyond the prediction piece, it will also function as a patient intake tool. One of the challenges we're facing across the U.S. is moving from paper to electronic medical records. They are necessary and are really going to move us all forward. But we're at a place where we are taking what we did on paper and trying to put it into electronic form, and we're not doing it very efficiently. There's so much opportunity to promote diagnostic accuracy and inform treatment options through electronic platforms, including and in addition to electronic health records. Creating our health records, which detail patient histories, exams and care delivery in our institution, can be very time consuming and repetitive...for both patients and providers. We need to be able to do clinical intake and decision-making quicker. There are opportunities using item reduction and other techniques to ask patients questions in a much more efficient, less redundant way. For example, we now do a history and then we ask patients to complete PROMs surveys, which may include some of same concepts we addressed in the history. Those questions in the PROMs are pretty much the same questions we're asking in the history. We need to merge those things and use computer adaptive testing to do it more efficiently and effectively. We want to ask as many questions as necessary to make an accurate diagnosis and direct treatment plan...no more and no less. As an example, there were many instances when a patient came to see me with advanced RA because that diagnosis was missed in the community. That's frankly sad in this day and age because early and aggressive treatment of RA can prevent deformity. So, it would be exciting if we could make a tool like this available to primary care doctors to assist in diagnostic accuracy, which would prevent treatment delays with significant consequences.

“We have very well-established patient cohorts. We can incorporate biologic data into clinical data and gain new insights into how we can predict who is going to have better outcomes and who needs additional management.”

Mary K. Crow, MD, Physician-in-Chief; Chair, Department of Medicine; and Chief, Rheumatology Division



Dr. Crow: You probably know that we just rolled out a lupus app for an iPhone. This allows patients to collect their own data on how they're feeling and how their rash is looking, and to be able to more effectively communicate it to their doctors. So, I think there are going to be many opportunities to collect more real-time data in between doctor visits that can improve care.

Dr. Albert: I think it's our obligation to get these things out. My view is the cream always rises to the top and if we have great things, they will go viral because they will become known. We have to put these things out there academically, but as patients start to use them, they will hopefully spread the word. Our social media work is progressing nicely, and that's a useful platform through which the word will get spread.

**HSS HAS BEEN LOOKING AT VALUE FOR MANY YEARS, BUT NOW, WITH THE CENTER, WE ARE FOCUSING IT IN ONE PLACE. HOW HAS THE CENTER HELPED YOU TO GET THE WORD OUT THAT THIS IS WHAT'S HAPPENING AT HSS?**

Dr. Crow: Cathy is a rheumatologist, and I think she has a certain affinity for our Rheumatology Division. She's come to speak at our staff meetings, and I think our physicians are receptive to being involved in moving the efficiency and effectiveness of healthcare forward. Cathy's description of what she'd like to do has really stimulated some of our physicians to get together and try to identify projects that they could participate in and lead to identify problems that could be addressed through more formal collection of data and risk assessment. So it's been exciting to get our physicians involved in thinking about how they can participate.

Dr. Albert: I am really proud to have the Center here. We've had the good luck or wisdom to get Cathy to come and lead it because every single person I know at HSS — from the people you meet when you walk in the door to every nurse and therapist — is so proud to be here. The physicians here have always been academically minded but are doing their individual projects to improve patient care. The Center creates a platform to bring everyone together so that we can create a more cohesive bundle of information that hopefully will improve healthcare, our patients' conditions and the world of musculoskeletal care.

**HOW DO YOU THINK THE WORK WE ARE DOING AROUND BIG DATA IS GOING TO IMPACT THIRD-PARTY PAYORS, PARTICULARLY EMPLOYERS?**

Dr. MacLean: Third-party payors have big data, and they've had big data for decades. They have done a lot with those data. Their administrative claims databases include information on procedures that were done, the diagnoses associated with those procedures, drugs that were prescribed and, in some cases, the amount that was paid or charged. There are a lot of very nice models that can be applied to these large administrative databases to predict 'risk,' meaning which patients are the most expensive. We know, for example, through these models, about 20 percent of patients account for 80 percent of direct medical

costs. This — and the ability to predict which patients will have higher utilization and cost — is useful. That being said, these are administrative data that were developed for billing purposes, so they don't include the richness of a clinical data set. I think in the future, we are going to be able to do great things with the data that are being collected in electronic health records and in registries. We already have some big data at HSS because the organization has been collecting patient-reported outcomes for decades. Most places don't have this at this juncture. I see great promise with the clinical big data. Think about what we can do with lupus, for example. Peggy's the expert on lupus, but I view lupus as a spectrum, and I'm not sure that in 10 years we're going to think of it as one disease. I think big data will help with that.

Dr. Crow: That may be. Regarding the payors, there is so much drug development going on in the rheumatic disease area and particularly in lupus. It was avoided by the pharma companies for quite a while, but there is a lot of drug development going on now. These are going to be expensive therapies. We regularly get pushback, of course, from the payors with all sorts of requirements for authorizations or denials. Collecting data and being able to demonstrate who benefits from particular medications, particularly the biologic medications, is something we can add to the medical environment. We can allow the payors to see when these drugs should be used. So, we can make a contribution through our own data in demonstrating which drugs are effective, and when and where.

Dr. MacLean: I think that improves value. The fact of the matter is, health professionals, at times, are unhappy with insurance companies. But the reality is that in our health system, the job that we have collectively given to them is to hold down costs. Having worked in the insurance industry before, I can tell you that not all claims that come through are claims that should be paid. There are some crazy things that come through, and a few bad apples really do wreck it for everybody else. That being said, an insurance company does not deliver healthcare, and they have a limited view into what's happening. They are getting pushback from employers, from people like us who are buying their products. We don't want to pay a big premium and so I think that within our system, if we can identify those patients who are the right ones to get those very expensive drugs or procedures and say no, these other patients aren't going to benefit from these expensive drugs or procedures, then we will promote value.

Dr. Crow: And have the data.

Dr. MacLean: If we have the data to do that, then I think that it's a win for everybody.

**WHAT DOES THE FUTURE HOLD FOR ADVANCING VALUE AT HSS?**

Dr. MacLean: I think the future is bright. Building on what we've already accomplished here, and given the advent of large data and new techniques to evaluate those data, I think we are going to do great things.

# Reports From the Field

The latest advances in patient care, research and education from our 10 Orthopaedic Surgery Services and Department of Biomechanics, plus our five Rheumatology Centers of Excellence and Division of Pediatric Rheumatology

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# Message from the Surgeon-in-Chief



In orthopaedic surgery, we have a tendency to get caught up in fads. Patients often demand the latest procedure or treatment, but they don't know whether it's right for them, based on their health history and comorbidities. In addition, they may not be familiar with the risks and side effects of a new procedure or treatment. It's our obligation — and our oath — to do the right thing for the patient. We need to honestly and responsibly evaluate exciting new technologies or advances that may be heavily promoted and ask ourselves, would we recommend this procedure or treatment for our mother or other family member? Do we have enough data to show that a new procedure or treatment really works and is safe? Here are three areas worth paying attention to:

## STEM CELLS

There's no shortage of ads for stem cells, which are touted to improve knee osteoarthritis and other musculoskeletal conditions without surgery. But there's very little data on their effectiveness, and most have not been approved by the U.S. Food & Drug Administration (FDA). (The only stem cell-based products that are FDA-approved come from cord blood.) Scott Rodeo, MD, Attending Orthopaedic Surgeon and Director of the Orthopedic Soft Tissue Research Program at HSS, is studying stem cells, and he has pointed out that although cell-based therapies have tremendous potential, "the number of true stem cells by molecular criteria in the bone marrow and fat is vanishingly small. Furthermore, if you take stem cells out of bone marrow or fat and put them in a different environment, like a tendon, they may well act very differently. Cells are very environment-dependent. So our ability to use stem cells is pretty limited right now." There is potential for intrinsic stem cells, which are present in all of the body's tissues, to be effective in healing tendon injuries, but the research is in its infancy.

## LASER SPINE SURGERY

There are a handful of spine centers across the country promoting the benefits of minimally invasive laser spine surgery, in which a laser is used to vaporize and shrink soft tissue. The data to support these procedures is sparse, but patients are drawn to the idea of a "quick fix" at these ambulatory care centers. As physicians, it is our job to educate patients about procedures with limited data.

## MAJOR SURGERY ON AN OUTPATIENT BASIS

Although the idea of performing traditionally inpatient procedures like total joint replacement on an outpatient basis is not radical, it must be done responsibly. In order to avoid complications and readmission, we need strict criteria for patient eligibility. A recent review of 14 studies on patient selection criteria for outpatient arthroplasty published in *Knee Surgery, Sports Traumatology and Arthroscopy* indicates that a good candidate for the outpatient procedure is a patient who is undergoing primary arthroplasty, has a low ASA classification, is under 75 and has support at home during the first postoperative days. A patient with a high ASA classification, a bleeding disorder, poorly controlled and/or severe cardiac or pulmonary comorbidities, uncontrolled diabetes, a high BMI (above 30), or chronic opioid consumption is not considered a good candidate.

At HSS, we're enthusiastic about new technologies, and not just the latest fads. I'm proud that we have physicians who perform well-proven traditional procedures, as well as surgical pioneers who are pushing the envelope and reporting on it. It's great to be able to provide that spectrum of care under one roof.

Todd J. Albert, MD, FACS

*Surgeon-in-Chief and Medical Director  
Korein-Wilson Professor of Orthopaedic Surgery*

# Adult Reconstruction and Joint Replacement Service

Physicians in the Adult Reconstruction and Joint Replacement Service perform more joint replacement procedures than any other hospital in the country. Our surgeons are at the forefront of developing novel techniques and process improvements that enable our patients to return to a pain-free, active lifestyle quickly.

## CHIEF

Douglas E. Padgett, MD

## CHIEF, HIP SERVICE

Mathias P. Bostrom, MD

## CHIEF, KNEE SERVICE

Steven B. Haas, MD

## CHIEF, SURGICAL ARTHRITIS SERVICE

Mark P. Figgie, MD

49,854

Patient visits

10,494

Surgeries

8

Fellows

82

Published studies

110

Presentations at conferences

21

New HSS eAcademy® modules

109

Academic visitors

2

Patents

## ACHIEVEMENTS

- In 2016, Douglas E. Padgett, MD joined the American Joint Replacement Registry Board of Directors as an American Academy of Orthopaedic Surgeons (AAOS) representative. He is serving a three-year term. In addition, he was an invited speaker at the Canadian Orthopaedic Association/ Hip Symposia in Ottawa in June 2017.
- Friedrich Boettner, MD, Associate Attending Orthopaedic Surgeon, received the Best Poster Award at the European Knee Society meeting in London in April 2017.
- Mathias P. Bostrom, MD, Attending Orthopaedic Surgeon, is a member of the AAOS Research Development Committee and is Past President of the Orthopaedic Research Society.
- Thomas P. Sculco, MD, Attending Orthopaedic Surgeon, is President of the New York Medical and Surgical Society. He recently served as President of the Knee Society.
- In March 2017, Charles N. Cornell, MD, Attending Orthopaedic Surgeon, was named Chair of the newly created Department of Orthopedic Surgery at Stamford Health.
- Jose A. Rodriguez, MD, Attending Orthopaedic Surgeon, was awarded the Best Instructional Video, Adult Reconstruction at the AAOS annual meeting in 2017. He also received the Pioneer Award, National Medical Fellowships.
- In July 2017, HSS was named a Center of Excellence for joint replacement surgery by Optum, a health services company. The designation is given to institutions that combine top-quality clinical care with excellent patient support and outcomes.

## PATIENT CARE

- We are improving care continuity through our Post-Operative Care Program, which was created to help patients safely recover from surgery. It enables patients to report concerns or ask questions even if their surgeon is not available. The program is available via phone at the main campus seven days a week. We recently expanded it to the HSS Long Island Outpatient Center, where a Nurse Practitioner is available for a consultation. Expansion to other satellite locations is in the works.
- As part of a broader initiative run by the Hospital's Value Management Office, we have begun collecting patient-reported outcomes on all ARJR patients through the PROMIS Global-10.
- To ensure that patients are discharged within the expected length of stay, we refined our clinical pathway targets for total knee and total hip replacement patients. Our ARJR pathways now have three levels to reflect patient types, which are determined by their clinical complexity. Since an interdisciplinary team launched the project, pathway adherence has increased.

## RESEARCH INITIATIVES

- We are focused on advancing the functional evaluation of patients before and after surgery — and determining optimal implant position to allow for maximal and expeditious return to full activity. Seth A. Jerabek, MD, Assistant Attending Orthopaedic Surgeon; David J. Mayman, MD, Associate Attending Orthopaedic Surgeon; and Christina I. Esposito, PhD, Assistant Scientist, have identified the interplay between the lumbosacral spine and functional hip position. Several studies suggest that the ideal implant position is patient specific, and adjustments should be made on an individualized basis.
- To place implants more precisely, we have begun exploring innovative surgical techniques, such as robotics, computer navigation and “smart” sensors, and novel imaging techniques.
- We collaborate with a variety of departments. The Surgical Arthritis Service, led by Mark P. Figgie, MD, Attending Orthopaedic Surgeon, is studying lupus and other rheumatic diseases with Rheumatologist Susan M. Goodman, MD, Attending Physician. Michael L. Parks, MD, Clinical Director of Orthopaedic Surgery, is working closely with the Public Health team to better understand health disparities in orthopaedic care. We are also collaborating with Thomas W. Bauer, MD, PhD, Pathologist-in-Chief, to study biologic reaction around failed implants.
- We presented several research initiatives at the AAOS conference in March 2017. Among them: Alexander S. McLawhorn, MD, Assistant Attending Orthopaedic Surgeon; Peter K. Sculco, MD, Assistant Attending Orthopaedic Surgeon; and Catherine H. MacLean, MD, PhD, Chief Value Medical Officer, investigated post-discharge complications in total knee arthroplasty and total hip arthroplasty patients. In the study of primary total knee arthroplasty patients, we found that after controlling for pre-discharge patient characteristics, discharge to inpatient care instead of home was associated with higher odds of complications and unplanned readmission. In the study of total hip arthroplasty patients, they found that discharge to continued inpatient care was independently associated with increased morbidity.
- Dr. Padgett, Stephen Lyman, PhD, Associate Scientist, and Timothy M. Wright, PhD, Director of the Department of Biomechanics, surveyed patients who were dissatisfied with total knee arthroplasty. They found that these individuals had unrealistic expectations of kneeling and participation in recreational activities and had a five times higher rate of subsequent revision.
- Drs. Jerabek, Mayman, Peter Sculco and Esposito and Han Jo Kim, MD, Associate Attending Orthopaedic Surgeon, have been studying primary total hip arthroplasty outcomes in patients with multi-level degenerative disc disease in the lumbar spine. Their research has showed that decreased

posterior pelvic tilt in these patients decreases combined functional anteversion in the seated position, which may elevate the risk of posterior hip dislocation.

- In analyses of quantitatively derived hospital and surgeon volume categories, Dr. McLawhorn, Robert G. Marx, MD, MSc, FRCSC, Attending Orthopaedic Surgeon, and Dr. Lyman found that the additional risk of adverse events for hospitals and surgeons performing lower annual volumes of Total Hip Arthroplasty is greater than previously evident.
- Chitranjan S. Ranawat, MD, and Dr. Mayman were awarded a patent for a product that creates a patient-specific preoperative plan using 3-D image data for orientation and implantation of the acetabular component. It produces a patient-specific 3-D printed acetabular guide for cup placement. The guide is shaped and configured to conform to the acetabular notch of the patient’s acetabulum in the planned anteversion and inclination angles. It allows surgeons to place an axis pin parallel to a center axis of the acetabular guide, which can be referenced for implant placement. The product can be used in both primary and revision total hip replacement cases and is compatible with any implant system.
- Dr. Boettner was granted a patent for new instruments designed to improve visualization, access and technique during arthroscopic treatment of femoro-acetabular impingement (FAI). These include a CAM Resection Guide with a round tip that can evaluate the spherical contour of the bone at the head-neck junction and a drill guide with a rounded tip that allows for improved access to the acetabular rim. If the labrum requires repair, the arm with the rounded tip decreases the chances of penetrating the articular cartilage.

EDUCATION

- In March 2017, we hosted the Rothman-Ranawat Traveling Fellows, sponsored by the Hip Society. This fellowship program is open to four young orthopaedic surgeons throughout the world who

visit up to 12 host sites in North America within four weeks. The goal is to expose emerging thought leaders to state-of-the-art facilities that provide exemplary hip surgical care. The fellowship is partially sponsored by Dr. Ranawat.

- The Service hosted 15 Greek surgeons who participated in the HSS Stavros Niarchos Foundation Orthopaedic Education Program in late November and early December 2016. The program was the brainchild of Thomas P. Sculco, MD, Attending Orthopaedic Surgeon, who continues to be the lead faculty member. There were two days of case presentations and hands-on workshops, followed by three days at the 28th Annual Holiday Knee & Hip Course, a CME-accredited professional education meeting.
- We continued the tradition of the Wilson-Insall Visiting Professors program with our 2017 guest, Thorsten Gehrke, MD, Chief Physician at the HELIOS ENDO-Klinik in Hamburg, Germany. A world-renowned expert in the field of musculo-skeletal infection, his two-day visit provided the ARJR staff with an update on unique approaches to the diagnosis and management of this devastating complication.
- We continue to provide in-person and video didactic instruction of new techniques, using observations and training labs, for colleagues in South Korea and China.
- We released 21 HSS eAcademy® modules in June 2017. All were based on courses taught at the 2016 Holiday Knee & Hip Course, which emphasized evidence-based approaches to diagnosis and treatment. Modules include “Navigation and Robotics”; “Modifiable Risk Factors”; and “How does the spine affect what we do?”.

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Opposite page

Left to right:

Paul M. Pellicci, MD  
Daniel S. Rich, MD  
Jose A. Rodriguez, MD\*  
Geoffrey H. Westrich, MD  
Seth A. Jerabek, MD  
Robert L. Buly, MD  
Mathias P. Bostrom, MD  
Allan E. Inglis, Jr., MD  
Mark P. Figgie, MD  
Michael L. Parks, MD  
Michael B. Cross, MD  
Alejandro Gonzalez Della Valle, MD  
Peter K. Sculco, MD  
Russell E. Windsor, MD

\*New Physician

Below

Left to right:

Friedrich Boettner, MD  
Chitranjan S. Ranawat, MD  
Eduardo A. Salvati, MD  
Edwin P. Su, MD  
Charles N. Cornell, MD  
Thomas P. Sculco, MD  
Michael M. Alexiades, MD  
Amar S. Ranawat, MD  
Douglas E. Padgett, MD  
David J. Mayman, MD  
Steven B. Haas, MD  
Alexander S. McLawhorn, MD, MBA







## Tackling the most complex cases

Given that we repair and replace more joints than any other hospital in the world, it only seems natural that we would provide care for patients with the most complex problems. Although most joint replacement procedures are successful, “you’re still looking at a 10 percent failure rate within the first 15 to 20 years, which is a large number of people,” says Thomas P. Sculco, MD, Surgeon-in-Chief Emeritus. “The revision operation is also often far more complex than the primary one in terms of blood loss, soft tissue and bone loss problems, and the need for specialized implants.” As a result, many patients find themselves passed from surgeon to surgeon, experiencing a fragmentation in care. “Most surgeons do not want to take on these cases, since the risks and complications are greater than for primary hip and knee surgery; the patients require a lot of care; and insurance reimbursement, particularly under Medicare, to the surgeon is woefully inadequate. That means many people are not getting the care they need.”

These concerns led Dr. Sculco to create the Complex Joint Reconstruction Center (CJRC), which serves as a point of access for patients with complex joint disorders, the first of its kind anywhere in the world. The CJRC provides best-in-class diagnosis and treatment of the most challenging reconstruction cases — and conducts cutting-edge research on the causes, prevention and treatment of implant failure.

The Center, which opened in January 2017, has now treated more than 400 patients of surgeons in the Center and others referred by physicians from around the world for a complicated joint disorder or treatment of an infected or failed implant. When surgeons perform a revision procedure, the research coordinator is in the operating room collecting information. “The power of that is you are less likely to miss something, which happens when you dictate it in a note two days after the procedure,” says Dr. Sculco.

The CJRC has also established a revision registry, which will allow surgeons to investigate why implants fail. “We will be looking for potential biomarkers that may indicate that a patient could react adversely to certain types of implants before they undergo surgery,” explains Dr. Sculco. While the research is still early, Dr. Sculco hopes the CJRC will serve as a repository of information for other major joint replacement sites, both in the United States and abroad.

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# Foot and Ankle Service

The Foot and Ankle Service is the largest program of its kind in the United States. Its surgeons have expertise in deformity correction, trauma, sports injuries and arthritis.

**CHIEF**  
Matthew M. Roberts, MD

23,923  
Patient visits

2,605  
Surgeries

3  
Fellows

54  
Published studies

45  
Presentations at conferences

1  
New HSS eAcademy® module

20  
Academic visitors

Opposite page

Left to right:

- Martin J. O'Malley, MD
- Jonathan T. Deland, MD
- David S. Levine, MD
- Andrew J. Elliott, MD
- Matthew M. Roberts, MD
- Constantine A. Demetracopoulos, MD
- John G. Kennedy, MD
- Mark C. Drakos, MD
- Scott J. Ellis, MD
- Harvey Strauss, DPM, FACFAS

## ACHIEVEMENTS

- Matthew Roberts, MD, is a Board member of the New York State Society of Orthopaedic Surgeons. He chaired the Society's 2017 Symposium and Annual Meeting, which was held at HSS.
- Dr. Roberts chairs the Postgraduate Education and Training Committee of the American Orthopaedic Foot & Ankle Society (AOFAS).
- Scott J. Ellis, MD, Associate Attending Orthopaedic Surgeon, was named President-Elect of the American Orthopaedic Foot & Ankle Society Foundation in July 2017. The Foundation funds humanitarian efforts, research and education.
- Dr. Ellis's study of patient expectations of foot and ankle surgery, published in May 2017 in *Foot & Ankle International*, was selected as the lead article and received a podcast.
- Mark C. Drakos, MD, Assistant Attending Orthopaedic Surgeon, and Constantine A. Demetracopoulos, MD, Assistant Attending Orthopaedic Surgeon, are members of the AOFAS Young Physicians Committee.
- Martin J. O'Malley, MD, Associate Attending Orthopaedic Surgeon, is a Team Physician for the Brooklyn Nets and consistently sees professional athletes from across the country.
- David S. Levine, MD, Associate Attending Orthopaedic Surgeon, is Medical Director of the new HSS Ambulatory Surgery Center (ASC), which focuses on hand, foot and ankle, and sports medicine procedures. It opened in September 2017.
- John G. Kennedy, MD, Assistant Attending Orthopaedic Surgeon and co-founder of the International Society on Cartilage Repair of the Ankle, is working with other members of the organization to standardize the diagnosis and care of patients with ankle cartilage injuries.
- Our foot and ankle registry, composed of more than 35,000 patients, is the largest in the country and allows our department to draw on patient experiences to improve care.

## PATIENT CARE

- We recently began using a weight-bearing 3-D CT scan, which provides a complete representation of all of the bones in the foot and allows us to visualize how joints and bones interact in a weight-bearing state. The unit emits five times less radiation than a standard CT and is faster. The patient stands or sits in the unit so his or her feet and ankles can be imaged in a weight-bearing position, enabling us to view deformities. While we reserve the scan for more complicated bunion and flatfoot cases, our use of it is increasing.
- The new HSS Ambulatory Surgery Center (ASC) — the first joint venture of its kind between surgeons and HSS — features four operating rooms and a pre- and post-surgical unit. It provides efficient care for patients who are having uncomplicated foot and ankle procedures.

- All of our patients benefit from a multimodal pain protocol. We worked with the Department of Anesthesiology to create a pain pathway that has decreased our patients' needs for narcotics. We are using popliteal blocks, which are administered by the anesthesiologist at the time of surgery. Pain relief lasts for one to two days, allowing patients to go home comfortably and giving them a head start in pain control. This has allowed most of our surgeries to be done on an outpatient basis, and it has improved the patient experience.

## RESEARCH INITIATIVES

- With generous support from the Susan and Elihu Rose Foundation, we established the *Susan W. Rose and Jonathan T. Deland Chair for Research in Foot and Ankle Surgery*. Jonathan T. Deland, MD, Attending Orthopaedic Surgeon, is the holder of the Chair and conducts research focused on improving treatments for foot and ankle conditions. His major research projects address tibial posterior tendon dysfunction, flatfoot deformity and ankle arthritis. The Chair supports the Rose Registry, one of the largest foot and ankle registries in the nation dedicated to evaluating patient outcomes following conservative and surgical treatment of foot and ankle problems, as well as other research initiatives of the Service.
- In a study published in the *Journal of Orthopedic Research* in 2016, we confirmed that our state-of-the-art gait simulator reproduces foot and ankle motion and thus emulates real-life walking. This finding validates our simulator as a research tool for testing treatments of foot and ankle maladies. Research using the simulator led to the discovery that ankle fusion causes increased motion and, ultimately, stress in foot joints — particularly the hindfoot — which may lead to arthritis, according to a study published in *Foot & Ankle International* in 2017. Future studies will use the simulator to compare the effects of different ankle replacement surgeries on foot joints.
- We have implemented the NIH PROMIS CATs, a nationally accepted outcomes instrument that is more precise and takes less time to complete. In a study published in *Foot & Ankle International* in 2017, we compared three Patient-Reported Outcomes Measurement Information System (PROMIS) Computer Adaptive Tests (CATs) relevant to the foot and ankle discipline to the Foot and Ankle Outcome Score (FAOS) and the Short Form 12 general health status survey. More than 200 patients with six common foot and ankle pathologies completed the surveys at their preoperative and postoperative visits. We found that the CATs performed as well or better than the FAOS.
- We recently created a patient survey to assess expectations of foot and ankle surgery. We found that the HSS Foot & Ankle Surgery Expectations Survey was valid, reliable and applicable to diverse diagnoses, according to a study published in December 2016 in *Foot & Ankle International*. The survey may be used preoperatively by surgeons





## The benefits of 3-D surgical planning

The case perplexed Scott Ellis, MD, Associate Attending Orthopaedic Surgeon. He had just seen Patricia Mack, 32, who was in severe pain due to a recurring bunion that had been operated on twice at another hospital. She could no longer exercise, and she walked on the outside of her foot to avoid the painful pressure point. “Her sesamoid bones weren’t sitting right, and it was clear we would need to do a revision surgery to reposition the bones,” he says. “The challenge was to figure out exactly how these bones

were positioned so we could correct them.”

That’s where Darrick Lo, MEng, Design Engineer in the Department of Biomechanics, stepped in. Lo was Mack’s neighbor, and he discovered that she had seen Dr. Ellis. A few weeks later, Lo brought up the case to Dr. Ellis at a meeting. “Scott mentioned it was a challenging case, so it occurred to me: Why not offer to build him a 3-D printed model?” Lo recalls. It seemed easy enough to do: part of Lo’s job is to help convert two-dimensional CT scans into

3-D models of a patient’s anatomy. (The Department prints about 50 patient bone models each year.) “It provides additional information the surgeon may need to prepare for surgery,” he explains.

Dr. Ellis was thrilled when he saw the model Lo created. “It gave me a much more precise view of the sesamoid bones than I had anticipated,” he says. “It helped me develop a mental model of how to realign the bones and get them back in position.” Mack underwent a successful surgery in January 2016. “I have

none of the pain I experienced pre-surgery,” she says. Today, she is exercising regularly and expecting her first child in March.

As a result of this case, Dr. Ellis is now routinely using the 3-D standing CT scan to understand how a patient’s sesamoid bones are positioned. “When you look at the sesamoid bones this way preoperatively, you can understand exactly how to reposition them,” he explains. “It’s not just cutting bone and moving it over; it’s fine-tuning things. I performed Patricia’s third surgery, and hopefully it’ll be her last.”

to help guide patients’ expectations and facilitate shared decision making. In another study, published in May 2017 in *Foot & Ankle International*, we found that patients who had taken narcotics, reported depression or anxiety, or had lower levels of function had greater expectations for the outcomes of foot and ankle surgery. The findings suggest that educating or counseling these patients about their expectations preoperatively may help improve their satisfaction with surgery. In another study, which is under review, we investigated whether certain foot and ankle diagnoses — such as bunions and ankle arthritis — are associated with higher or lower expectations.

- We collaborated with Rheumatologist Susan M. Goodman, MD, Attending Physician, to examine how gender, race and socioeconomic factors affect pre-surgical patient expectations. The research was presented at the American College of Rheumatology meeting in November 2017. We found that female sex and non-Caucasian race were independently associated with greater expectations, and community social factors were not significant.

### EDUCATION

- Our physicians regularly host national and international visitors, including German and Australian traveling fellows. We are one of seven designated American Orthopaedic Foot & Ankle Society (AOFAS) sites for international visitors.
- We established the foot component of the HSS-China Orthopaedic Education Exchange, a unique program that allows Chinese orthopaedic surgeons to gain valuable knowledge and experience through structured observation programs at HSS and live video conferences.

- Dr. Demetracopoulos hosted a webinar on ankle arthritis.
- We offer a simulated exam program to medical students, in which they examine a patient actor with symptoms of a certain foot and ankle condition. Students must demonstrate competency by identifying the condition and prescribing the appropriate treatment.
- We are working with physicians in Rheumatology, Hand and Adult Reconstruction and Joint Replacement to develop a hands-on curriculum for second-year medical students. We give lectures in our areas of musculoskeletal expertise and demonstrate physical exams for common conditions. We recently filmed a series of videos of these exams so medical students can access the information online.

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# Hand and Upper Extremity Service

The Hand and Upper Extremity Service is internationally renowned for its treatment of adults and children suffering from bone and soft-tissue conditions of the hand, wrist, forearm, elbow and shoulder.

CHIEF

Edward A. Athanasian, MD

20,889  
Patient visits

2,680  
Surgeries

4  
Fellows

57  
Published studies

88  
Presentations at  
conferences

13  
New HSS eAcademy® modules

8  
Academic visitors

Opposite page

Left to right:

- Andrew J. Weiland, MD
- Scott W. Wolfe, MD
- Robert N. Hotchkiss, MD
- Lana Kang, MD
- Daniel Osei, MD\*
- Edward A. Athanasian, MD
- Aaron Daluiski, MD
- Michelle G. Carlson, MD
- Steve K. Lee, MD
- Duretti T. Fufa, MD

\*New Physician

ACHIEVEMENTS

- In March 2017, Scott W. Wolfe, MD, Attending Orthopaedic Surgeon and Chief Emeritus of the Hand and Upper Extremity Service, received the prestigious Kappa Delta Orthopaedic Research Award — the highest honor in orthopaedics — from the American Academy of Orthopaedic Surgeons. The award is given to investigators who make key discoveries leading to major advances in the field of orthopaedics.
- Duretti T. Fufa, MD, Assistant Attending Orthopaedic Surgeon, received the Richard H. Gelberman Scholar Award from the American Foundation for Surgery for the Hand. The award is given to a young hand surgeon who demonstrates strong potential for excellence in patient care, research and education. Dr. Fufa will travel across the country to study hand microsurgery centers. She received training in microsurgery from the world-renowned expert Fu-Chan Wei, MD, at Chang Gung Memorial Hospital in Taipei, Taiwan.
- Dr. Fufa received the HSS Richard S. Laskin, MD Young Attending Award in 2017.
- Lana Kang, MD, Assistant Attending Orthopaedic Surgeon, serves as a New York Society Surgery of the Hand delegate to the New York House Assembly.
- Dr. Kang is Government Affairs Committee Chairman for the American Society for Surgery of the Hand.
- Steve K. Lee, MD, Associate Attending Orthopaedic Surgeon, served as President-Elect for the New York Society for Surgery of the Hand in the 2016-2017 academic year and is now President.
- Dr. Lee placed first in the New York Society for Surgery of the Hand’s Research Award for a project that examined the vascularity of the scaphoid bone. He also received the HSS 2017 Charles Christian Award for Excellence in Musculoskeletal Research.

PATIENT CARE

- We have discovered that high-resolution peripheral nerve MRI can play an important role in identifying hourglass constrictions of nerves in Parsonage-Turner syndrome (PTS) in a study published in 2016. In addition, we found that a bullseye sign of the nerve can accurately localize hourglass constrictions. Identifying these constrictions may help predict which patients with PTS will experience spontaneous recovery and which ones may require surgery. Drs. Lee and Wolfe were study co-authors.
- In an effort to correlate patient expectations with the effectiveness of treatment, we surveyed patients seeking treatment for trapeziometacarpal arthritis. In the study, which was published in

- Clinical Orthopaedics and Related Research* in 2017, we discovered that patients who were female, whose dominant side was affected and who chose surgical treatment had higher expectations than others. By identifying these factors, we can effectively counsel patients about their expectations prior to surgery. Dr. Kang was the lead study author, and Andrew J. Weiland, MD, Attending Orthopaedic Surgeon; Dr. Lee; and Carol A. Mancuso, MD, Attending Physician, were co-authors.
- Robert N. Hotchkiss, MD, Associate Attending Orthopaedic Surgeon, is collaborating with the Department of Radiology and Imaging to map out the best donor sites for osteocartilagenous autograft transplants in the elbow among pediatric patients with osteochondral defects. One promising area is the knee; a cylinder of bone or cartilage can be removed and transferred to the elbow.
- RESEARCH INITIATIVES
- We are developing a machine learning algorithm to improve the sensitivity and specificity of X-ray detection of fractures. In 2017, Aaron A. Daluiski, MD, Associate Attending Orthopaedic Surgeon, presented an abstract at the American Society for Surgery of the Hand meeting. He and Dr. Hotchkiss conducted a study evaluating a convolutional neural network and discovered that it is fast, accurate and improves clinicians’ ability to detect fractures.
  - We are investigating ways to improve treatment outcomes for patients with scaphoid nonunions without adding to the complexity of the procedures. In a study published in the *Journal of Hand Surgery (European Volume)* in 2017, Drs. Wolfe and Lee found that non-vascularized autogenous bone grafting and rigid internal fixation led to successful healing in a series of scaphoid nonunions with a high incidence of compromised vascularity. Our overall union rate was 97 percent.
  - Dr. Fufa is collaborating with the Department of Radiology and Imaging to investigate the use of ultrasound for diagnosing carpal tunnel syndrome and predicting a patient’s response to treatment. Eventually, this noninvasive and inexpensive imaging technique could replace painful nerve studies.
  - Dr. Fufa is recruiting subjects for a prospective, randomized controlled trial on the impact of pain management education on postoperative narcotics consumption.
  - Michelle G. Carlson, MD, Associate Attending Orthopaedic Surgeon, published two reviews of upper extremity injuries in elite athletes. The first, published in December 2016 in the *Journal of the AAOS*, found that for four common soft-tissue sports injuries — flexor digitorum profundus avulsion, flexor pulley rupture, extensor carpi



## Optimizing outcomes during a high-risk microsurgery

The patient wanted the surgery, but Duretti Fufa, MD, Assistant Attending Orthopaedic Surgeon, was cautious to offer it. It wasn't just that the procedure in question — a toe to thumb transfer — was one of the most complex hand microsurgeries around. Dr. Fufa was confident that she would be able to perform it, given her microsurgery expertise and the fact that she had spent a year training under the man who had pioneered the surgery himself, esteemed Taiwanese surgeon Fu-Chan Wei, MD. But the patient, James, wasn't an ideal candidate, given the fact that he was in his 50s with heart disease. "His small blood vessels were not of great quality," Dr. Fufa recalls, noting that the patient had already had an unsuccessful surgery to try to reattach his thumb at an outside hospital when the injury first occurred a year ago. "I was clear with him that in pursuing this reconstruction of his thumb, we had to accept the risk that the surgery would not be successful given his medical history."

James was undeterred. He had lost the thumb of his dominant right hand in an accidental saw injury, and as an electrician, he needed it to perform his work. (The thumb comprises up to 50 percent of hand function.) The other options presented to him — a prosthetic or a thumb lengthening procedure — didn't seem palatable to him, because they wouldn't restore any mobility to his thumb. Dr. Fufa decided the next step would be to perform an MRA of his foot to make sure his small blood vessels would be suitable for the procedure. But when she first imaged him, the radiologists could see very few blood vessels in his foot. That's when she enlisted the help of the Radiology and Imaging and Anesthesiology departments. "When we consulted with Dr. Potter, she suggested that because James was cold in the scanner, his blood vessels had clamped down, which contributed to us not seeing them," says Dr. Fufa. Dr. Potter suggested that Anesthesiology perform a nerve block to dilate his blood vessels in advance of the scan. This proved successful at demonstrating improved circulation in the foot. "If we hadn't worked with Radiology and Anesthesiology, I never would have felt comfortable offering him the surgery, because his blood vessels initially appeared too limited to perform the procedure successfully," says Dr. Fufa.

The operation itself took eight hours, a laborious process conducted by Dr. Fufa and Daniel Osei, MD, Assistant Attending Orthopaedic Surgeon. "We worked simultaneously: I worked on removing the big toe while Dr. Osei was at the hand preparing the recipient site by finding tendons and blood vessels to which we would connect," she recalls. The most technically demanding part of the operation was joining the blood vessels and nerves, which requires microsurgery.

Although the procedure went well, James wasn't out of the woods yet. "The post-op period is also incredibly critical, which is why nursing and house staff are key," Dr. Fufa explains. HSS's nurses, residents and physician assistants watched James around the clock to monitor his situation. "Whenever we do this type of surgery, if we see signs of challenge or compromise to a patient's circulation, we need to bring them back to the OR right away," she says. "Normally, we only have a failure rate of one out of fifty, but in his case, I knew we were looking at something more like one out of five."

Fortunately, James' surgery was a success story. After 21 days at HSS, he was cleared to return home and is now undergoing physical therapy to try to gain optimal use of his thumb. He hopes that over the next six months to a year he will be able to restore some range of motion to it, as well as some sensitivity. "I can press things against it, which gives me confidence that down the road I'll be able to write my name and hold a hammer or set of pliers again," he says. "The most important thing to me now is that I have a thumb again — all thanks to Dr. Fufa."

Dr. Fufa, however, gives credit to the tireless efforts of the anesthesiologists, nurses, residents and physician assistants who helped to closely monitor James in the days following his surgery. "They had to constantly monitor that he wasn't in pain, which would have led to blood vessels clamping down; that his hand was warm; and that he had good oxygen saturation to the area, among other things," explains Dr. Fufa. "If any of those things were not quickly corrected, the surgery could have failed. James's case is an illustration of how collaboration between many different teams — hand surgery, radiology, anesthesiology, nursing — can lead to a successful outcome, even in a high-risk surgery."

# Hand and Upper Extremity Service cont'd

ulnaris dislocation, and thumb metacarpophalangeal joint ulnar collateral ligament injury — the assessment, treatment and considerations for return to play should be individualized based on the patient, the sport, and the timing of the injury. The other review, published in February 2017 in *Hand Clinics*, found that after an upper extremity injury, return-to-play decisions must be individualized to the athlete and his or her injury.

## EDUCATION

- In 2017, we hosted L. Scott Levin, MD, Chair of the Department of Orthopaedic Surgery at the University of Pennsylvania School of Medicine and Director of the Hand Transplant Program at Children's Hospital of Philadelphia (CHOP). He gave the Lee Ramsey Straub, MD, Honorary Lecture in Hand Surgery as part of the HSS Visiting Professor Lecture Series.
- We created 13 HSS eAcademy® modules, including "Distal Radius Fracture Fixation" and "Applied Anatomy of the Brachial Plexus: A Cadaveric and Intra-operative Correlation."
- We continue to emphasize Fellow training in microsurgery with Dr. Fufa and pediatric and congenital hand problems with Dr. Daluiski. Fellows attend weekly and bi-monthly academic conferences supervised by Dr. Lee and are required to complete at least one research project a year under the supervision of an assigned research mentor.
- Edward A. Athanasian, MD, taught an instructional course at the American Association for Hand Surgery annual meeting in January 2017 entitled "Complications of Upper Extremity Tumor Surgery."
- Dr. Carlson was co-chair of a half day pre-course entitled "Arthroscopy of the Upper Extremity: Tips and Tricks from Fingers to Elbow" at the American Society for Surgery of the Hand's 71st Annual Meeting in September 2016.
- Dr. Hotchkiss gave a presentation called "Management of Fractures of the Distal Humerus" at the American Shoulder and Elbow Surgeons annual meeting in October 2016.

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# Hip Preservation Service

The Hip Preservation Service and the Center for Hip Preservation are dedicated to understanding the causes and long-term effects of hip degeneration and injuries.

**CHIEF**  
Robert L. Buly, MD

22,864  
Patient visits

3,040  
Surgeries

1  
Fellow

20  
Published studies

162  
Presentations at conferences

2  
Patents

**ACHIEVEMENTS**

- In 2016, Ernest L. Sink, Associate Attending Orthopaedic Surgeon and Fellowship Director of the Hip Preservation Service, became a member of the International Society for Hip Arthroscopy.
- In 2016, Dr. Sink was a Peer Reviewer for the American Academy of Orthopaedic Surgeons' (AAOS) "Clinical Practice Guideline on the Management of Osteoarthritis of the Hip."
- In 2017, Dr. Sink was an invited faculty speaker at the AAOS conference and the 12th Symposium on Joint Preserving and Minimally Invasive Surgery of the Hip and COA Annual Meeting in Ottawa, Canada.
- Danyal H. Nawabi, MD, Assistant Attending Orthopaedic Surgeon, received the Richard Villar Basic Science Award from the International Society for Hip Arthroscopy for his paper entitled "Outcomes After Arthroscopic Treatment of Femoroacetabular Impingement for Patients With Borderline Hip Dysplasia."
- In 2016, Anil S. Ranawat, MD, Associate Attending Orthopaedic Surgeon, became a Board Member of the Eastern Orthopaedic Association.
- Dr. Ranawat was an invited speaker at the AAOS Annual Meeting in March 2017. He gave a presentation entitled "Osteotomy of the Knee: Pearls & Pitfalls."
- In October 2016, Edwin P. Su, MD, Associate Attending Orthopaedic Surgeon, won the Fellow research presentation award for "Prospective Evaluation of the Posterior Tissue Envelope After Anterior THA" at the Eastern Orthopaedic Association meeting in New Orleans.
- Dr. Su was Hip Program Chairman at the North American Hip and Knee Symposium in Phoenix, AZ, in April 2017.

**PATIENT CARE**

- We are developing new pain protocols. Instead of relying on just one way to manage pain, we are moving toward a combination of pathways — preoperative analgesia, intraoperative injection/ local anesthetics and regional anesthesia. For instance, when we administer local injections, we will counsel patients about their pain expectations during rehabilitation. Our goal is to reduce the postoperative use of opioids.
- We discuss our complex cases at weekly meetings to reach consensus decisions about treatment.
- Since some patients may not benefit from arthroscopy alone, we are performing a growing number of hip preservation cases using a combination of arthroscopic and open procedures simultaneously.
- We are performing the anterior approach to hip replacement more frequently. By

using robotic-assisted technologies, we have obviated the need for fluoroscopic imaging during procedures.

- We are exploring specialized MRI sequences that will enable us to reduce our dependence on CT scans when diagnosing and treating certain morphologic abnormalities in hip preservation patients.

**RESEARCH INITIATIVES**

- Thanks to improved surgical techniques and implant designs, we are developing accelerated rehabilitation protocols for patients who have undergone femoroacetabular impingement (FAI) surgery. We are investigating whether patients can return to work and daily activities four weeks earlier than the current guidelines of 24 weeks, or six months. In addition, we will determine whether patients can return to 100 percent, rather than 30 percent, weight-bearing activities. The advantages include no need for a brace and faster weaning off crutches.
- We are continuing to study hip preservation outcomes. In order to better counsel our patients preoperatively, we have defined the minimal clinically important difference (MCID) and substantial clinical benefit (SCB) thresholds for certain outcome scores after hip arthroscopy.
- We have conducted the first in-depth study investigating the learning curve for hip arthroscopy. Using statewide databases, we have found that the learning curve is much steeper than it is for other commonly performed hip surgeries, and outcomes are better in high-volume centers. These findings have important implications for how we train the next generation of hip arthroscopic surgeons.
- The overlap between FAI and athletic pubalgia has been recognized recently. At the International Society for Hip Arthroscopy meeting, we presented the largest experience of combined hip arthroscopy and open sports hernia surgeries, demonstrating excellent outcomes and high rates of return to sport.
- We continue to publish studies based on our hip preservation registry. We regularly report on hip arthroplasty outcomes in adolescent athletes, professional athletes and soccer players.

**EDUCATION**

- In August 2016, Robert L. Buly, MD, was a co-presenter at the International Congress for Joint Reconstruction, 3rd Annual Pan Pacific Congress in Kona, HI. His lecture was entitled "Femoral Derotation Osteotomies in Adults for the Treatment of Version Abnormalities."
- In September 2016, Dr. Buly was a presenter at the 37th SICOT Orthopaedic World Congress in Rome, Italy.



## Femoral anteversion: an elusive diagnosis

From an early age, Cailey Scott walked with her toes pointed inward. Initially, her parents weren't concerned since it was barely noticeable and was not causing any pain. She started swimming competitively and ultimately won multiple state championships in her hometown of Mitchell, SD. When Cailey was in 7th grade, however, she began to run cross-country and experienced hip pain so severe that she had to quit. She began physical therapy and, over the course of several years, saw three different local physicians. She received cortisone shots and eventually had an iliotibial band debridement in April 2016. Unfortunately, the hip pain continued, and soon even walking became difficult for Cailey.

Desperate for relief, the Scotts reached out to a family friend who knew an orthopaedic surgeon in Chicago. He referred Cailey to Robert L. Buly, MD, Chief of the Hip Preservation Service. In March 2017, Cailey, 16, and Tehra, her mom, traveled to New York for a consultation. Dr. Buly took a video of Cailey walking down the hall and scheduled a CT scan, but he was able to identify the problem almost immediately: femoral anteversion, a rotational limb deformity of the femur, as well as a discrepancy in leg length. Her right leg was 3/8 of an inch longer than her left. "No one had noticed these things — every doctor had assumed there was an issue with my muscles or tendons," says Cailey.

In most people, the anteversion of the femur is about 15 degrees, but Cailey's was 53 degrees. "It's stunning how often fixable conditions like rotational deformities aren't diagnosed," says Dr. Buly. "If you don't think about it or get the right studies, you can miss these things."

After reviewing Cailey's CT scan, Dr. Buly recommended an osteotomy of the femur, as well as surgery to rotate the tibia and correct the leg length discrepancy. The latter two procedures would be performed by S. Robert Rozbruch, MD, Chief of the Limb

Lengthening and Complex Reconstruction Service. "We often work with the Hip Preservation Service to correct rotational deformity of the femur and tibia to help protect and preserve the hip joint," says Dr. Rozbruch, who, in collaboration with Dr. Buly, has presented the results of the procedure and submitted the study for publication. "Patients with rotational deformities load the hip joint in an abnormal way, and they end up with hip pain and pathology."

Cailey and Tehra were relieved they finally had a diagnosis, but there was one last hurdle: the family's insurance company insisted that Cailey get the procedure done locally. "One orthopedic surgeon they recommended in Sioux Falls said he wouldn't operate on patients under age of 60; another said, 'I wouldn't touch that,'" recalls Tehra. With the help of the HSS office staff, the 5.5-hour procedure ended up being covered in-network.

Cailey had the two-part procedure on June 6, 2017. In May 2018, she will have a second surgery to remove the titanium rods holding Cailey's bones in place. Six months after the first procedure, Cailey is already pain-free, walking straight and back to swimming. In November 2017, during her first post-surgery swim meet, she won the 100-meter butterfly stroke. "I can't wait to tell Dr. Buly," says Cailey.



#### Left to right:

Edwin P. Su, MD  
 Douglas N. Mintz, MD  
 Peter J. Moley, MD  
 Robert L. Buly, MD  
 David S. Wellman, MD  
 Bryan T. Kelly, MD  
 Ernest L. Sink, MD  
 David L. Helfet, MD  
 Struan H. Coleman, MD, PhD  
 Anil S. Ranawat, MD  
 Danyal H. Nawabi, MD

#### Not pictured:

Dean G. Lorch, MD

- In September 2016, Dr. Buly was a presenter at the 8th annual meeting of the International Society for Hip Arthroscopy in San Francisco, CA. He gave several lectures, including "The Role of Femoral Torsion and Acetabular Version" and "Assessing Pediatric and Young Adult Patients with Hip Pain and the Role of Hip Arthroscopy."
- In October 2016, David L. Helfet, MD, Attending Orthopaedic Surgeon, and Dean G. Lorch, MD, Associate Attending Orthopaedic Surgeon, were presenters at the 47th Annual Meeting of the Eastern Orthopaedic Association in New Orleans. Their lecture was entitled "Assessment of Bone Perfusion and Arterial Contributions of the Retinacular System."
- In October 2016, Dr. Su gave a lecture at the German Congress of Orthopaedics and Traumatology in Berlin, Germany, entitled "Why I use PS TKR and resurface the patella; Hip Resurfacing in the USA."
- Bryan T. Kelly, MD, Chief of the Sports Medicine and Shoulder Service, is co-editor of the book *Sports Hip Injuries: Diagnosis and Management*.
- In April 2017, Peter J. Moley, MD, Assistant Attending Physiatrist, gave several talks at the Musculoskeletal Rehabilitation Program at the Rehabilitation Institute of Chicago, including "The Evolution of FAI."
- In July 2017, at the Annual Symposium for New Concept and Development in Traumatology, David S. Wellman, MD, Assistant Attending Orthopaedic Surgeon, gave a lecture entitled "ERAS in Hip Fractures and general management of geriatric fractures" at the Chinese Geriatrics Society, China International Exchange and Promotion Association for Medical and Healthcare, Jishuitan Orthopedic Research Center, Trauma Department of Beijing Jishuitan Hospital in Beijing, China.

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# Limb Lengthening and Complex Reconstruction Service

The Limb Lengthening and Complex Reconstruction Service (LLCRS) is the only comprehensive limb lengthening and deformity program that is part of an academic orthopaedic surgery department in the United States.

**CHIEF**  
S. Robert Rozbruch, MD

2,997  
Patient visits

588  
Surgeries

2  
Fellows

37  
Published studies

63  
Presentations at conferences

3  
New HSS eAcademy® modules

21  
Academic visitors

1  
Patent

[Opposite page](#)

[Left to right:](#)

Austin T. Fragomen, MD  
S. Robert Rozbruch, MD

## ACHIEVEMENTS

- Best Papers of 2016 Annual Meeting of the Limb Lengthening and Reconstruction Society Specialty Day/American Academy of Orthopedic Surgeons (AAOS) meeting in March 2017: “Oxygen Consumption Testing and Self-Reported Outcomes Following Limb Salvage with Tibiocalcaneal or Tibio-talo-calcaneal Fusion”
- Top Foot and Ankle Poster, AAOS meeting in March 2017: “Survival of Ankle Distraction Arthroplasty”

## PATIENT CARE

- We are innovating and expanding on the motorized internal lengthening nail, which is fundamentally changing clinical care. We have initiated, presented and submitted studies that compare the clinical and cost effectiveness of the internal lengthening nail with more conventional techniques previously used on patients. We are involved with industry related to this technology, which is widely acknowledged as the single greatest innovation in limb reconstruction in the last 15 years. It has resulted in safer surgeries for patients with less pain, fewer complications and better results.
- We are developing a new humerus lengthening nail and a retrograde tibia and ankle fusion lengthening nail, which will allow us to lengthen the tibia and reconstruct the ankle without an external fixator. In addition, we are developing a bone transport nail to address bone defects and osteomyelitis.
- In June 2017, we published our findings using the internal-lengthening nail off-label for lengthening the humerus. We discovered that patients had greater range of motion and less scarring. The study, entitled “Humerus Lengthening With the Precice Lengthening Nail,” appeared in *Pediatric Orthopedics*.
- We are spearheading the use of osteointegration, a two-step technique designed to make prostheses work better for amputee patients, resulting in greater comfort, mobility and function. With this approach, a titanium implant is inserted into the bone of the residual limb, then the bone osteointegrates into the implant. In a follow-up procedure, the prosthetic leg is directly attached to the implant, enhancing patients’ proprioception, energy transfer and movement beyond traditional methods. The first surgery using this technique in the U.S. was done in 2016 in California. In 2017, Dr. Rozbruch performed the first surgery in the Northeast and is evaluating it in a study.

## RESEARCH INITIATIVES

- We are actively engaged in knee deformity correction. We published a study in *HSS Journal* on distal femoral osteotomies to unload the knee joint and preserve it. The results showed significant

improvement in lower extremity alignment and outcomes.

- In collaboration with the Hip Preservation Service, we are pioneering a technique known as minimal incision rotational osteotomy to correct rotational deformity of the femur and tibia and to help protect and preserve the hip joint. We presented the results at several meetings, and a manuscript is under review for publication. In addition, a review article for the *Journal of Bone and Joint Surgery* is underway.
- We are actively engaged in ankle distraction arthroplasty to address ankle arthritis. Research published in the *Journal of the American Academy of Orthopaedic Surgeons* in 2016 suggests that the technique improves cartilage repair and provides pain relief. More recently, we demonstrated an average joint survival of 11.4 years in a study of 144 patients. Our poster, “Ankle distraction for end stage ankle arthritis: a survival analysis,” was presented at the AAOS meeting in March 2017. We used cartilage regeneration techniques and an external fixator to unload the ankle joint, avoiding ankle replacement in young patients with advanced arthritis.

## EDUCATION

- Drs. Rozbruch and Fragomen have written a chapter about the internal lengthening nail for the sixth edition of *Skeletal Trauma*, due out in 2018.
- Dr. Rozbruch is an Associate Editor of the new *Journal of Limb Lengthening and Reconstruction*.
- We created three HSS eAcademy® courses in the 2016–2017 academic year, including modules on trauma and reconstruction and adult deformity.
- In December 2016, Dr. Rozbruch was Visiting Professor at the 28th Annual James J. Callahan, MD Lecture on Musculoskeletal Trauma at the Stritch School of Medicine, Department of Orthopedic Surgery, Loyola University Medical Center in Chicago, IL.
- In January 2017, Dr. Rozbruch lectured on the “Evolution of Limb Lengthening and Reconstruction Surgery” at the Hospital for Special Surgery-Hadassah University Medical Center Orthopedic Conference at Hadassah Hospital, Hebrew University, in Jerusalem, Israel.
- Austin T. Fragomen, MD, was the invited keynote speaker at the 2016 National Society of Orthopaedics and Traumatology of CHILE meeting in Vina del Mar, Chile, in November 2016.

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## A better prosthesis for amputee patients

In 2006, Dave Giaimo was commuting home from his job on his Vespa when a driver made a left turn straight into his bike, running over his right leg — twice. The Georgia resident was left with myriad injuries, including a crushed tibial plateau and a broken fibula. After surgery at the local hospital, Giaimo developed osteomyelitis.

Fourteen surgeries later, Giaimo continued to experience intermittent severe leg pain and problems with the rods that were holding his right leg together. Just as disabling, his chronic osteomyelitis left him with flu-like symptoms and night sweats, despite years-long courses of IV and oral antibiotics. In 2016, Giaimo learned that the inter femoral rod in his leg had shifted again.

The local orthopaedist refused to operate, claiming that Giaimo's skin wasn't in good enough condition. It was at that appointment that Giaimo first heard about osteointegration. "He mentioned that this was a new technique but said he wouldn't do it on me because of my osteomyelitis," says Giaimo, who decided to get a second opinion. He saw S. Robert Rozbruch, MD, in the spring of 2017.

Dr. Rozbruch's diagnosis: In addition to the chronic osteomyelitis, Giaimo had a massive 20-centimeter bone defect and septic loosening of the endoprosthesis. "Dave's bone defect was too large for limb salvage," he says. The most predictable options were routine amputation or osteointegration. The latter,

both agreed, would leave Giaimo with the most functionality.

Giaimo's first surgery took place on July 27, 2017. Dr. Rozbruch amputated his right leg, which wiped out Giaimo's chronic osteomyelitis. "When someone like him comes in, in a lot of pain and with limited mobility and a massive bone defect, limb salvage is not always the best way to go," says Dr. Rozbruch. On October 4, Giaimo, free of infection for the first time in years, returned to HSS for his second surgery. Dr. Rozbruch implanted a custom titanium rod directly into Giaimo's remaining bone, marking the first time osteointegration amputation surgery was performed in the Northeast. The procedure was among the first 10 done in the U.S. since the technique was approved by the FDA in 2016. The final surgery took place in December, when Dr. Rozbruch inserted a connector post to extend the titanium rod — now an integral part of his bone — to create an anchor for the prosthetic leg.

Up walking the day after surgery, Giaimo said, "This feels more like my own leg than it has in many years." He feels stronger than he has in decades and considers his surgery "transformative." "I've read a lot about problems amputees have with sockets — they get blisters, burns, infections," he says. "Osteointegration allows people like me, with a short residual limb, to use a prosthetic leg without those problems. Now, I'm looking forward to doing things like going for a walk and a bike ride — and living an unfettered life."

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# Metabolic Bone Disease/ Musculoskeletal Oncology Service

The Metabolic Bone Disease/  
Musculoskeletal Oncology  
Service is focused on the  
prevention and treatment of  
musculoskeletal disorders,  
including osteoporosis  
and fragility fractures. It  
unites practitioners from  
multiple disciplines, including  
orthopaedics, rheumatology,  
physiatry, endocrinology,  
nephrology and pediatrics.

CHIEF

Joseph M. Lane, MD

8,952  
Patient visits

335  
Surgeries

2  
Fellows

19  
Published studies

25  
Presentations at  
conferences

Opposite page

Left to right:

- Emily Stein, MD
- Richard S. Bockman, MD, PhD
- Dorothy Fink, MD\*
- Linda A. Russell, MD
- Alana C. Serota, MD
- Joseph M. Lane, MD
- Juliet B. Aizer, MD, MPH
- Kevin Math, MD\*

Not pictured:

- Azeez M. Farooki, MD
- Marci Anne Goolsby, MD
- Robert Schneider, MD

\*New Physician

ACHIEVEMENTS

- Joseph M. Lane, MD, serves on the editorial boards of *Bone*, *Journal of Arthroplasty*, *Journal of Orthopaedic Research* and *Journal of Orthopaedic Trauma*.
- In 2016, Richard S. Bockman, MD, PhD, Chief of the Endocrinology Service, became a member of the Ethics Committee for the Endocrine Society.
- In 2016, Linda A. Russell, MD, Director of the Bone Health and Osteoporosis Center of Excellence, was a Voting Panel Member for the development of the new American College of Rheumatology guidelines, “Perioperative Management of Rheumatic Disease Medications in Total Joint Arthroplasty on the Hip and Knee.”
- In 2017, Emily M. Stein, MD, MSc, Associate Attending Physician, became an NIH International Cooperative Projects Study Section Member.

PATIENT CARE

- In 2017, we joined forces with Frank Schwab, MD, Chief, Spine Service, to identify and treat Spine patients with underlying metabolic bone disease prior to surgery. We are hiring nurse practitioners to evaluate these patients, with the goal of improving surgical outcomes.
- We are working with other Services, including Hip Preservation and Limb Lengthening and Complex Reconstruction, to develop nutritional and drug protocols that will facilitate quicker healing of patients undergoing surgery and realignment. We hope to make these protocols the standard of care.
- Together with the Foot and Ankle Service and Martin J. O’Malley, MD, Associate Attending Orthopaedic Surgeon, we are identifying underlying metabolic bone disorders in professional athletes with stress fractures. We are developing protocols and strategies to treat them with calcium, vitamin D and/or medication.
- We are working with the Orthopaedic Trauma Service to establish a procedure for dealing with hip fractures that will be broadly used in emergency departments across all NewYork-Presbyterian systems. The goals are to screen and treat incoming patients for underlying metabolic bone disease and, ultimately, improve surgical outcomes.

RESEARCH INITIATIVES

- We have received a grant of \$300,000 per year for four years from the National Institutes of Health to conduct the first randomized, double-blind controlled study in the U.S. to investigate whether the anabolic agent teriparatide can accelerate healing in patients with pelvic fractures. One group of patients will receive standard treatment (pain management, bed rest and prevention of complications from comorbid conditions), and the other group will receive 20 micrograms of teriparatide

daily to determine whether the drug will be effective in accelerating fracture healing.

- We are one of eight study sites in the U.S. investigating the use of bimagrumab, an anti-myostatin antibody, which has been shown to build muscle without exercise. This may be beneficial for elderly patients with sarcopenia. We helped to rewrite the protocol for the Food & Drug Administration (FDA), and the 275-patient trial will be conducted at HSS with funding from Novartis.
- As part of our ongoing investigation into how bone quality affects surgical outcomes, Dr. Stein is studying the osteoprobe, a needle that is inserted into bone to measure its strength. Along with other biomechanical and imaging techniques, it could be used to help quantify bone softness as well as identify other risk factors in patients so we can intervene and improve surgical outcomes.
- In collaboration with Susan M. Goodman, MD, Director of the Integrative Rheumatology and Orthopedic Center of Excellence, we are investigating how a drug that inhibits interleukin-17 affects bone turnover and bone density in patients with ankylosing spondylitis.
- Dr. Bockman is working with the Spine Service to investigate the effectiveness of anabolic agents in warding off complications related to implants and fixation. We have initiated a multi-institutional clinical trial to determine whether these agents could help enhance spinal fusion outcomes.
- We are working with Rheumatologist Lisa A. Mandl, MD, MPH, Assistant Attending Physician, to study the factors that affect long-term mortality in patients who experience fragility fractures. In 2016, we found that women with hip fractures in New York City have a 24 percent chance of dying within a year. According to our preliminary data, pre-fracture social isolation is associated with mortality in elderly patients undergoing repair of low-trauma hip fracture. If we are able to confirm that social isolation leads to higher mortality rates in these patients, we will develop an intervention.

EDUCATION

- In October 2016, Dr. Lane delivered a lecture entitled “Own the Bone: Establishing a FLS and Preventing the Next Vertebral Fracture” at the North American Spine Society Meeting in Boston, MA.
- Dr. Lane gave a lecture at the AAOS MOC Review Course in Boston, MA, on Metabolic Bone and Inflammatory Joint Diseases in November 2016.
- In March 2017, Dr. Lane made several presentations at the AAOS Annual meeting, including “*The Answer is Vitamin D*,” “*Flash Five—What’s Coming Down the Pike?*,” “*Is Medical Clearance Enough?*” and “*Owning Osteoporosis in Your Practice*.”
- Dr. Stein delivered a lecture at the Parathyroid Disease and Osteoporosis: 2016 Frontiers in Management meeting in New York City entitled





## An extraordinary recovery from Cushing's disease

As far back as 2001, Eric Ricciardi recalled he was depressed and anxious and was having trouble sleeping. He also noticed he was bruising more easily than usual. But it wasn't until his left hip started hurting in 2007 that he ended up at HSS in the office of Alejandro Gonzalez Della Valle, MD, Attending Orthopaedic Surgeon. An MRI revealed that Ricciardi had avascular necrosis with collapse and destruction of the head of the femur — unusual for an otherwise healthy and active 33-year-old. Dr. Della Valle performed a core decompression.

The surgery went well, but soon after, Ricciardi developed pain in his right knee. More scans revealed that he had numerous hairline fractures. Dr. Della Valle referred him to Richard S. Bockman, MD, PhD, Chief of the Endocrinology Service. Dr. Bockman immediately suspected that his patient had Cushing's Disease. "Eric had a pituitary adenoma that was activating his adrenal gland to produce an overabundance of glucocorticoids," he recalls. Ricciardi also had severe osteoporosis and an extremely low bone mineral density (BMD) score of -3.1. The benign tumor was removed in January 2008, and within a few months, Ricciardi's symptoms resolved. But follow-up bone scans revealed that while his Trabecular Bone Score — which measures the underlying matrix of the bone — had returned to normal, his BMD remained alarmingly low. "We observed him for almost a year and there was absolutely no change," says Dr. Bockman.

That's when Dr. Bockman got the idea to treat Ricciardi with the bone-building agent teriparatide, which, he says, may be the first instance of the drug being used to treat Cushing's. The patient's response, says Dr. Bockman, "was extraordinary." After two years on the medication, his bone health was restored to slightly above normal — a process that usually takes a decade. The case was published in *Bone Reports* in March 2015.

Today, Ricciardi, 44, who had a total hip replacement in 2011, is able to ride a bike, run and climb multiple flights of stairs. Says Dr. Bockman: "Eric's bone density might have corrected itself on its own, but it never would have happened so fast."

"Vitamin D: A Necessary Nutrient for Skeletal Health, But How Much?" in October 2016.

- In July 2017, Dr. Russell gave a presentation at the annual meeting of the New York State Society for Orthopaedic Surgeons entitled "Metabolic Bone" in New York City.

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# Orthopaedic Trauma Service

The Orthopedic Trauma Service (OTS) collaborates with NewYork-Presbyterian/Weill Cornell Medical Center to provide unrivaled orthopaedic emergency care.

CHIEF

David L. Helfet, MD

William M. Ricci, MD,  
effective September 2017

11,872  
Patient visits

1,161  
Surgeries

3  
Fellows

45  
Published studies

55  
Presentations at  
conferences

2  
New HSS eAcademy® modules

14  
Academic visitors

Opposite page

Left to right:

- David S. Wellman, MD
- William M. Ricci, MD\*
- David L. Helfet, MD
- John P. Lyden, MD
- Gregory S. DiFelice, MD
- Duretti T. Fufa, MD
- Joseph M. Lane, MD

Not pictured:

- Dean G. Lorch, MD
- David E. Asprinio, MD
- Andrew Grose, MD

\*New Physician

ACHIEVEMENTS

- David L. Helfet, MD, received the Service Excellence Award from the Healthnetwork Foundation in 2017. This award is presented annually to physicians who have demonstrated a high level of integrity and compassionate care.
- Dr. Helfet received the AO Recognition Award from the AO Foundation in 2017. The award was given in recognition of his lifetime achievements and dedication to patient care.
- Dr. Helfet is co-author of *Management of Limb Injuries During Disasters and Conflicts*, a unique collaboration between the World Health Organization (WHO), the International Committee of the Red Cross (ICRC) and the AO Foundation. It was published in December 2016.
- Dean G. Lorch, MD, Associate Attending Orthopaedic Surgeon, was the keynote speaker at the 48th Brazilian Congress of Orthopaedics and Traumatology in November 2016.
- In 2016, Gregory S. DiFelice, MD, Assistant Attending Orthopaedic Surgeon, became a reviewer for the *American Journal of Orthopedics*, *Journal of Bone and Joint Surgery* and *The Knee*.

PATIENT CARE

- We have begun using novel MRI scans to quickly and reliably identify periarticular fractures. This approach is more efficient and more accurate than performing both CT and MRI scans, and it delivers no radiation, unlike a traditional CT scan. It allows us to assess ligaments, bones and cartilage and to identify all of the fractures around a joint.
- We are personalizing the treatment of fractures by focusing on each patient's injury pattern. We are using small, non-locking implants to target each fracture instead of one large, bulky implant. Each implant and screw plays a role in neutralizing the forces that caused the fracture to occur. Our goals are to restore the patient's anatomy perfectly and promote healing. We have found that our union rates are better, our complications are lower, and patients heal more quickly.

RESEARCH INITIATIVES

- We have conducted several studies of a surgical database of more than 500 Trauma patients over the course of more than 20 years on the outcomes of their acetabular fracture reductions. Taken together, our results will be a landmark study of the most complicated fractures we treat. In one new study, which was published in *The Journal of Bone and Joint Surgery*, we collaborated with the Department of Radiology and Imaging to evaluate the outcomes of more than 200 patients who had acetabular fracture surgery. We followed the patients for up to 23 years — the longest follow-up in the United States. Drs. Helfet, Wellman and several other Trauma Service researchers compared radiographs and computed tomography (CT) in terms of their ability to detect residual

fracture displacement after fixation and predict hip survivorship. We found that CT is superior to radiographs, and, not surprisingly, hip survivorship is greater in patients with the best reductions on CT scans.

- We are conducting a series of vascular studies, in which we evaluate the blood supply to periarticular injuries to determine why some lose their blood supply and won't heal. We also want to identify the "safe zones" for fixation. In collaboration with many other HSS Services, we have investigated the proximal humerus, scaphoid, hip, knee and calcaneus. We are using a unique injection technique to determine the significant blood supply to all of these body parts. By gaining a clearer understanding of the anatomy in these areas, we will be able to reduce the risk of damage to arteries during surgery. To date, we have completed 16 studies, and another two are in progress. In one of our most recent studies, published in *The Bone and Joint Journal* in August 2016, we used MRI to quantify the relative contributions of the medial and lateral femoral circumflex arteries to the head and neck of the femur.
- We are collaborating with the Adult Reconstruction and Joint Replacement Service to develop techniques to better manage periprosthetic fractures, which are among the most common injuries we're seeing now. We are developing techniques to more efficiently and effectively preserve the prosthetic joint and avoid revision surgery.
- We are collaborating with the Metabolic Bone Service, using parathyroid hormone medications such as teriparatide to heal pelvic fractures in elderly people with poor bone quality.

EDUCATION

- In 2016, we received about 100 Fellow applications, interviewed about 40 candidates and chose three. We matched with our first, second and fourth choices. We provide a mentorship program for Fellows at HSS and Westchester Medical Center, a Level One Trauma Center. It allows them to participate in office visits, surgeries and research.
- In February 2017, we had our second annual Fellow reunion. About 40 former Fellows and their families traveled to Jacksonville, Florida for a week-end. Each Fellow presented his or her best and worst case from the past year, and we discussed the cases. Our third reunion will be held in South Carolina in 2018.
- Dr. Lorch was an invited speaker at the 2016 Orthopaedic Trauma Association Annual Meeting in October 2016. His presentation was entitled "Surgical Techniques for Reduction and Fixation of Femoral Neck Fractures in Both Young and Old Patients."
- Dr. DiFelice gave two E-poster presentations at the 11th Biennial International Society of





## On the front lines of trauma

Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) Congress in June 2017 in Shanghai, China.

- David S. Wellman, MD, Assistant Attending Orthopaedic Surgeon, was an invited speaker at the Annual Symposium for New Concept and Development in Traumatology in July 2017 in Beijing, China. He gave a presentation entitled “ERAS in Hip Fractures, and general management of geriatric fractures.”
- Duretti T. Fufa, MD, Assistant Attending Orthopaedic Surgeon, created an HSS eAcademy® module called “Needle Aponeurotomy Procedure for Dupuytren’s,” which launched in June 2017.
- We had 14 academic visitors from countries such as Turkey, China, Italy and India.

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*We were saddened by the unexpected loss of our dear colleague, Dean G. Lorich, MD, Associate Attending Orthopaedic Surgeon. He was a respected surgeon, teacher and friend to many at HSS, NewYork-Presbyterian and Weill Cornell Medicine. We extend our deepest sympathies to Dr. Lorich’s family, friends and patients.*

In January 2010, David L. Helfet, MD, was watching the nightly news when scenes of the devastating earthquake in Haiti flashed onto the screen. “This was a humanitarian crisis,” he recalls. “I knew I had to be there.” Within 24 hours, Helfet had assembled a 14-member team of surgeons, anesthesiologists and operating room nurses, along with orthopaedic operating room equipment and supplies. “The Hospital was behind us 100 percent,” he says.

The HSS group was the first musculoskeletal trauma team to arrive in Haiti. They traveled to a small community hospital, where about 500 patients were waiting to be triaged. With no sterilization equipment and only sporadic electricity and water, the surgeons rolled up their sleeves and began treating injuries and salvaging limbs, as was possible, around the clock. “It was like Civil War medicine,” Dr. Helfet recalls. “We had no blood, no labs, no EKG and no oxygen, and yet, with our expert anesthesiologists, we did not lose one patient.”

After five days, the team was forced to return home, having completely run out of supplies. (Dr. Helfet had arranged for a second plane filled with critical medical supplies to arrive, but the truck delivering the equipment to the hospital was hijacked, leaving them with nothing.) “It simply wasn’t safe for the team to stay there any longer,” Helfet says.

Haunted by his experience in Haiti, Dr. Helfet convinced the International Committee of the Red Cross, the World Health Organization and the AO Foundation to create a handbook, *Management of Limb Injuries During Disasters and Conflicts*, which was published in December 2016. “I wanted to offer clear advice to surgical teams that found themselves in crisis situations vastly different from what they experience in daily practice,” he explains. “My experience in Haiti made me realize that even a 24-hour delay in care can mean death and suffering for thousands of people. I never want to see that happen again.”



# Pediatric Orthopaedic Service

The Pediatric Orthopaedic Service is a key member of the Lerner Children's Pavilion, a team of pediatricians and specialty-trained surgeons, anesthesiologists and rheumatologists dedicated to best-in-class musculoskeletal care for children.

## CHIEF

Roger F. Widmann, MD

16,464

Patient visits

3,723

Surgeries

1

Fellow

45

Published studies

43

Presentations at conferences

4

New HSS eAcademy® modules

8

Academic visitors

## ACHIEVEMENTS

- For the first time, the Lerner Children's Pavilion was nationally ranked as a Best Children's Hospital for pediatric orthopaedics by *U.S. News & World Report*. In 2017, we celebrated the five-year anniversary of the Pavilion.
- In 2017, Ernest L. Sink, MD, Associate Attending Orthopaedic Surgeon, received the Achievement Award for the fourth time from the American Academy of Orthopaedic Surgeons (AAOS).
- Dr. Sink is Chair of the AAOS Council on Education: Pediatric Orthopaedic Content Committee.
- Daniel W. Green, MD, MS, FAAP, FACS, Attending Orthopaedic Surgeon, became a member of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine in 2017.
- In November 2016, Peter Fabricant, MD, Assistant Attending Orthopaedic Surgeon, won the Young Investigator Award from the American Academy of Pediatrics for "Fixation of Chondral-Only Fragments of the Knee in Pediatric and Adolescent Athletes."
- Emily Dodwell, MD, Assistant Attending Orthopaedic Surgeon, is Vice President of the Pediatric Orthopedic Club of New York.
- Dr. Dodwell participates in a medical mission trip to Buga, Colombia with the charity Casa de Colombia. She evaluates and treats children with severe disabilities, such as clubfoot, arthrogryposis, rickets, Blount's disease and cerebral palsy. Dr. Dodwell performs a variety of surgeries, including osteotomies, guided growth, tendon lengthening and tendon transfers. She teaches residents from the nearby Cali university orthopedic program. In recent years, HSS residents have started traveling to Buga with Dr. Dodwell to contribute to this humanitarian effort.

## PATIENT CARE

- In August 2017, about 20 of our patients with cerebral palsy enjoyed surfing and therapeutic horseback riding through the Adaptive Sports Academy at the Lerner Children's Pavilion. This unique program enables patients with musculoskeletal conditions to participate in activities they would not have dreamed possible, building their confidence and self-esteem and reinforcing physical therapy goals. When the program first launched several years ago, it only offered skiing. In 2017, it expanded to include other activities — including surfing and rock climbing — three times per year.
- We are using three-dimensional intraoperative surgical navigation with increasing frequency. In spine procedures, it increases the speed and accuracy of our placement of implants and screws. With non-spine procedures, three-dimensional navigation directs us to the area of pathology and enables us to make smaller incisions and resect

abnormal tissue more completely so there is a lower risk of recurrence.

- We are optimizing our sports medicine patient-reported outcomes by entering our patient data into national databases, which allows us to reach more meaningful and significant conclusions.
- In 2013, we developed Pedi-FABS, a survey that measures a child's fitness and activity level and enables physicians to prescribe appropriate treatment and assess a patient's return to activity after a procedure, like ACL reconstruction. In 2017, we conducted a study to establish normative activity level data in youth and determine whether there is a natural decrease in activity level during adolescence. We found that there is a decrease in activity level during this time. This will help us better interpret the Pedi-FABS survey results, since we can now differentiate between a "normal" level of activity and one that indicates a possible injury.

## RESEARCH INITIATIVES

- We have conducted one of the largest and most comprehensive studies to date of infection rates in pediatric spine surgery. The study, which followed over 1,000 patients over a period of 12 years, was published in *Spine* in February 2017. We found that the incidence of infection varied with diagnosis. Patients with idiopathic scoliosis had a 1 percent incidence of deep infection, whereas patients with syndromic and neuromuscular scoliosis had higher rates of infection (5 percent and 14 percent, respectively). Our findings help us identify the patients at highest risk and take specific precautions to reduce the chances of infection.
- Although advances in ACL reconstruction techniques have improved clinical results, the ability to safely return to play may be determined more by differences in rehabilitation and return-to-sport criteria. We created a rehabilitation model that combines quantitative testing and quality of movement assessment — perhaps the first of its kind. We tested its effectiveness in terms of return to activity and prevention of second injury in 42 skeletally immature athletes who had undergone ACL reconstruction. Most (83 percent) of our patients returned to unrestricted activity in 12 months. Our reinjury rate was just 14 percent, compared to the 29.5 percent rate that has been reported in other studies. Children who were reinjured were hurt in a cutting sport, and half were injured in sports they were not cleared for. Our excellent outcomes may be a result of a close collaboration among members of a multidisciplinary team. Study authors were Dr. Green; two physical therapists, Theresa Chiaia and Polly de Mille; Danyal H. Nawabi, MD, Assistant Attending Orthopaedic Surgeon; and Frank A. Cordasco, MD, Attending Orthopaedic Surgeon. The study was published in April 2017 in *The Orthopaedic Journal of Sports Medicine*.
- We frequently use our unique motion analysis laboratory to analyze limb alignment, movement,



strength and endurance related to congenital anomalies, neuromuscular conditions and injuries. The Leon Root, MD, Motion Analysis Laboratory is one of only 11 labs in the U.S. to be accredited by the Commission for Motion Laboratory Accreditation, Inc. We have recently initiated several studies using the lab. In one, we are evaluating two different techniques for pediatric flatfoot reconstruction. We are measuring plantar pressures (how the weight pattern is distributed in the foot) before and after surgery. In another study, teenagers with broken and misaligned clavicle fractures are being recruited. We are quantifying the functional benefits of plate fixation for displaced clavicle fractures in teenagers by evaluating shoulder strength, endurance and range of motion in two groups of patients: those who did not have surgery and those who have a perfectly aligned clavicle after internal fixation with a plate and screws.

- We evaluated the safety of implant-mediated guided growth for correcting pediatric lower extremity angular deformity in a study published in the *Journal of Pediatric Orthopaedics* in 2016. We reviewed three implants — the Biomet peanut plate, Orthofix eight-plate and Pega Medical hinge plate — used by HSS surgeons between 2004 and 2014, and we found there was no significant difference in the rate of deformity correction between the implant types. However, overweight patients had a significantly higher rate of implant-related complications, and cannulated screws were more likely to break. As a result, we recommend using solid, noncannulated screws in overweight children who are at increased risk of implant failure.

- Dr. Green, in collaboration with other HSS researchers, created a new MRI-based classification system for planning the treatment of tibial spine fractures in children. In one-third of cases, MRI substantially modified the grading as previously assigned with X-rays.

## EDUCATION

- In May 2017, Dr. Sink was an invited faculty speaker at the European Pediatric Orthopaedic Society (EPOS)/Pediatric Orthopaedic Society of North America (POSNA), Annual Meeting in Barcelona, Spain.
- Shevaun Doyle, MD, Associate Attending Orthopaedic Surgeon, developed a webinar entitled “Orthopaedic Conditions of Early Infancy.” It is now available online as an HSS eAcademy® course.
- Dr. Green and Dr. Dodwell are pediatric faculty members of AOTrauma, an international community of trauma and orthopaedic surgeons, musculoskeletal researchers and operating room personnel dedicated to improving patient care and outcomes in the field of musculoskeletal trauma.
- Every year, we host a medical student for the Pediatric Orthopaedic Clinical Research Step-Out Year. Students come to HSS between years three and four of medical school and conduct research.

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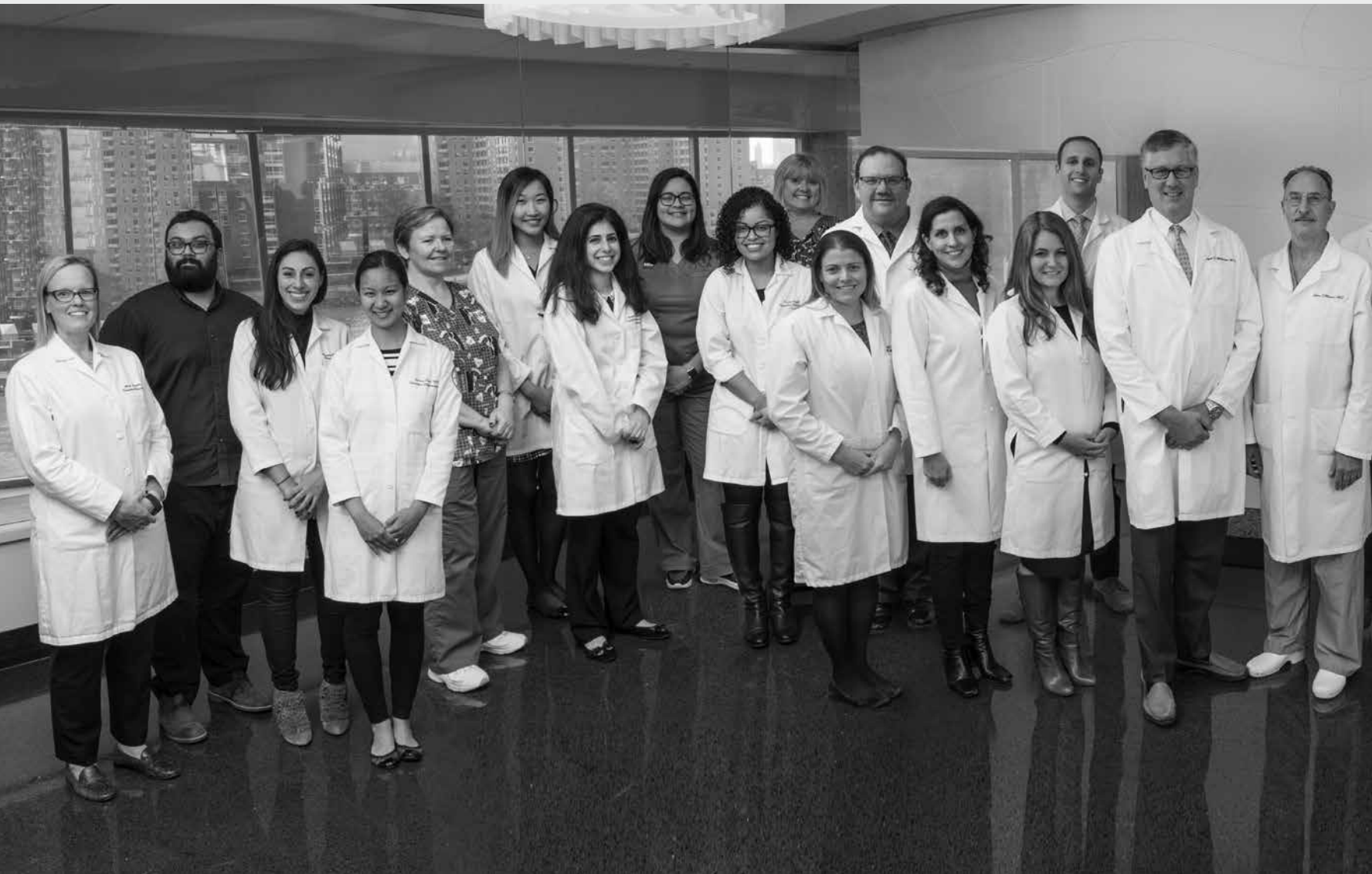
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## Left to right:

Emily R. Dodwell, MD, MPH, FRCSC  
 Peter D. Fabricant, MD, MPH  
 Daniel W. Green, MD, MS, FAAP, FACS  
 John S. Blanco, MD  
 Roger F. Widmann, MD  
 Ernest L. Sink, MD  
 David M. Scher, MD  
 Cathleen L. Raggio, MD  
 Shevaun M. Doyle, MD  
 Aaron Daluiski, MD



# Pediatric Orthopaedic Service cont'd



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## Left to right:

Alexa Adams, MD  
Jonathan Haimindra  
Natalie Rosenwasser, MD  
Nancy Pan, MD  
Josephine Fitzgerald, RN  
Cindy Wang  
Nadine Saad, MD  
Andrea Aguilera, RN  
Keila Vega, MD  
Eileen Vance, RN  
Emily Dodwell, MD  
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Lisa Ipp, MD  
Stephanie Perlman, MD  
Peter Fabricant, MD  
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Ernest L. Sink, MD  
Susan Cha, MD  
Shevaun Doyle, MD  
David Scher, MD

Cathleen Raggio, MD  
Aaron Daluiski, MD  
Karen B. Onel, MD  
Alice Quinn, RN  
Ronae Henderson  
Erin Treemarcki, MD  
Amy Silberman  
Sarah Taber, MD  
Mary Wiebolt, RN  
Esther Alberttis  
Melissa Flores  
Peyton Katz  
Marcia Julius, RN  
Rebecca Trachtman, MD  
Nicole E. Atkins



**Lerner  
Children's  
Pavilion**  
HOSPITAL FOR  
SPECIAL SURGERY





## A tale of four surgeons, a flap, a sensor and an external fixator

By the time two-year-old Bridget Wagner entered the office of David M. Scher, MD, Associate Attending Orthopaedic Surgeon, in October 2016, she had already undergone seven surgeries. The first, which took place when she was a newborn, was for the treatment of the congenital heart condition supraventricular tachycardia. The surgery was not successful, so she required a second procedure. In the meantime, Bridget developed a complication: an IV placed in her left foot during the first few days of her life had infiltrated, causing compartment syndrome. Although surgeons performed an emergency fasciotomy to relieve the pressure in her leg, damage to her muscles and nerves had already been done. Three plastic surgeries followed, but scar tissue formed, causing tendons to bind up her ankle. "Her foot started to bend up in the air, so when she started walking at 15 months her toes were not able to touch the ground," says Dr. Scher. "She was walking with her toes up and only her heel on the ground. Over the course of two years, her parents had seen her foot draw up further and further, and it was clear that this was only going to get worse."

Bridget's physicians had recommended waiting until she was older to attempt surgery again, but her parents were concerned that waiting would result in a more severe deformity. So they sought out Dr. Scher for a second opinion. He agreed with them. "I felt that Bridget needed this fixed sooner rather than later, but there were real challenges with this surgery," he recalls. "This was an atypical deformity, so we really had to be creative when it came to formulating a treatment plan. We needed to release scar tissue to bring her foot down, but given the fact that scarred muscle and previous skin grafts were involved, we expected it would be a challenge to free up all of her joints. We also felt that we needed to get different tissue on top of her muscle to make the remaining muscle she had function and glide properly and prevent it from scarring down again."

Dr. Scher consulted with his colleague, microsurgeon Duretti T. Fufa, MD, and they formulated a plan. They would remove the existing skin grafts, release the scarred tissues, then cover the area with a flap

of new, uninjured tissue from the other leg. "We planned extensively for her surgery, as it is not common to perform microsurgery in patients as young as Bridget," Dr. Fufa recalls. One issue the surgeons considered was how best to keep the toddler immobilized after surgery in order to protect the delicate reconstruction. They consulted Roger F. Widmann, MD, Chief of the Pediatric Orthopaedic Service, who suggested using an external fixator to immobilize the leg, allowing Dr. Scher to keep the foot and toes in position after performing the release.

The six-hour surgery was performed on May 22, 2017 with Drs. Scher, Fufa, Widmann and Daniel Osei, MD, Assistant Attending Orthopaedic Surgeon. While Drs. Osei and Scher opened the front of Bridget's leg and foot and removed scar tissue, lengthening tendons and opening joints, Dr. Fufa harvested the flap from her other leg. Then the team worked together to attach the new flap. Dr. Fufa placed a sensor on the flap so she could monitor blood flow to the region 24 hours a day remotely via a mobile phone app. "Dr. Fufa's devotion to this little girl was incredible," says Dr. Scher. "She monitored the blood flow to the flap continuously over the next week. She'd even wake up in the middle of the night and check the app to make sure the flap was still viable."

More than six months later, Bridget is enjoying swimming. "She's a very cheerful and resilient little girl," says Dr. Scher. Bridget will be followed closely throughout her childhood to monitor her leg growth and limb length. "She still does not have normally functioning muscles in that area, since there was some permanent nerve damage that can create a muscle imbalance around her foot," explains Dr. Scher. But her mother, Karen Wagner, says her daughter is a fighter. "I don't think an adult could handle all she's been through, but Bridget is a born optimist," she says. "I know she has what it takes to get through this."

# Spine Service

The Spine Service is world-renowned for its innovative and research-based treatment of children and adults with all levels of spine disease and deformity.

CHIEF

Frank Schwab, MD

18,112  
Patient visits

3,623  
Surgeries

4  
Fellows

82  
Published studies

382  
Presentations at conferences

8  
New HSS eAcademy® modules

32  
Academic visitors

[Opposite page](#)

[Left to right:](#)

- Steven J. McNany, MD\*
- Andrew A. Sama, MD
- John S. Blanco, MD
- Harvinder S. Sandhu, MD
- Bernard A. Rawlins, MD
- Sheeraz Qureshi, MD, MBA\*
- Roger F. Widmann, MD
- Frank Schwab, MD
- James C. Farmer, MD
- Todd J. Albert, MD
- Matthew E. Cunningham, MD, PhD
- Charles B. Goodwin, MD
- Frank P. Cammisa, Jr., MD
- Darren R. Lebl, MD
- Russel C. Huang, MD
- Patrick F. O’Leary, MD
- Han Jo Kim, MD
- Alexander P. Hughes, MD

[Not pictured:](#)

- Federico P. Girardi, MD
- Joseph M. Lane, MD

\*New Physician

ACHIEVEMENTS

- John H. Moe Award for Best Basic Research E-Poster, Scoliosis Research Society; Prague, Czech Republic (2016). “Medical Complications in 3,519 Surgically Treated Elderly Patients with Adult Spinal Deformity: Comparison of Multicenter Surgeon Maintained vs. Medicare Claims Database.”
- Value Abstract Award, North American Spine Society; Chicago, IL (2016). “Cost-Effectiveness Of Surgical Treatment Of Adult Spinal Deformity: Comparison Of Posterior-Only Versus Anterior-Posterior Approach.”
- Kostuik Innovation Award, Best Podium at the International Society for the Advancement of Spine Surgery; Boca Raton, FL (2017). “Principal Radiographic Characteristics for Cervical Spinal Deformity: A Health-related Quality of Life Analysis.”
- Whitecloud Clinical Award Nominee — Best Clinical Paper, Scoliosis Research Society, Milwaukee, WI (2017). “Does Local Intraoperative Corticosteroids Delivered in a Gel-Matrix Minimize Dysphagia following Anterior Discectomy and Fusion (ACDF)? A Preliminary Analysis of a Double Blinded Randomized Controlled Trial.”
- Todd J. Albert, MD, Surgeon-in-Chief and Medical Director, became the 48th president of the Scoliosis Research Society (SRS) in 2017. He has been an SRS member since 1994.
- Frank Schwab, MD, serves as a Board member of the SRS.
- Dr. Schwab is Vice President of the International Spine Study Group (ISSG). He and Virginie Lafage, PhD, Senior Director, Spine Research, are also on the board of the ISSG.

PATIENT CARE

- We launched a pilot program called Fast Track to ensure that patients are referred to the most appropriate provider and begin treatment quickly — as soon as 24 to 48 hours after the initial appointment request. Patients fill out a comprehensive but simple spine intake form or answer questions on the phone, and a physician-supervised Spine liaison and trained Nurse Practitioner (NP) review the information. The NP refers the patient to the appropriate provider based on specific clinical criteria. Since the program began in early 2017, we have designed and implemented a patient tracking system for data collection and follow-up, and we have worked with our Department of Rehabilitation Medicine to establish a process for transitioning care to onsite and offsite physical therapy. In addition, we presented the program as part of the Spine Care “Cost Effectiveness and Safety of Non-Operative Approaches” webinar series. At press time, we had successfully triaged approximately 300 patients, and half of them have had office visits with the NP.

- We are collaborating with the Division of Rheumatology on a number of studies that involve assessing patient frailty and predicting surgical outcomes. We are also investigating the correlation between bone density and surgical techniques of anchoring and attaching implants to bone. We are working to establish protocols for the use of agents that can enhance bone density prior to and immediately after surgery.
- We are collecting patient-reported outcome measures on all of our patients, enabling us to conduct prospective studies. Currently, we have at least 20 ongoing studies.
- We will be bringing predictive analytics into daily clinical care. Our data and multi-center data from the International Spine Study Group will enable us to make better decisions about when and how to treat a patient. It will also allow us to better educate our patients about the likely outcome of surgery and different treatment approaches — even non-surgical ones. Ultimately, we will be able to more precisely anticipate the specific risks associated with a complex patient or procedure — and the approaches we need to take to mitigate them and optimize outcomes.

RESEARCH INITIATIVES

- Orthopaedic surgeons are among the top three prescribers of opioids. In an effort to help prevent narcotic abuse, we are developing several studies on the subject. Preliminary results of one of our investigations have shown that an alternative treatment for pain could help reduce the amount of opioids taken after surgery.
- In the course of our extensive research on postoperative spine complications, we discovered that people of different ages have different spine shapes — and need different alignment as a result. Over-correcting to achieve a youthful spine curve may not only be harmful; it is also not “normal” for people at various ages, according to our study, which was published in *Spine* in May 2017. We learned that the risk of failure above the site of an operation is directly correlated to the shape of the spine prior to the surgery.
- We are developing a new patient-reported outcome measure on pain and disability for complex spine conditions. This novel questionnaire is designed to obtain pre- and postsurgical information through precise measurements from patients suffering from spinal deformity. We are collaborating with investigators at Oxford University to produce and validate this linear score, which will ultimately enable surgeons around the globe to compare and evaluate the benefits of different treatments for complex spine conditions.

EDUCATION

- Our HSS eAcademy® courses included “Cervical Deformity and Disability: The Clinical Perspective” and a surgical video focusing on Revision Spinal Fusion T11 Pelvis/L4 PSO.





## A new method for reporting patient-centered outcomes

- We produce three webinars each year. In the 2016–2017 academic year, the theme was safety, complications and their management.

- In October 2016, Dr. Schwab; James C. Farmer, MD, Associate Attending Orthopaedic Surgeon; Han Jo Kim, MD, Associate Attending Orthopaedic Surgeon; and Matthew E. Cunningham, MD, PhD, Assistant Attending Orthopaedic Surgeon, gave a live-streaming webinar entitled “Spine Surgery Techniques Around Complex Cases: Pitfalls and Pearls.”

- Academic visitors came from 12 countries, including China, Spain and Argentina. They visit us in the OR to learn our techniques for complex spine and revision surgery.

- We hosted the annual David B. Levine Spine Symposium in June 2017. The theme was value, cost-effectiveness and safety in the treatment of spinal conditions.

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Our Spine Service is known for being among the busiest in the nation, but we are also known for our commitment to research. With more than 80 papers published in a single academic year, we are dedicated to examining the most pressing issues in spine care and sharing our findings with the international orthopaedic community. Back in the office, we use our results to continuously push forward our clinical performance. “We apply our research to every aspect of patient care, whether it’s how we plan our surgeries or recovery protocols, how we get patients engaged in their recovery, or how we manage wounds, drains and antibiotics,” says Frank Schwab, MD, Chief of the Spine Service. “We are constantly adjusting and improving protocols and treatment pathways for our patients.”

One of our unique research initiatives is focused on patient expectations of spine surgery — one of the least studied variables. Our multidisciplinary expertise in studying patient expectations and our large patient population make us well-positioned to perform this kind of investigation. Carol A. Mancuso, MD, Attending Physician and Senior Scientist, has conducted a series of studies to better understand patients’ expectations of spine procedures. We developed lumbar and cervical spine surgery Expectations Surveys to systematically and rigorously measure patients’ expectations. They complete the 20-item survey, which measures the amount of improvement expected for symptoms, physical function and psychological well-being, prior to surgery. Two years

postoperatively, they rate the amount of improvement they experienced. The results provide details about why a procedure did or did not meet patients’ goals.

In one study, which was published in *Spine* in October 2016, researchers found that fulfillment of expectations after spine surgery is associated with multiple pre- and postoperative variables, including the amount of improvement expected preoperatively. About 90 percent of patients who had lumbar and cervical surgery had at least some of their expectations fulfilled. Variables associated with a lower proportion of expectations fulfilled included having greater preoperative expectations for improvement and less improvement in pre- to postoperative pain scores. In another study, which focused on pain improvement — a major expectation of patients undergoing lumbar surgery — our researchers found that patients reported less pain relief if they expected greater improvement prior to surgery, had a positive screen for depression and were having revision surgery, among other variables. In the study, which was published in *The Clinical Journal of Pain* in February 2017, Dr. Mancuso and her co-authors wrote that the study supported discussing pain-related expectations with patients prior to surgery and providing formal preoperative patient education. Ultimately, the hope is that our research in this area will provide surgeons with the opportunity to address patients’ unfulfilled expectations — and influence the definition of spine surgery outcomes.



# Sports Medicine and Shoulder Service

Members of the Sports Medicine and Shoulder Service are dedicated to providing the highest level of musculoskeletal care for active and athletic patients of all abilities, including those affiliated with local high school, collegiate and professional teams and organizations.

**CHIEF**  
Bryan T. Kelly, MD

**CHIEF, PRIMARY CARE SPORTS MEDICINE**  
Brian C. Halpern, MD

73,203  
Patient visits

9,754  
Surgeries

10  
Fellows

287  
Published studies

322  
Presentations at conferences

40  
New HSS eAcademy® modules

109  
Academic visitors

4  
Patents

5  
Number of centers and specialized services:

- Women's Sports Medicine Center
- Institute for Cartilage Repair
- Patellofemoral Center
- Sports Rehabilitation and Performance Center
- Non-surgical Foot and Ankle Service

## ACHIEVEMENTS

- Thomas L. Wickiewicz, MD, Attending Orthopaedic Surgeon, was inducted into The American Orthopaedic Society for Sports Medicine® (AOSSM) Hall of Fame in 2017.
- Frank A. Cordasco, MD, MS, Attending Orthopaedic Surgeon, is President-Elect of the American Shoulder and Elbow Surgeons.
- David M. Dines, MD, Attending Orthopaedic Surgeon, received the Founder's Award from The Children's Health Fund in May 2017.
- Dr. Dines received the American Academy of Orthopaedic Surgeons (AAOS) Achievement Award in 2017.
- In 2017, Robert G. Marx, MD, MSc, FRCSC, Attending Orthopaedic Surgeon, received the O'Donoghue Sports Injury Award from AOSSM for best overall paper concerning clinical-based research or human in-vivo research. He was co-author of the paper, which was entitled "10-Year Outcomes and Risk Factors after Anterior Cruciate Ligament Reconstruction: A MOON Cohort Study."
- Danyal H. Nawabi, MD, Assistant Attending Orthopaedic Surgeon, received the International Society for Hip Arthroscopy Basic Science Award.
- Scott A. Rodeo, MD, Attending Orthopaedic Surgeon, received the Thomas Wickiewicz, MD Attending Teaching Award from the Sports Medicine and Shoulder Service in June 2017.
- Beth E. Shubin Stein, MD, Associate Attending Orthopaedic Surgeon and a member of the Women's Sports Medicine Center, received the Patellofemoral Research Excellence Award in 2016 from the Arthroscopy Association of North America/Patellofemoral Foundation. The paper was entitled "Anisometry of Medial Patellofemoral Ligament Reconstruction in the Setting of Patella Alta and Increased Tibial Tubercle-Trochlear Groove (TT-TG) Distance."
- Dr. Shubin Stein received the Fellow Research Award – Clinical Science in 2016 from AOSSM. The award is given to the best papers in clinical science and basic science submitted by a sports medicine fellow. The winner was entitled "Anisometry of Medial Patellofemoral Ligament Reconstruction in the Setting of Patella Alta and Increased Tibial Tubercle-Trochlear Groove (TT-TG) Distance."
- Dr. Shubin Stein received the AOSSM Fellow Research Award in Basic Science at the 2017 Annual Meeting for a paper entitled "Medial Patellofemoral Ligament Isometry in the setting of Patella Alta."
- Marci A. Goolsby, MD, Assistant Attending Physician and a member of the Women's Sports Medicine Center, and Brett G. Toresdahl, Assistant Attending Physician, are Team Physicians for the U.S. Biathlon.

## PATIENT CARE

- The Sports Medicine Service has 27 orthopaedic surgeons and 15 physicians who specialize in Primary Care Sports Medicine.
- In August 2016, we opened the Patellofemoral Center of Excellence, which provides care for patients with kneecap injuries and conditions, such as "runner's knee" and dislocations. Dr. Shubin Stein and Sabrina Strickland, MD, Associate Attending Physician, are Co-Directors of the Center.
- In May 2017, we announced a multi-year partnership with UFC®. As the global brand's first-ever Official Hospital, we will provide UFC with access to our Sports Medicine physicians, who will serve as orthopaedic consultants in conjunction with the brand's medical team.
- Our Women's Sports Medicine Center — the first of its kind in the U.S. — is a nationally recognized resource for women of all ages and athletic abilities. The multidisciplinary staff includes physicians trained in sports medicine, nutritionists, exercise physiologists, physical therapists, sports psychologists and nurses.
- Our Center for Hip Preservation provides multidisciplinary care for patients and athletes with complex non-arthritic hip injuries and disorders. The members of this multidisciplinary team include surgeons trained in sports medicine, pediatrics, trauma and joint replacement, as well as radiologists, physiatrists, physical therapists, exercise physiologists and nurses.
- The Shoulder Registry was relaunched on the new OBERD platform, giving researchers and clinicians the ability to connect with patients digitally for follow-up once their information has been entered. Now that we have transferred the registry to the OBERD platform, we are strategically evaluating our outcomes data collection and patient inclusion criteria.
- The HSS Sports Safety ACL Program, which launched in 2017, aims to reduce the risk of ACL injuries in children by educating parents, coaches and young athletes about prevention strategies. The hallmark of the program is NeuroDynamic Reinforcement™ (NDR), a system that promotes movements that improve sports performance and safety on the playing field. At interactive workshops, coaches learn how to design and implement customized warm-up programs. Young athletes receive specific movement training, and parents learn how to identify and reinforce ideal movement patterns for their children during athletic activity. Studies are underway to determine the ability of children of different ages to perform exercises with and without the use of corrective cues. Researchers are also investigating the effects of NDR™ on movement quality and sports performance and quantifying the effectiveness of the training and instruction participants receive at workshops.



- Next year, we will launch the HSS Center for Professional Sports Medicine to bring together leading experts in orthopaedics, sports medicine and related specialties to provide best-in-class care. The Center will offer clinical care (both individual and team medicine); perform research to prevent injury, optimize performance and promote recovery; and provide residency and fellowship training programs.

## RESEARCH INITIATIVES

- To determine when it is safe to return to a sport after ACL surgery, we are monitoring primary ACL reconstruction patients who are competitive athletes. We will evaluate participants at six months, one year and two years postoperatively. Study visits will involve MRI scans, Triple Play Physical Therapy and a Quality of Movement Assessment (QMA), a proprietary evaluation by the HSS Sports Rehabilitation & Performance Center. In QMA, patients perform athletic movements, critiqued by a performance coach and physical therapist. These assessments were created to identify any “risky” movement patterns in hopes of preventing re-injury. We will evaluate the utility of QMAs as standard-of-care return to sport assessments.
- We are exploring the impact of arthroscopic knee surgery on the biologic milieu of the knee. We will assess serum concentrations of articular cartilage biomarkers indicative of inflammation, cartilage metabolism and degeneration, as well as articular cartilage morphology and composition, in patients undergoing primary meniscal repair or partial meniscectomy. We are enrolling non-arthritic patients between the ages of 18 and 40 with no prior ipsilateral knee surgery or injury and no current concomitant ligament or cartilage (> Outerbridge Grade II) defects. Study participants will have bloodwork one to three weeks preoperatively and one, six to eight, 26 and 52 weeks

postoperatively. They will also undergo MRI scans at one to three weeks preoperatively and 26 and 52 weeks postoperatively.

- We are investigating the prevalence of ipsilateral knee pain in patients presenting with femoroacetal impingement (FAI). We will follow this group of patients to determine the incidence of new onset ipsilateral knee pain after hip osteoplasty — or worsening of ipsilateral knee pain after hip osteoplasty. Patient-reported outcomes of patients with knee pain and FAI will be compared to those with anterior knee pain and no FAI (from our Knee Registry). We will survey 100 new patients preoperatively, and then at six-week, three-month, and six-month intervals. To evaluate patients, we will use the Kujala Knee Score, International Knee Documentation Committee score, Knee injury and Osteoarthritis Outcome Score — Quality of Life, and the Hospital for Special Surgery Pediatric Functional Activity Brief Scale.

- We are evaluating ACL reconstruction patients postoperatively for signs of knee osteoarthritis progression. We have reviewed the results of patients’ MRI scans one year postoperatively, and we are now performing scans three years postoperatively to look for changes in the articular cartilage composition and morphology.

- To determine the risk of having an acromial fracture after a Reverse Total Shoulder Arthroplasty, we are initiating an investigation of the acromion strain created by postsurgical passive deltoid tension. We are also exploring the effect the implant configuration — which consists of glenoid lateralization and humerus distalization — has on acromial strain. By studying these factors, we hope to identify the acromion strain preoperatively.

## EDUCATION

- In April 2017, we hosted the 11th Annual Sports Medicine Symposium. The two-day conference

### Left to right:

Lawrence V. Gulotta, MD  
 Riley J. Williams III, MD  
 Jennifer L. Solomon, MD  
 Howard A. Rose, MD  
 Robert G. Marx, MD, MSc, FRCSC  
 Anne M. Kelly, MD  
 John D. MacGillivray, MD  
 Bryan T. Kelly, MD  
 Struan H. Coleman, MD  
 Michael J. Maynard, MD  
 Samuel A. Taylor, MD  
 Jo A. Hannafin, MD, PhD  
 Answorth A. Allen, MD  
 Beth E. Shubin Stein, MD  
 Stephen Fealy, MD  
 Frank A. Cordasco, MD, MS  
 Hollis G. Potter, MD  
 David M. Dines, MD



# Sports Medicine and Shoulder Service cont'd

provided clinicians with guidance on how to care for athletes of all levels — both surgically and nonsurgically. At this year's symposium, topics included unstable shoulder, the adolescent athlete, runner and proximal hamstring injuries, and the anterior cruciate ligaments.

- We held the first annual HSS Professional Sports Medicine Conference in July 2017. The meeting brought together medical and training personnel from seven professional sports teams from the tristate area to share best practices and discuss innovative ways to treat and prevent injuries in elite athletes. Sports medicine physicians, team medical personnel and training staff attended the multidisciplinary conference. They reviewed case studies, which involved complex decision-making about injuries to the hip, knee, shoulder and head. They also exchanged strategies for treating and rehabilitating both professional and collegiate athletes. Attendees discussed surgical and nonsurgical care of athletes, rehabilitation techniques and return-to-play strategies. The meeting was so successful we plan to make it an annual event and expand it beyond the tristate area. Our goal is to improve the quality of care athletes receive.

- We had 109 academic visitors in 2016–2017. They came from all over the world — Mexico, Chile, Rwanda, the Czech Republic, Australia, Switzerland and China. Our visitors are exposed to all advanced surgical techniques, including reverse total shoulder and complex knee ligament procedures.

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## A rewarding surgical mission trip

In October 2016, Bryan T. Kelly, MD, Chief, Sports Medicine and Shoulder Service, and Riley J. Williams III, MD, Attending Orthopaedic Surgeon, traveled to the Dominican Republic to perform surgeries on five patients with sports-related orthopedic injuries. The physicians brought their medical teams, including two physician assistants and two scrub nurses. There were three ACL reconstructions, one shoulder arthroscopy and one knee arthroscopy chondroplasty meniscal debridement. All of the patients had financial hardships that had been barriers to care. “It was rewarding to provide care to patients who would otherwise be unable to get it,” says Dr. Kelly.

HSS partnered with Hospital General de la Plaza de la Salud (HGPS) for the mission. A large portion of the medical equipment and implants used were donated by Arthrex, Inc. The day after the surgeries, Drs. Kelly and Williams joined an HGPS orthopaedic surgeon to hold a conference on sports injuries in athletes. Dr. Kelly’s presentation was entitled “Hip Injuries in Athletes,” and Dr. Williams’ talk was called “Current Concepts in Articular Cartilage Repair in the High Demand Athlete.” About 100 physicians, residents, fellows and other medical professionals attended the conference.

The mission was so successful that Drs. Kelly and Williams returned to the Dominican Republic in October 2017. “It is an honor to be able to share our skills and expertise,” says Dr. Williams.

Opposite page

Left to right:

John D. MacGillivray, MD  
Russell F. Warren, MD  
Anil S. Ranawat, MD  
Sabrina M. Strickland, MD  
Thomas L. Wickiewicz, MD  
Danyal H. Nawabi, MD  
Scott A. Rodeo, MD  
Stephen J. O’Brien, MD, MBA  
David W. Altchek, MD  
Joseph H. Feinberg, MD  
Moirá M. McCarthy, MD  
Peter J. Moley, MD  
Joshua S. Dines, MD

Not pictured:

Kenton H. Fibel, MD  
Andrew D. Pearle, MD  
Rock G. Positano, DPM, MSc, MPH

Above:

PRIMARY CARE SPORTS MEDICINE

William W. Briner, Jr., MD  
Jordan D. Metzl, MD  
Daphne A. Scott, MD  
Brett G. Toresdahl, MD  
Lisa R. Callahan, MD  
David A. Wang, MD  
Brian C. Halpern, MD  
Osric S. King, MD  
James J. Kinderknecht, MD  
Marci A. Goolsby, MD  
Warren K. Young, MD

# Department of Biomechanics

Engineers in the Department of Biomechanics perform research and develop orthopaedic devices and instrumentation with the goal of improving patient care.

**DIRECTOR**

Timothy M. Wright, PhD

90

Surgeon requests for assistance with commercial products

41

Patient-specific implant designs created

19

Department engineers

8

Fellows

25

Published studies

60

Presentations at conferences

5

Patents

25

Academic visitors

Opposite page

Left to right:

Carl W. Imhauser, PhD  
Joseph D. Lipman, MS  
Timothy M. Wright, PhD  
Christina Esposito, PhD  
Suzanne Maher, PhD

Not pictured:

Nelly Andarawis-Puri, PhD  
Christopher J. Hernandez, PhD  
Marjolein van der Meulen, PhD  
Department engineers

**ACHIEVEMENTS**

- Timothy M. Wright, PhD, serves as a reviewer of applications for the National Institutes of Health (NIH)'s Loan Repayment Programs. These programs, established by Congress, are designed to recruit and retain highly qualified health professionals in research careers by repaying a portion of a researcher's qualified educational debt in return for a commitment to engage in NIH mission-relevant research.
- Dr. Wright is the coordinating program director at the Weill Cornell Medical College Clinical & Translational Science Center, a multi-institutional consortium that provides funds for young investigators.
- Suzanne Maher, PhD, Associate Director of the Department of Biomechanics, was Co-Chair of the "AAOS/ORS Translating Orthopaedic Technologies into Clinical Practice: Pathways from Novel Idea to Improvements in Standard of Care Research Symposium" in May 2017.
- Dr. Maher is a member of the Musculoskeletal Oral and Skin Sciences Special Emphasis Panel, which reviews grant applications to the NIH.
- Postdoctoral Fellow Mohammad Kia, PhD, received an award for the best presentation at the 2017 Biomedical Engineering Society/ FDA Frontiers in Medical Devices Conference for an abstract he presented called "Anatomic Features of the Femoral Condyle Correspond to Intersubject Variations in MCL Tension in Total Knee Arthroplasty."

**PATIENT CARE**

- We are working with the Hospital's orthopaedic surgeons to improve outcomes. Using information from two-dimensional scans, we are creating three-dimensional models of patients' anatomy to help guide presurgical planning. Surgeons use the models to visualize how to perform a complex procedure.
- In collaboration with the Sports Medicine and Shoulder Service and the Department of Radiology and Imaging, we are using sensor technology to improve outcomes for ACL patients. Sensors provide engineering information in real time in the operating room, helping to better inform surgical approaches. In a new study, Dr. Maher is implanting sensors into a patients' knees during meniscal allograft transplantation. A device applies a load to the knees, and the sensor measures the pressure. Scott A. Rodeo, MD, Attending Orthopaedic Surgeon, and Dr. Maher will relate those pressures to patient outcomes. So far, we have followed seven patients for three years. The Department of Radiology and Imaging scans the patients periodically, allowing us to investigate the relationship between the postsurgical change in mechanics and the longer term outcome. Ultimately, we would like to use sensor technology to improve partial meniscectomy outcomes.

- We will soon submit our Modular Total Elbow System to the Food and Drug Administration (FDA) for approval. The implant, which allows the surgeon to intraoperatively select a linked or unlinked constraint by using a modular connection located on the body of the humeral and ulnar system, was developed in collaboration with Lima Corporate, an Italian medical device company at the forefront of 3-D printing porous implants. The elbow prosthesis combines technology from an HSS patent with Trabecular Titanium, a proprietary material produced by Lima. In 2017, the FDA allowed us to place the implant in two patients on a compassionate use basis. We expect the implant will be sold worldwide in 2018.

**RESEARCH INITIATIVES**

- Carl Imhauser, PhD, has developed a chair that can help physicians evaluate patients who need or have had ACL reconstruction. The chair, which could be used before and after a patient has surgery, can measure the stability of a patient's knee in different planes. It will help standardize physicians' examinations of knee stability — and modify patient outcome measures, which are currently subject to interpretation. Dr. Imhauser has applied for a patent and is developing computer-based models to improve the stability of a loose or slack knee.
- In collaboration with Adult Reconstruction and Joint Replacement and Sports Medicine clinicians, we've developed a computer model of the knee joint that includes all of the bony geometry and ligaments that attach the femur to the tibia. Our clinicians are trying to use the model, which has been validated, to personalize ACL and total knee replacement surgery. A patient who needs a total knee replacement, for instance, would have an MRI or EOS scan, and we would use that information to create a model of the knee. The model would help us determine where to place the components relative to the patient's unique anatomy. Small changes in angles — even a few millimeters — can make a different in terms of outcomes.
- We are investigating ways to design cementless knee implants. We recently collaborated with Fabio Catani, MD, an orthopaedic surgeon from Modena, Italy, and a visiting scientist at HSS. He had performed fluoroscopy on patients with total knee replacements, which indicated where the loads were distributed. His findings, combined with our use of additive manufacturing — which enables us to change the properties of an implant — enables us, for the first time, to optimize implant components for particular patients. For instance, we discovered that there is a relationship between patients' body mass index and the size of their tibia. This helps us to determine which areas of the implant need cement and which ones don't. Our findings will be presented at the 2018 Orthopaedic Research Society Annual Meeting.



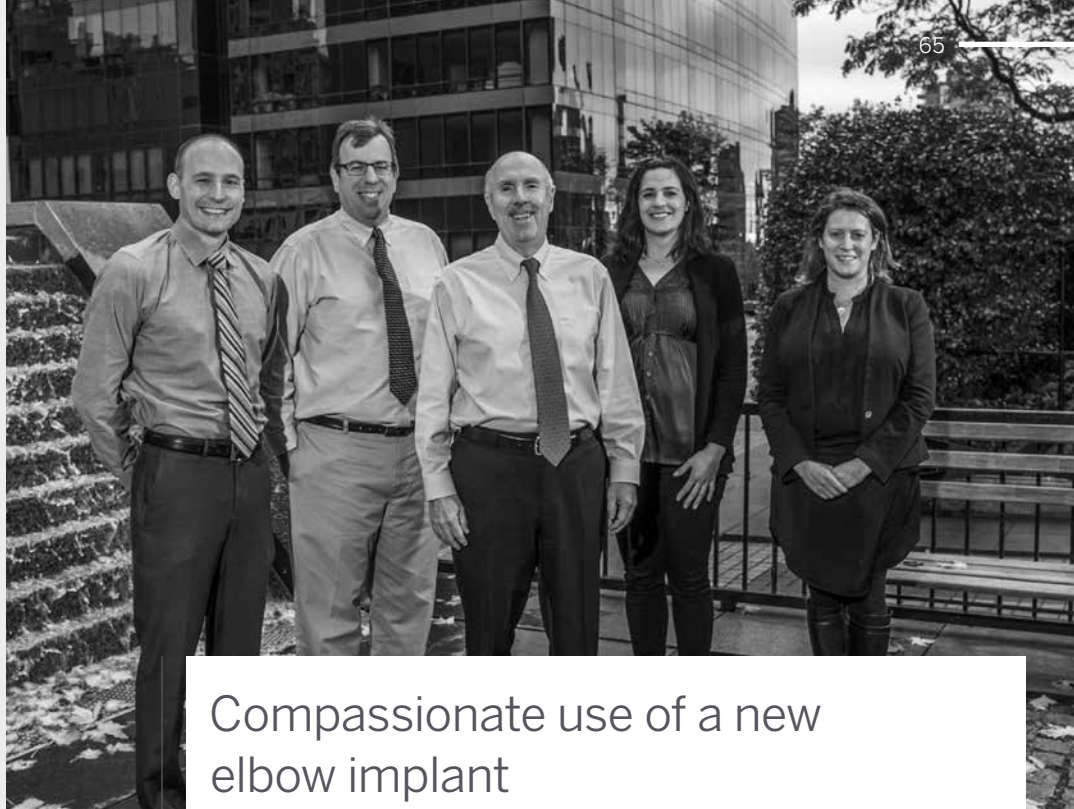
- We conducted a study of more than 18,000 total knee replacement surgeries performed at HSS between 2007 and 2012 to determine why about 400 of the procedures failed. Patients were surveyed prior to surgery, as well as six months, two years and five years afterward. Common reasons for failure included infection (nearly 26 percent), instability (24 percent), aseptic loosening (21 percent) and stiffness (14 percent). The results will help to inform future research directions. The study will be published in an upcoming issue of *Clinical Orthopaedics and Related Research*.

## EDUCATION

- We collaborate with the Sibley School of Mechanical and Aerospace Engineering at Cornell University, offering a program that exposes bio-mechanics and biomedical engineering students to HSS research. They accompany HSS physicians on surgical rounds and in the operating room for a full immersion experience.
- We hosted two mechanical engineering students from the U.S. Military Academy in West Point for the second year in a row. They spent a month immersed in our department, learning about research opportunities in orthopaedic biomechanics and sports medicine.
- Dr. Wright wrote the musculoskeletal biomechanics chapter for *Orthopaedic Knowledge Updates* with Marjolein C.H. van der Meulen, PhD, Adjunct Senior Scientist and James M. and Marsha McCormick Director of Biomedical Engineering at Cornell University. The book was published in 2017.
- We hosted two NIH-funded minority predoctoral students in biomedical research from the University of Chicago.
- In the 2016–2017 academic year, we hosted academic visitors from China, Scotland, England and Spain.

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## Compassionate use of a new elbow implant

Elbow implants are notorious for failing after a short time in comparison to hip and knee replacements. Approximately 25 percent last only five to seven years. After years of investigating why retrieved implants fail, Timothy Wright, PhD, Director of the Department of Biomechanics; Robert N. Hotchkiss, MD, Medical Director, Innovation; Mark P. Figgie, MD, Attending Orthopaedic Surgeon; and Joseph Lipman, MS, Director, Device Development, created a new design based on the analysis of failed implants. “One of the arcane parts of elbow replacement is that almost all of the devices used in the past are linked, which raises the probability of failure since the implant isn’t relying on native ligaments,” says Dr. Hotchkiss. The new implant may be placed without a linked hinge, potentially increasing the chances that it will perform for a greater duration. “It sounds like a small change, but it’s so significant that we’re hopeful elbow replacements will start lasting 10, 15, even 20 years,” says Dr. Hotchkiss.

The implant, which has not been submitted for FDA approval yet, isn’t available commercially. But under the agency’s compassionate use provision, Dr. Hotchkiss felt that a 21-year-old was an excellent candidate and would qualify because of her age. Jennifer Leary had severely injured her elbow while rock climbing in 2008. After multiple attempts to restore a functional joint without an implant, Leary and Dr. Hotchkiss agreed she could not continue to live with

the pain and instability, and that a traditional implant might fail, given her age and activity. “She had lost function to the point where she could not even hold a pen,” Dr. Hotchkiss recalls.

Unwilling to give up, Dr. Hotchkiss submitted an application to the FDA for compassionate use of the new implant. “This was a young woman who was active and charismatic, and here she was unable to hold her arm out straight or unsupported,” he recalls. The FDA approved his request, and Leary underwent surgery in December 2016.

One year later, both patient and physician consider the implant a provisional success. “I can finally lift a fork and a mug of tea, and I’m able to write my name — things I wasn’t able to do before the procedure,” Leary says, who had weekly physical therapy sessions for eight months after the elbow replacement. “For so long, I felt like the bottom half of my arm was disjointed from my body. Now I finally feel connected again.”

Leary’s experience gives Dr. Hotchkiss the confidence that one day the new implant will be used by the thousands of people across the country in dire need of an elbow replacement. “We’ve now put in two of these devices on a compassionate use basis,” he says. “We’re still watching their cases closely, but we may very well have an implant that can satisfy patients with a wide variety of needs and across all age groups.”

# Message from the Physician-in-Chief



We have come a long way in our understanding of autoimmune and inflammatory diseases. We know much more about the underlying biology of many of the rheumatic diseases, and those important scientific advances have guided development of effective targeted therapies and their use in our patients. We now understand that early diagnosis and treatment are essential if optimal patient outcomes are to be achieved, but important questions still remain. For instance, it has been established that combinations of traditional disease-modifying drugs might be as effective as biologic agents in some patients with rheumatoid arthritis, but we don't yet have guidance on how to identify which patients will require which regimen. Also, we don't know how long the drugs need to be given once a patient shows a good response. Should the person be kept on the drug for one year, two years or five years? As a community, we are all working to generate the data that will guide us in achieving optimal patient management. For many of the rheumatologic diseases — systemic sclerosis comes to mind, but to some extent systemic lupus erythematosus, Sjogren's syndrome and vasculitis — there is a critical need for more extensive investigation of the underlying immunologic mechanisms and target organ pathology, with particular value coming from studies of well-characterized patients.

At HSS, our five Centers of Excellence and Division of Pediatric Rheumatology enable us to address these questions through our patient cohorts, clinical research studies and laboratory-based research. The Centers are a way for us to bring together faculty and staff with an interest in a particular disease area to develop projects and new research initiatives. They allow us to be more productive by including interested faculty members and healthcare professionals from other departments, such as Orthopaedics, Social Work, Nursing and Research. In 2017, we launched a new Center, the Integrative Rheumatology and Orthopedic Center of Excellence (IROC), to encourage collaborative research between our rheumatologists, orthopaedic surgeons and outcomes researchers. One area of special research focus of the IROC team is health disparities. The results of one of their studies recently published in *Arthritis Care & Research* reported the relationship between education and poverty in outcomes of total knee replacement surgery.

In the last year, our Centers have had many accomplishments. Our lupus app, LupusMinder, which we anticipate will enrich communication between patients and their rheumatologists, grew out of discussions between the Lupus and Antiphospholipid Syndrome Center of Excellence

and our patients. Translational research in lupus, in which we study patient samples in the laboratory, continues to generate significant insights into disease mechanisms and depends on the engagement and enrollment of patients by the talented research coordinators working with our Center of Excellence. Clinicians and investigators in our Inflammatory Arthritis Center of Excellence are contributing to the Accelerating Medicines Partnership (AMP), supported by the National Institutes of Health (NIH) and industry partners. Through the AMP initiative, we participated in the discovery of a new T cell population that might be critical in rheumatoid arthritis. We are also establishing a cohort of patients with seronegative spondyloarthropathy who will participate in investigations of the role of the microbiome in those disorders. Rheumatologists in the Scleroderma, Vasculitis & Myositis Center of Excellence collaborated closely with Franck Barrat, PhD, Senior Scientist in the HSS Research Institute, to characterize the contribution of plasmacytoid dendritic cells to the immunopathology of systemic sclerosis. The Center has organized their patients in such a way that many are available and willing to participate in studies, facilitating productive, collaborative research that we hope will lead to a new understanding of disease mechanisms and future novel therapies.

In my view, osteoarthritis (OA) may be the disease that provides the greatest opportunities for significant research advances. OA, which affects more than 30 million adults, is a major public health challenge. According to NHANES III data, about one-quarter of people with the disease cannot perform the major activities of daily living. Aggregate annual absenteeism costs of OA are estimated to be about \$10 billion, which is higher than many other major chronic diseases, according to the U.S. Medical Expenditure Panel Survey. While total joint arthroplasty is a highly effective tool for management of end-stage OA, our goal should be to intervene early in the process to prevent disease progression. At HSS, our Precision Medicine Laboratory is working with patient joint tissue to gain a better understanding of the disease.

HSS rheumatologists are committed to sustaining our leadership and collaborative approach relevant to these and many other advances that will ultimately achieve better lives for our patients.

Mary K. Crow, MD

Physician-in-Chief  
Chair, Department of Medicine  
Chief, Rheumatology Division



# Bone Health and Osteoporosis Center of Excellence

The Bone Health and Osteoporosis Center of Excellence, which educates, tests and treats patients with bone health disorders, is the oldest of its kind in the country — and the only New York City-based center that is accredited by the International Society for Clinical Densitometry.

## DIRECTOR

Linda A. Russell, MD

## ACHIEVEMENTS

- Linda A. Russell, MD, served as the ACR Annual Meeting Abstract Selection Committee Co-Chair for “Osteoporosis and Metabolic Bone Disease — Clinical Aspects and Pathogenesis.” She was also the Poster Tour Guide Leader on the same topic at the ACR meeting.
- Dr. Russell was selected as a Castle Connelly Top Doctor in Rheumatology in the New York Metro Area in 2016 and 2017.
- Richard S. Bockman, MD, PhD, Chief of the Endocrinology Service, is Director of the Advances in Mineral Metabolism Meeting and a member of the Editorial Board of the *Journal of Clinical Endocrinology and Metabolism*.
- In 2017, Emily M. Stein, MD, MSc, Associate Attending Physician, was named Associate Editor, *BMC Rheumatology*.
- Our Center has received accreditation from the International Society for Clinical Densitometry for compliance with established facility performance standards for Dual-energy X-ray Absorptiometry skeletal assessment services.

## PATIENT CARE

- We are among just a few centers nationwide and the only center in New York City that goes beyond simple DEXA scanning to do the full complement of bone testing. Since 2016, we’ve been getting patients’ trabecular bone score, which measures the strength of the vertebral body. We also perform a body composition analysis, which measures a patient’s fat-to-muscle ratio and can help diagnose sarcopenia, as well as a vertebral fracture assessment to check for back fractures. Recently, we began doing femur fracture assessments. They are helpful for patients who take bisphosphonates, which have been shown to increase the risk of atypical femur fracture. By screening patients for early bone changes, we can treat them proactively and possibly prevent fractures.
- In 2017, our patients began filling out an electronic questionnaire on bone health for our REDCap data base. This data collection will allow us to conduct more research on our patients who have had bone density scans.
- Every week, we meet to discuss our patients in an interdisciplinary conference. Each case is reviewed not only by Center practitioners but also an orthopaedic surgeon, radiologists, endocrinologists, fellows and medical students. Together, we devise a treatment plan for each patient.

## RESEARCH INITIATIVES

- We are working with the Spine Service to investigate the usefulness of Quantitative Computed Tomography (QCT) — which can reveal osteoporosis in the spine — in patients undergoing surgery. It is a more accurate measure of bone density in patients with arthritis, since DEXA can show falsely

elevated bone density levels. QCT can help surgeons get a better sense of patients’ bone quality before surgery. If appropriate, patients could be treated prior to their procedure with bone-building agents such as teriparatide, which studies suggest helps improve the success of spine fusion.

- In a National Institutes of Health (NIH)-funded study, we are investigating changes in bone turnover and structure in patients who receive epidural steroid injections for back pain. Results suggest that patients who receive these steroids on a regular basis have an increased risk of developing weakened bone in the spine and have lower measures of bone density. This could ultimately lead to a change in the frequency of injections.
- We recently found that short-term postoperative complications can be reduced by admitting a hip fracture patient for surgery within 24 hours. The study was published in *The Bone & Joint Journal* in 2017. As a result, we have changed our protocol for the hip fracture pathway, the process by which a patient comes in with a fracture and is taken to the operating room.

## EDUCATION

- We are committed to educating our patients about bone health. In addition to the full complement of testing, all Center patients meet with a nurse practitioner who reviews their exercise habits, calcium intake and nutritional status.
- We continually educate our orthopaedic surgery services about the importance of evaluating patients’ bone strength prior to surgery to improve outcomes. We’ve come up with a set of clinical guidelines and regularly give lectures to attendings about best perioperative practices.
- In July 2017, Dr. Russell gave a presentation at the annual meeting of the New York State Society for Orthopaedic Surgeons entitled “Metabolic Bone” in New York City.
- In October 2016, Dr. Stein gave a lecture at the “Parathyroid Disease and Osteoporosis: 2016 Frontiers in Management” meeting in New York City entitled “Vitamin D: A Necessary Nutrient for Skeletal Health, But How Much?”

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## A surprising cause of fractures, pain and muscle weakness

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### Left to right:

Catherine Sutton, RT  
Joseph M. Lane, MD  
Dorothy Fink, MD\*  
Jonathan Cheah, MD  
Richard Bockman, MD  
Linda A. Russell, MD  
Tomas Esparra, RT  
Emily M. Stein, MD, MSc  
Patricia Donohue, NP  
Huma Morel  
Kevin Math, MD\*  
Douglas Mintz, MD

### Not pictured:

Taryn Griswold

\*New Physician

When Martin Smith\* first visited HSS in September 2017, he arrived in a wheelchair with multiple fractures of his ribs, sacrum, femurs and tibia, his pain so severe that he had moved in with his daughter. At 59, Smith had always been active, healthy and independent. “What was striking was that there had been a precipitous decline in his function over two years, and the cause was undiagnosed,” says Emily M. Stein, MD, MSc, Associate Attending Physician in the Endocrinology Service.

Smith initially saw Karmela Kim Chan, MD, Assistant Attending Physician in the Rheumatology Division. Dr. Chan realized that Smith, who was contemplating joint replacement surgery, might have an underlying metabolic bone disorder. “Some lab abnormalities had shown up during his previous hospitalizations, and they’d never been put together with all the other symptoms,” says Dr. Stein.

Dr. Chan referred Smith to Dr. Stein. It turns out that he had osteomalacia, which causes undermineralization of the skeleton due to inadequate vitamin and mineral intake or a loss of minerals. In Smith’s case, his kidneys were not reabsorbing phosphorous that was leaching from his bones; he was losing the mineral through his urine. “The patient’s bones were very soft,” says Dr. Stein. “He was prone to fractures and had proximal muscle weakness, and it was difficult for him to walk or even rise from a chair.”

The cause was an antiretroviral medication known as tenofovir, which Smith had been taking for 15 years to treat

hepatitis B. Though one of the most effective — and common — treatments for the disease, “It can cause patients to leak phosphorous,” says Dr. Stein. “With these symptoms, it’s easy to believe that the cause is osteoporosis. But osteomalacia is a different entity altogether, and it was missed in this patient for a long time — almost to the point that he had unnecessary joint surgery.” Another red herring: A person with osteomalacia can receive a false positive result for osteoporosis on a bone density test. “This condition makes bone density look low,” says Dr. Stein. “But the other hallmarks of the disease — diffuse bone pain, weakness, insufficiency fractures in the ribs, and lab results that indicate problems with mineralization [alkaline phosphatase is very high] — should be a warning sign that the physician needs to check the patient’s phosphorous levels, a lab test that is not always standard. And if the patient is taking tenofovir, it’s especially crucial to be conscious of this possible side effect.”

Stopping the tenofovir was the first part of Smith’s treatment. “But we also needed to build his skeleton back up,” says Dr. Stein. She prescribed phosphorous replacement and an active form of vitamin D that would help him better absorb the mineral. In addition, he was given calcium. “This process happened over 15 years, so it will take some time for his skeleton to recover,” says Dr. Stein. “But after only two weeks, he was already much better — he was stronger and his pain had abated. He should make a full recovery.”

\*Name changed to protect privacy



# Inflammatory Arthritis

## Center of Excellence

The Inflammatory Arthritis Center of Excellence has established cohorts of patients with early inflammatory arthritis and other rheumatic diseases and is collaborating with basic scientists to discover new therapeutic targets. The Center also provides patient support and education through workshops, webinars and social media.

### DIRECTOR

Vivian P. Bykerk, MD

### ACHIEVEMENTS

- In 2016, Vivian P. Bykerk, MD, became a member of two American College of Rheumatology (ACR)/European League Against Rheumatism (EULAR) Task Forces: use of biosimilars in Rheumatoid Arthritis (RA) and practice recommendations for RA. Dr. Bykerk was a member of the Abstract Selection Committee for EULAR.
- In 2016, Dr. Bykerk was named Associate Editor of *Arthritis, Research & Therapy* and Associate Editor of *Rheumatology*. She is a reviewer of 10 journals, including *RMD BMJ Open*, *The New England Journal of Medicine* and *Journal of Clinical Epidemiology*.
- In 2016, Ted Fields, MD, Attending Physician, became a reviewer for the *Annals of Internal Medicine*. He is also a reviewer of five other journals, including *Arthritis & Rheumatism*, *Arthritis Care & Research* and *PLOS Journal*.
- In 2016–2017, Dr. Fields was a member of the Abstract Selection Committee for Gout Abstracts, American College of Rheumatology meeting.
- In 2017, Laura T. Donlin, PhD, Assistant Scientist, was a Ben Pernis Memorial Lectures awardee at the FASEB Autoimmunity Conference.

### PATIENT CARE

- We provide patients with disease-specific support and educational forums. These programs are developed by our team of rheumatologists, social workers, nurses, physical therapists and nutritionists. In May 2017, Dr. Fields participated in a Facebook chat on living with gout. We co-sponsored the Spondyloarthritis Patient Education Symposium, which was featured in an on-demand webinar.
- In 2017, we held eight workshops for patients newly diagnosed with rheumatoid arthritis (RA). Called "The Early RA Support and Education Program," the workshops covered topics such as stress reduction, exercise management and co-occurring conditions in people with RA.
- To improve the quality of care and help our physicians better address symptoms patients may not mention during an appointment, we have developed questionnaires for patients, which can be answered through the Patient Portal. The long-term goal is to combine this self-reported information with observations and data to enhance clinical interactions and patient outcomes.

### RESEARCH INITIATIVES

- One of our goals is to personalize the treatment of inflammatory arthritis to facilitate shared decision-making between providers and patients. We are one of 16 sites participating in the National Institutes of Health (NIH)-funded Accelerating Medicines Partnership (AMP), which launched in 2014. We are studying molecular pathways in RA treatment response and flares, with the goal

of identifying promising biologic targets for new therapies. HSS patients with early or established RA will provide synovial tissue for research, as well as answer standardized outcome measures regarding their disease activity and well-being. We are studying these synovial biopsies using novel technologies, such as RNA sequencing and ATACseq, to better understand immune system activation and identify new biomarkers for RA. Our research will help identify molecular pathways that distinguish patients who experience disease flares from those who don't, as well as patients who respond to specific medications from those who don't. Over the long term, we hope to use these biomarkers to predict patient outcomes and/or develop new treatments.

- We have participated in the largest longitudinal study of early RA in North America to date to examine the association between sustained remission and body mass index (BMI). In a study soon to be published in *Arthritis Care and Research*, Dr. Bykerk and her co-investigators discovered that patients who were overweight and obese were 25 percent and 47 percent, respectively, less likely than normal weight participants to achieve sustained remission in the three years following their RA diagnosis. This finding indicates that weight may be a modifiable risk factor to consider in overweight and obese early RA patients who are not responding well to standard therapy. The trial is part of the CATCH (Canadian Early Arthritis Cohort) study, which Dr. Bykerk launched in 2007.
- We are investigating the relationship between cardiac and joint inflammation to determine whether we can improve both measures in patients with RA. In an NIH-funded, 21-site study of up to 200 RA patients who are taking methotrexate but are not responding well, we are comparing the effects of two different treatments on cardiovascular health. One group of patients is taking a TNF inhibitor in addition to methotrexate, and the other is using triple therapy (methotrexate, sulfasalazine and hydroxychloroquine). Cardiovascular health will be measured by comparing two FDG-PET/CT scans on patients — one taken before the treatment change and one taken afterward.
- To help prevent RA from developing in high-risk patients, we are studying the efficacy of treatment with hydroxychloroquine versus placebo in a three-year, NIH-funded randomized controlled trial known as StopRA. It will involve 18 sites and up to 200 patients. Selection criteria include elevation of the RA-related autoantibody anti-CCP.

### EDUCATION

- Treatment of RA has changed significantly in the last five years, so we educate other healthcare professionals, such as internists and primary care physicians, about the standard of care for newly diagnosed patients. In June 2017, Dr. Bykerk, Stephen A. Paget, MD, Attending Physician, and Adena Batterman gave a CME presentation for

# Inflammatory Arthritis

## Center of Excellence cont'd



### A team approach to groundbreaking research

Vivian P. Bykerk, MD, Director of the Inflammatory Arthritis Center of Excellence, and her colleagues are accustomed to crossing traditional boundaries — as well as borders — to get their research done. Case in point is the CATCH study, which stands for Canadian Early Arthritis Cohort. Dr. Bykerk directs this long-term, multi-center observational study of more than 2,600 patients, which began in 2007. It continues to yield results that are critical for the treatment and prevention of rheumatoid arthritis, including the effects of lifestyle factors such as smoking and obesity. “The more you can show that you’re getting similar study results in different settings, whether in the U.S. or Canada, the more valid those results are, because you are showing that your findings apply to people of multiple races in multiple socioeconomic situations,” says Ted Fields, MD, Attending Physician.

That kind of collaboration works on a micro level as well. “Most rheumatology divisions are separated by types of diseases, and physicians don’t necessarily work together,” says Dr. Bykerk. At HSS, transdisciplinary research is common. In a recent

pilot study of a multidisciplinary team approach to gout patient education and monitoring, Rheumatology, Nursing, Social Work and Pharmacy collaborated for a year. In the study, which was published in *Seminars in Arthritis and Rheumatism* in April 2017, Dr. Fields enlisted HSS nurses to give the 45 enrolled patients a questionnaire and review the answers at regular intervals, along with teaching them about gout management from a standardized curriculum. Our Pharmacy Department called the patients monthly, monitoring their adherence, and a social worker met with patients whenever needed to address financial or other psychosocial issues interfering with adherence. The results indicated that this kind of multi-pronged approach to patient education is feasible. The patients learned more about the disease — as measured by their performance on the questionnaires — and their levels of uric acid dropped. “No single healthcare professional knows it all,” says Dr. Bykerk. “The way we collaborate among different disciplines at HSS — and across the country and internationally — is what makes us unique.”

#### Left to right:

Sergio Schwartzman, MD  
 Caroline Reidy  
 Michael McNamara  
 Shirin Dey  
 Sarah Grond  
 Adena Batterman  
 Ted Fields, MD  
 Vivian Bykerk MD  
 Laura Donlin, PhD  
 Carey Ford  
 Joan Westrich  
 Serene Mirza  
 Ludis Williams-Mitchell  
 Dalit Ashany, MD  
 Karmela Chan, MD\*

\*New Physician





professionals on the treatment and assessment of early RA patients. It was entitled “Assuring the Best Outcome for Your Patients with Early Rheumatoid Arthritis: It’s All About the Patient.” It was turned into a webinar.

- Dr. Bykerk coauthored a chapter for the textbook *Rheumatology 7e* entitled “Non-immunosuppressive disease-modifying anti-rheumatic drugs, from Gold to Leflunomide.”
- In August 2016, Dr. Bykerk gave the Keynote address for the “UC Beyond Symposium” in Melbourne, Australia. The lecture was entitled “Cancer Immune Checkpoint Blockade: Implications for Rheumatology.”
- In 2016, Dr. Bykerk was Visiting Professor at several institutions in Australia, including Monash Medical Centre, Royal Melbourne Hospital and the University of Queensland-Diamantina Institute.
- In November 2016, Dr. Fields presented an abstract at the American College of Rheumatology conference entitled “Developing a Gout Needs Assessment Incorporating Patient Perspective on Self-Management, Self-Efficacy and Disease Specific Knowledge to Inform a Patient Education Initiative.”
- Social worker Adena Batterman, MSW, LCSW, Senior Manager, Inflammatory Arthritis Support and Education Programs, held a multidisciplinary lecture for patients on gout, which was developed based on a 26-question patient needs assessment. The results were presented at the ACR Annual Scientific Meeting in September 2016. The abstract is entitled “Developing a Gout Needs Assessment Incorporating Patient Perspective on Self-Management, Self-Efficacy and Disease-Specific Knowledge to Inform a Patient Education Initiative.”

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# Integrative Rheumatology and Orthopedic Center of Excellence

The new Integrative Rheumatology and Orthopedic Center of Excellence is a unique group of rheumatologists, basic scientists and orthopaedic surgeons who collaborate to improve the outcomes of patients with rheumatic diseases and minority populations undergoing hip and knee arthroplasty.

## DIRECTOR

Susan M. Goodman, MD

## ACHIEVEMENTS

- Susan M. Goodman, MD, is a peer reviewer for the following journals: *Seminars in Arthritis and Rheumatology*; *HSS Journal*; *The New England Journal of Medicine*; *Arthritis Care and Research*; *Arthritis and Rheumatology*; *Journal of Rheumatology*; and *Annals of Rheumatic Diseases*.
- Dr. Goodman is an Associate Editor for *Current Rheumatology Reports*. She became a Section Editor for *BMC Rheumatology* in 2017.
- Dr. Goodman is a Grant Reviewer for the U.S. Department of Defense.
- Dr. Goodman was named one of *New York Magazine's* Best Doctors in 2017.
- Mark P. Figgie, MD, Attending Orthopaedic Surgeon, is a peer reviewer for *Clinical Orthopaedics and Related Research* and *HSS Journal*.

## PATIENT CARE

- We spearheaded the creation of the first-ever guideline for managing perioperative anti-rheumatic medications in patients undergoing joint replacement surgery. The guideline is sponsored by the American College of Rheumatology (ACR) and the American Association of Hip and Knee Surgeons (AAHKS). Led by Dr. Goodman, the expert panel determined that patients' values and preferences are important in weighing the benefits and harms of treatment. The experts took the unusual step of convening a patient panel to vote on the proposed recommendations.
- Iris Navarro-Millan, MD, Assistant Attending Physician, is interviewing rheumatoid arthritis (RA) patients receiving glucocorticoids to understand the medication's effects from the patient perspective. This novel information, along with a systematic literature review performed by Jonathan Cheah, MD, Adult Rheumatology Fellow, will be presented at the 2018 Outcome Measures in Rheumatology in Clinical Trials (OMERACT) meeting. The results of the research will inform the development of a patient reported outcome measure (PROM) assessing the effects of glucocorticoids.

## RESEARCH INITIATIVES

- We are studying arthroplasty outcomes in RA patients. Our research shows that RA patients undergoing total hip arthroplasty experience more pain and poorer function two years after surgery than osteoarthritis patients. On the other hand, RA and osteoarthritis patients undergoing total knee arthroplasty both have excellent outcomes. Upcoming research will assess the relationship between expectations, outcomes and satisfaction among patients with rheumatic disease.
- We are using patient data and census tract information — such as socioeconomic status and race — to investigate health disparities in

arthroplasty outcomes. Using a novel geocoding approach, we have discovered that poverty interacts strongly with both race and education in association with outcomes. Our goals are to learn why health inequities persist and devise strategies to eliminate them.

- Since patients with RA are at risk for surgery-related infection, we are comparing bacterial colonization in patients who are taking or not taking biologic medications with that of surgical patients who do not have rheumatic disease. The results of this study, led by Peter K. Sculco, MD, Assistant Attending Orthopaedic Surgeon, could lead to changes in the use of prophylactic antibiotics at the time of surgery.
- Using specimens derived from tissue routinely excised during hip and knee replacement surgery, we are studying gene expression profiles in RA. Paired with clinical data, the specimens will enable us to learn more about rheumatic disease activity.
- We are initiating a study to determine if there is a need for supraphysiologic glucocorticoids at the time of total hip and knee arthroplasty. Alana Sigmund, MD, Assistant Attending Physician and Medical Director for Arthroplasty, will lead the effort in collaboration with orthopaedic surgeons as well as physicians in Anesthesiology and Endocrinology.

## EDUCATION

- In May 2017, Dr. Goodman presented the webinar “How Can Patient Partners Improve Joint Replacement Research?,” which was sponsored by the patient advocacy groups Creaky Joints and the Global Healthy Living Foundation. The presentation was based on our experience creating a perioperative anti-rheumatic medications guideline using patient input, fulfilling the Institute of Medicine's recommendation that patients be included in the research planning process.
- Linda Russell, MD, Chief, Perioperative Medicine Division, presented “Surgical Patients with Rheumatic Diseases” at the Perioperative Summit in Scottsdale, AZ, in 2016.
- Dr. Goodman presented “Perioperative Medication Management Guideline for Patients with Rheumatic Diseases Undergoing Total Hip and Total Knee Replacement Surgery” at the American College of Rheumatology Annual Meeting in November 2016 and “Medical Management of the High-Risk Patient” at the American Academy of Orthopaedic Surgeons Annual Meeting in San Diego, CA, in March 2017.

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## Improving outcomes for arthroplasty patients with rheumatic disease

The Integrative Rheumatology and Orthopedic Center of Excellence formed in 2017 to answer a question: How can rheumatologists and orthopaedic surgeons improve outcomes for arthroplasty patients who don't fare so well? With research conducted by these physicians — as well as basic scientists — answers are beginning to emerge. "The molecular analyses of joint tissue performed by research colleagues enrich my observations enormously and vice-versa when they interpret their observations in the context of good clinical data," says Susan M. Goodman, MD, Director of the Center. "These are undertakings where two plus two adds up to six or seven."

The first areas of focus were on people with rheumatic disease and vulnerable minorities, who are at risk for poor clinical outcomes. The research has already yielded important insights (see "Investigating health disparities to improve outcomes for all patients" on page 12). Center physicians are also studying patients with rheumatoid arthritis (RA) who are undergoing arthroplasty. In one project, researchers are identifying the clinical characteristics and risk factors for RA flares after arthroplasty. Using HOOS (Hip disability and Osteoarthritis Outcome Score) and KOOS (Knee injury and Osteoarthritis Outcome Score) surveys, they are assessing patients' pain and function prior to surgery and one year later to determine how outcomes might be affected by disease activity. "This longitudinal collaboration has permitted us to answer questions germane to our own fields that would be impossible to perform without the collaboration of the entire group," says Dr. Goodman. "This study has had a 'blind men and elephant' quality to it, since each of us is observing and analyzing very different aspects of the same problem." In related research, scientists are trying to gain a better understanding of RA flares using genomics approaches. They are taking a sample of tissue at the time of surgery and using next-generation gene sequencing techniques to investigate the fundamental pathophysiology of RA — and ultimately determine if they can predict and prevent flares.

The Center has several papers published, several under review, and many others planned. What started as a casual collaboration now has the commitment and infrastructure to undertake complex research projects. Says Dr. Goodman, "It's coming together in a much more formal and productive way."

### Left to right:

Anne R. Bass, MD  
Michael L. Parks, MD  
Susan M. Goodman, MD  
Linda A. Russell, MD  
Mark P. Figgie, MD  
Iris Navarro-Millan, MD

### Not pictured:

Laura T. Donlin, PhD  
Emily M. Stein, MD, MSc

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# Lupus and Antiphospholipid Syndrome Center of Excellence

The Lupus and Antiphospholipid Syndrome Center of Excellence provides multidisciplinary care, education and support to patients with lupus and APS and works closely with scientists in the Mary Kirkland Center for Lupus Research to support research on these diseases.

## DIRECTOR

Jane E. Salmon, MD

## ACHIEVEMENTS

- Mary K. Crow, MD, Physician-in-Chief and Chief, Division of Rheumatology, was named an Honorary Member of the European League Against Rheumatism.
- Dr. Crow was elected a member of the National Society for Clinical Rheumatology in 2017.
- Dr. Crow was Chair, Lupus 2016 Research Conference in Armonk, NY; Featured Speaker at the Research Symposium in Honor of Peter H. Schur, MD, Brigham and Women's Hospital in December 2016; and Chair, Biomedical Research Review Committee, University of Uppsala, Sweden. She was also Co-Chair and Featured Lecturer, International Interferon Summit, in Gaithersburg, MD, in May 2017.
- Jane E. Salmon, MD, was elected to the National Academy of Medicine in 2016.
- In 2016, Dr. Salmon was the 3rd Annual Graciela S. Alarcon MD, MPH Lecturer at the University of Alabama at Birmingham.
- Dr. Salmon was the Keynote Speaker at the 3rd Annual Department of Medicine Research Retreat at the Medical College of Wisconsin in 2017.
- Lisa R. Sammaritano, MD, Associate Attending Physician, led the effort to develop guidelines for reproductive health for patients with rheumatic disease by the American College of Rheumatology. She also edited the textbook *Contraception and Pregnancy in Patients with Rheumatic Disease*.
- Michael D. Lockshin, MD, Director of the Barbara Volcker Center for Women and Rheumatic Disease, is author of the well-received book, *The Prince at the Ruined Tower: Time, Uncertainty & Chronic Illness*, which was published in March 2017. Based on his decades of experience caring for patients with lupus and APS, the book provides valuable insights for patients and physicians grappling with the challenges of autoimmune diseases.
- Doruk Erkan, MD, Clinical Co-Director, Mary Kirkland Center for Lupus Care, wrote the iBook *APS Antiphospholipid Syndrome*, a resource for medical students that became available in 2016.
- Dr. Erkan organized the 15th International Congress on Antiphospholipid Antibodies to build consensus on patient care. The Congress was held in September 2016.





- Drs. Lockshin and Erkan edited *APS: Current Research Highlights and Clinical Insights*, which was published in 2017.

PATIENT CARE

- Our research is influencing the management of pregnant women with lupus, who have higher rates of preeclampsia, fetal and neonatal death, and fetal growth problems. Our data, which was published in the *American Journal of Obstetrics and Gynecology* in 2016, revealed that outcomes are usually favorable in about 80 percent of pregnant patients with inactive or stable lupus. Physicians can now reassure these patients that their pregnancies are likely to be uncomplicated.
- We launched LupusMinder, a mobile app that enables patients to record their symptoms between office visits with notes and photos and share them with their providers. Patients can also list their medications, track side effects and create appointment reminders. The app, which was developed by the Rheumatology, Social Work and Digital Communications departments — with input from lupus patients — is free of charge.

Left to right:

- Tricia Dougherty
- Jo-Ann Vega
- Theresa Lu, MD
- David Fernandez, MD, PhD
- Marta Guerra
- Juliette Kleinman
- Kyriakos Kirou, MD
- Kerri Merritt
- Mavis Seehaus
- Medha Barbhaiya, MD\*
- Julia Davis-Porada
- Jane E. Salmon, MD
- Ann Marie Rakowicz
- Doruk Erkan, MD
- Nadine Spring
- Carol A. Mancuso, MD
- Jillian Rose
- Michael D. Lockshin, MD
- Roberta Horton
- Lisa R. Sammaritano, MD
- Alessandra Pernis, MD
- Mary K. Crow, MD

Not pictured:

- Lionel B. Ivashkiv, MD
- Lindsay S. Lally, MD

\*New Physician



# Lupus and Antiphospholipid Syndrome

## Center of Excellence cont'd

- We integrate social work into patient care. Our Charla de Lupus (Lupus Chat)<sup>®</sup> program, which is offered in English and Spanish, provides a toll-free national helpline, which matches callers with peers for ongoing phone support and education. It also provides culturally relevant peer support and education to teens and young adults. In a study presented at the American College of Rheumatology/ Association of Rheumatology Health Professionals Annual Meeting in November 2016, 93 percent of participants reported that the group helped them to better manage lupus. Hispanic and Latino patients in particular reported benefits.
- We developed the Lupus Fast Track program to provide rapid appointments for newly diagnosed patients. In the 2016–2017 academic year, there were 105 patients triaged and 78 appointments made through Fast Track.
- We established internal recommendations to standardize the care of patients with lupus nephritis.

### RESEARCH INITIATIVES

- Dr. Salmon, an investigator for the Mary Kirkland Center for Lupus Research, has been studying pregnancy outcomes in women with systemic lupus erythematosus (SLE) and APS through PROMISSE (Predictors of Pregnancy Outcome: Biomarkers in Antiphospholipid Syndrome and Systemic Lupus Erythematosus), a 14-year, multicenter project funded by the National Institutes of Health (NIH). Recent data revealed that women with or without SLE who test positive for a specific antiphospholipid antibody — the lupus anticoagulant (LAC) — have a greater than 40 percent risk for an adverse pregnancy outcome. Prior research showed that pregnancy outcomes in experimental models improved with administration of a TNF- $\alpha$  inhibitor. Now Dr. Salmon and a colleague at the University of Utah are enrolling newly pregnant women with APS and LAC in the IMPACT (IMProve Pregnancy in APS with Certolizumab Therapy) study. It is a Phase II trial of the TNF- $\alpha$  inhibitor certolizumab, which is used to treat rheumatoid arthritis, psoriasis and Crohn's disease. The goal is to rescue these high-risk pregnancies.
- Research led by Dr. Crow, who works in the Mary Kirkland Center for Lupus Research, has linked high levels of virus-like elements within the human genome known as LINE-1 (L1) retroelements with lupus and Sjogren's syndrome. L1 can trigger an immune response and prompt the overproduction of interferon, which may give rise to an autoimmune disorder. The findings, which were published in *Arthritis and Rheumatology* in November 2016, suggest that L1 retroelements contribute to autoimmune diseases characterized by high interferon levels.
- Our research into Rho kinases (ROCK1 and ROCK2), led by Alessandra Pernis, MD, has revealed a fundamental pathway in the development of autoimmune diseases, which could lead to better treatments. The most recent study, published in April 2017 in *Annals of the Rheumatic Diseases*, revealed that ROCK activity levels are significantly higher among lupus and rheumatoid arthritis patients than healthy individuals. Drugs that target the ROCK pathway reduced the molecule's activity level in peripheral blood cells.
- Research performed by Dr. Crow and several other scientists has led to a multicenter Phase III study of a new monoclonal antibody called anifrolumab for lupus patients. The research builds on Phase II trial results, which showed the medication reduced disease activity and improved symptoms, including rash and arthritis.

### EDUCATION

- Our goal is to train future academic leaders in rheumatology. The HSS Research Institute Rheumatology Training Program, which is funded by the NIH, offers opportunities for two postdoctoral fellows and two predoctoral students each year to learn about rheumatic diseases and conduct translational research with the mentorship of a multidisciplinary team of investigators.
- We are training physicians to be effective mentors under the leadership of Carol A. Mancuso, MD, Attending Physician.
- The Center sponsored three live video chats and four Facebook chats, which were viewed by thousands of lupus patients around the world. Together with dermatologists, nephrologists, psychiatrists, Ob/Gyns and social workers, we answered questions regarding lupus and its treatment. The video chats and questions and answers from Facebook chats remain on the HSS website so patients can continue to find answers to their lupus-related questions.
- We developed four HSS eAcademy<sup>®</sup> courses, including "Pathogenic Mechanisms in Lupus" and "Lupus and Pregnancy: Background, Predictors, and Management."

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## The search for a treatment for troubled pregnancies

It's not every day, or even every decade, that physician-scientists see their research result in a treatment for patients. But Jane E. Salmon, MD, may be on the cusp of that experience.

The journey from test tube to treatment began four years ago, when Dr. Salmon's research identified a critical mediator — tumor necrosis factor- $\alpha$  — that injures the developing placenta and leads to preeclampsia, a common complication in pregnant lupus patients. This finding suggested TNF- $\alpha$  inhibitors as a possible treatment for their risk-prone pregnancies. A subsequent observational study in patients demonstrated that patients with antiphospholipid syndrome (APS) who test positive for lupus anticoagulant (LAC) were at the highest risk for the pregnancy complication.

The next steps were to approach the National Institutes for Health (NIH) about funding a drug trial and to find a pharmaceutical partner. Dr. Salmon joined with University of Utah researchers, and the team settled on the drug certolizumab, which has the advantage of not crossing the placenta, possibly reducing the risk to the fetus. Certolizumab is currently approved for rheumatic arthritis, psoriasis and Crohn's disease. In fact, patients with these autoimmune disorders sometimes take the TNF- $\alpha$  inhibitor during pregnancy, when the benefits outweigh the risks of the disease. "There were some safety data from patients taking certolizumab while they were pregnant," says Dr. Salmon. "That gave us the encouragement to proceed."

Two years passed as the team negotiated the terms of an agreement with the drug's manufacturer. At the same time, the researchers revised their NIH application twice to address safety and study design questions. They applied for Investigational New Drug (IND) approval for off-label use of the drug from the FDA.

The Hospital's Institutional Review Board then approved the study, clearing the last hurdle. The NIH assembled a data safety monitoring board tasked with reviewing trial details every six months.

Dr. Salmon then faced one of the most daunting challenges: finding patients to enroll. The researchers have relied on word of mouth and called or sent letters to rheumatologists and high-risk maternal fetal medicine specialists throughout the country. "It's quite uncommon for a woman to have all of the risk factors we've defined," says Dr. Salmon. "And the patient must be enrolled and receive the experimental drug when the placenta is first developing — before nine weeks of pregnancy. Identifying and enrolling patients this early in their pregnancies is a challenge."

In September 2017, Dr. Salmon enrolled the first of about 50 patients the study will include. The researchers hope to reduce the incidence of preeclampsia by at least 50 percent. If certolizumab proves effective, it holds the tantalizing possibility of preventing the pregnancy complication in a much larger group of women. "Our ultimate goal is to offer a treatment for women at risk for preeclampsia who don't have an autoimmune disorder," says Dr. Salmon. "We want to use lupus as a window to understand more common diseases."

# Division of Pediatric Rheumatology

The Division of Pediatric Rheumatology combines cutting-edge diagnostic technology and treatments for children with rheumatic disease with holistic care, which includes social services, child life and nutrition counseling.

## CHIEF

Karen B. Onel, MD

## ACHIEVEMENTS

- Karen B. Onel, MD, serves on the Finance and Ethics Committee of the Childhood Arthritis and Rheumatology Research Alliance (CARRA). She also co-chairs CARRA's Systemic JIA working group.
- Dr. Onel is a member of the Scientific Advisory Council of the Pediatric Rheumatology Collaborative Study Group (PRCSG).
- Dr. Onel is a member of the Juvenile Arthritis Committee of the Arthritis Foundation.
- Dr. Onel was selected as a Castle Connolly Top Doctor in Pediatric Rheumatology in 2016 and 2017.
- Alexa B. Adams, MD, Associate Attending Pediatrician, was selected as a Castle Connolly Top Doctor in Pediatric Rheumatology in the New York Metro Area in 2016 and 2017.
- Sarah Taber, MD, Assistant Attending Pediatrician, is a member of the Scleroderma, Vasculitis and Rare Diseases Advisory Committee of CARRA.

## PATIENT CARE

- We have developed patient education materials in multiple languages, critical in a city with marked diversity of culture and language.
- We are creating a comprehensive wellness program for our patients. Currently, we offer a monthly nutrition clinic staffed by a registered dietitian to help patients make healthy food choices to counteract the effects of medications. In addition, child life, social services and translators participate in our clinic, helping to provide whole patient care.

## RESEARCH INITIATIVES

- Many of our patients' parents struggle with the uncertainty about their child's prognosis. In addition, patients with systemic lupus erythematosus (SLE) often present in different ways and with different degrees of severity. To answer parents' questions and differentiate SLE from other autoimmune diseases, we are launching a study to identify biomarkers. We received a \$75,000 grant from the Barbara Volcker Center for Women and Rheumatic Diseases to study patients who present with a positive antinuclear antibody (ANA) and/or multiple positive blood tests. We are partnering with Virginia Pascual, MD, Gale and Ira Drukier Director of Children's Health Research at Weill Cornell Medicine, to evaluate whether gene expression profiling and flow cytometry can provide biomarkers that will predict whether asymptomatic patients are at risk of developing clinical disease — and differentiate SLE from mixed connective tissue disease and undifferentiated connective tissue disease.
- We are investigating how the Patient Reported Outcome Measurement Information System

(PROMIS) Computer Adaptive Tests correlate with disease activity in juvenile idiopathic arthritis (JIA). New research, which was presented at the American College of Rheumatology meeting in 2017, revealed that anxiety, depressive symptoms and pain correlated strongly with JIA disease activity, although the association was not statistically significant. Parent proxy CATs, however, showed poor correlations with disease activity, so parents may not accurately assess their child's health. More research is needed to evaluate the sensitivity of PROMIS CATs to changes in disease activity over time.

- Since our colleagues treat adults with rheumatic diseases, we are able to study how age affects disease. We have opportunities to collaborate with colleagues to conduct lifelong studies on patients. This will enable us to see the full spectrum of the disease at different ages.

- We found that procalcitonin is a reliable biomarker in distinguishing bacterial infections such as *Staphylococcus aureus* and *Kingella kingae* from active disease in patients with JIA. Our research was presented at the American College of Rheumatology meeting in 2017.

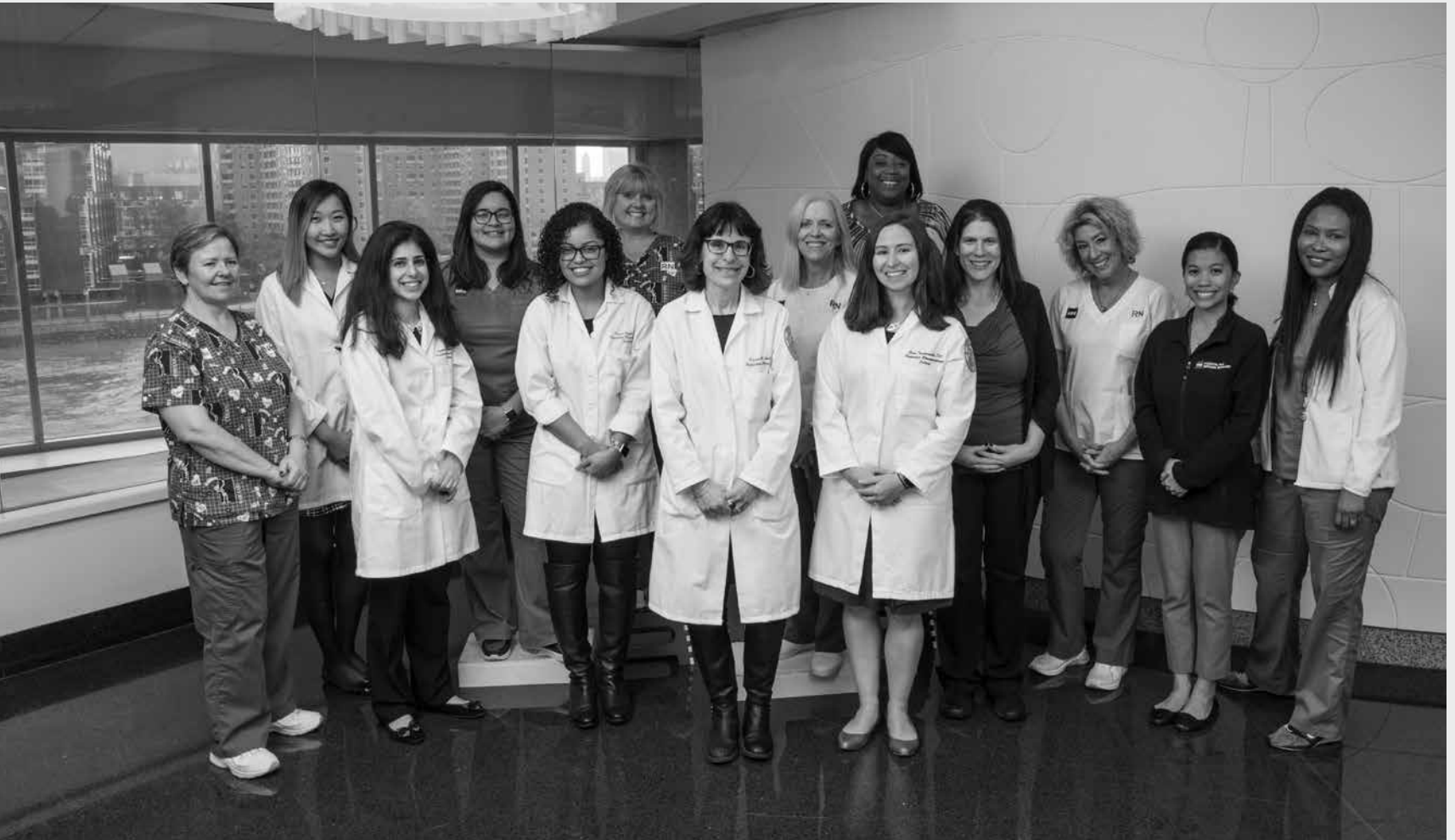
- We are gaining a greater understanding of the causes of rheumatic illnesses and evaluating the safety and tolerability of new treatments. We are collaborating with other institutions to define evidence-based treatments for children with JIA, SLE and recurrent non-infectious osteomyelitis. Dr. Onel is author of a paper published in *Pediatric Rheumatology* in April 2017, which reported that the CARRA Systemic Juvenile Idiopathic Arthritis Consensus Treatment Plans were able to be successfully integrated into clinical practice.

- Dr. Onel examined attitudes and approaches among pediatric rheumatologists about when and how to withdraw medications for children with clinically inactive JIA. She found that there was no uniformity of opinion, and clinicians had vastly different approaches. The study was published in the *Journal of Rheumatology* in March 2017.

- Thomas J.A. Lehman, MD, was an author of a study that examined the relationship between health-related quality of life, disease activity and disease-related damage in a multinational cohort of childhood onset SLE patients. He found that Asian and European patients had the highest health-related quality of life, while South and North American patients had lower scores. In addition, female gender, high disease activity and damage, non-white ethnicity, and use of cyclophosphamide and rituximab were related to lower health-related quality of life. The study was published in *Lupus* in March 2017.

- Theresa Lu, MD, PhD, was inspired by a former patient who was diagnosed with scleroderma at age five to understand how to better treat this disease. Mesenchymal stem cells in the fat have reparative and regenerative properties. In a





study published in the *Journal of Clinical Investigation* in 2016, Dr. Lu and other scientists discovered a new way of improving the stem cell longevity and, therefore, function. This understanding has the potential to improve mesenchymal stem cell therapy in scleroderma and other rheumatologic and musculoskeletal diseases in both children and adults.

#### EDUCATION

- Dr. Onel co-chaired the Systemic Juvenile Idiopathic Arthritis Session of CARRA's annual meeting in May 2017.
- Dr. Onel participated in Pediatric Rheumatology Grand Rounds at HSS, as well as the Children's Hospital-Montefiore in the Bronx, NY and NewYork-Presbyterian Hospital.
- Dr. Adams serves as director of our Pediatric Rheumatology Fellowship Training Program. She oversees the daily operations, conducts program administration and maintains required documentation.

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#### Front row Left to right:

Nadine Saad, MD  
Keila Vega, MD  
Karen B. Onel, MD\*  
Erin Treemarcki, MD

#### Back row Left to right:

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Cindy Wang  
Andrea Aguilera, RN  
Eileen Vance, RN  
Alice Quinn, RN  
Roane Henderson  
Amy Silberman  
Mary Wiebolt, RN  
Melissa Flores  
Marcia Julius, RN

\*New Physician

# Division of Pediatric Rheumatology cont'd



## Left to right:

Theresa Lu, MD, PhD  
 Alexa B. Adams, MD  
 Jonathan Haimindra  
 Natalie Rosenwasser, MD  
 Nancy Pan, MD  
 Thomas J.A. Lehman, MD  
 Sarah Taber, MD  
 Esther Alberttis  
 Peyton Katz  
 Rebecca Trachtman, MD  
 Nicole E. Atkins

## The advantages of collaborative care

One unique feature of the Division of Pediatric Rheumatology is the physicians' ability to work closely with colleagues in the Pediatric Orthopaedic Service, who are located on the same floor of the Hospital. In the case of one patient, Hunter\*, collaboration made all the difference in his treatment. In 2017, Hunter came to see Shevaun Mackie Doyle, MD, Associate Attending Orthopaedic Surgeon — whose office is across the hall from Dr. Onel's — after he hurt his foot playing basketball. Hunter, 11, had been diagnosed with systemic juvenile idiopathic arthritis (SJIA) at age four, had been asymptomatic for five years, then started to feel ill again. The formerly active youngster, who played baseball, basketball and flag football, found himself in so much pain that everyday activities like walking across a room proved nearly impossible. "His condition first presented as a series of sports injuries," Dr. Onel recalls. "But because he had been asymptomatic for so long, his doctors didn't think it was due to SJIA. I ran into Dr. Doyle in our shared hallway, and she brought up his case to me. He had been away at sleepaway camp and was miserable. I told her he should come home, and I would see him the next day."

Dr. Onel collaborated with Dr. Doyle and Radiology and Imaging. "There were some unusual findings on Hunter's MRI that I was uncertain about, and within a few minutes the radiologist had figured it out," she recalls. "The radiologist was able to pick up some musculoskeletal abnormalities, when up to this point all of the other specialists had been focused on his extremities." After consulting with her team for about 90 minutes, Dr. Onel called

Hunter's parents and grandfather into the room. "It was clear that Hunter had active inflammatory disease," say Dr. Onel. "I explained that I wasn't going to give them a short answer — I wanted the weekend to review his files and think hard about what I wanted to do."

Dr. Onel decided to try injections of tocilizumab (Actemra). "The family was nervous, as it was a step up from the steroids and nonsteroidal anti-inflammatories they'd used previously," recalls Dr. Onel. Hunter had his first infusion in mid-July. When he developed nausea, vomiting and a headache the next day, Dr. Onel met Hunter and his mom at the ER to check for dehydration and monitor his vitals. Two days later, she checked his labs and discovered that the anemia and inflammation he'd suffered over the last year were completely gone. Two weeks later, after his second infusion, Hunter felt well enough to insist that his parents drive him back to sleepaway camp, where he was able to participate in the last nine days. "To have a child who goes from being able to barely move to running, jumping and participating in all of his favorite sports in basically a span of three weeks — it was life-altering for everybody," says Hunter's mother.

Today, Hunter, who receives a tocilizumab infusion every two weeks, has resumed his previously active lifestyle. "Because Dr. Doyle's office is so close to mine, we get to think more broadly when we see patients," says Dr. Onel. "It's a real advantage for our patients."

*\*Name changed to protect privacy*



# Scleroderma, Vasculitis & Myositis

## Center of Excellence

The Scleroderma, Vasculitis & Myositis Center of Excellence initiates clinical trials of promising new treatments for rare diseases and provides support and education for patients.

### DIRECTOR

Robert F. Spiera, MD

### ACHIEVEMENTS

- Robert F. Spiera, MD, is Chairman of the Medical and Scientific Advisory Board of the Scleroderma Foundation Tristate, Inc. Chapter. He is also a member of the National Medical and Scientific Advisory Board of the national Scleroderma Foundation.
- Dr. Spiera is a member of the Medical and Scientific Advisory Board of the Vasculitis Foundation.
- In 2016 and 2017, Dr. Spiera was invited to be a speaker at the Meet the Professor session at the American College of Rheumatology (ACR) Annual Meeting. In 2017, he spoke about polymyalgia rheumatica.
- Jessica K. Gordon, MD, Assistant Attending Physician, is a member of the National Medical and Scientific Advisory Board of the Scleroderma Foundation.

### PATIENT CARE

- Patient education is integrated into our care. We recently surveyed physicians as well as patients who received and opened our monthly email news blasts to assess their perception of content value. We discovered that contrary to what was expected by physicians, patients prefer research-focused newsletters to those with psychosocial information. Our findings were reported by Center Manager Elizabeth Soto-Cardona, MPH, as an oral presentation at the ACR meeting in 2017.
- We host two Scleroderma Foundation patient forums each year. We also provide monthly support group meetings for scleroderma and vasculitis patients. We offer social work and occupational therapy services.
- Our physicians participate in educational Facebook Live events.

### RESEARCH INITIATIVES

- Dr. Spiera recognized the potential of the interleukin-6 receptor inhibitor tocilizumab, a drug now used to treat giant-cell arteritis (GCA), early on. He and Lindsay S. Lally, MD, Assistant Attending Physician, conducted an investigator-initiated clinical trial that tested its potential for managing the related condition polymyalgia rheumatica, which had encouraging results. Dr. Lally reported on it in an oral presentation at the ACR Annual Meeting in 2015, and the study was published in *Arthritis and Rheumatology* in 2016. Dr. Spiera was also involved in the design of the GiACTA trial, for which the Center was a study site. In the one-year study, patients who received tocilizumab in addition to prednisone were able to taper off the steroid more quickly and had longer lasting remission than those who received the steroid alone. Dr. Spiera was one of the authors of the study, which was published in *The New England Journal of Medicine* in July 2017. The U.S. Food & Drug Administration approved

the medication in May 2017 on the basis of that trial's findings.

- Dr. Spiera was the lead investigator for an industry-sponsored trial of a novel and promising medication that could eventually be approved for scleroderma, for which no approved therapy is presently available. Lenabasum, a selective cannabinoid receptor type 2 agonist, appears to abrogate inflammation and fibrosis in patients with scleroderma, according to the results of the Phase II, double-blind, placebo-controlled trial. Patients treated with active drug achieved a clinical response, as measured by the Combined Response Index in Systemic Sclerosis (CRISS) score, after three months of treatment. They also experienced less pain and skin symptoms. The drug was safe and well-tolerated. These encouraging results were presented by Dr. Spiera at the 2017 ACR Annual Meeting. Currently, a 350-patient, multicenter, international Phase III trial is underway, and Dr. Spiera is the lead investigator.
- Dr. Lally and colleagues studied whether assessing Temporal Artery (TA) biopsy specimens for activity of the protein Rho kinase (ROCK) may increase the diagnostic accuracy of a biopsy in patients with suspected giant-cell arteritis. Diagnosing GCA can be challenging, since a biopsy of the temporal artery fails to diagnose the disease in up to 40 percent of cases. Dr. Lally demonstrated that in biopsied temporal arteries, staining for pERM, a surrogate for ROCK activity, can increase the diagnostic accuracy dramatically since pERM is overexpressed in biopsies of patients with GCA. This study was published in *Rheumatology*. More recently, in collaboration with investigators from Oxford University, we confirmed those findings in a much larger cohort of patients. Dr. Lally presented these findings at the ACR Annual Meeting in 2016.
- We performed an investigator-initiated, randomized, double blind, placebo-controlled trial of belimumab, a drug currently approved to treat lupus, in patients with early diffuse scleroderma. In that pilot study, we found that belimumab was associated with a significant decrease in pro-fibrotic genes and pathways. In addition, a greater number of patients treated with active drug showed improvement than patients treated with placebo. This study was presented by Dr. Gordon at the ACR Annual Meeting in 2016 and was recently published in *Arthritis and Rheumatology*. Although the findings did not reach statistical significance, the clinical trend and translational findings seem to justify further evaluation.
- In collaboration with the Department of Radiology and Imaging, Dr. Gordon found that using ultrasound to scan the hands of patients with scleroderma can contribute to a better understanding of what causes the contractures associated with the disease. She is studying how these findings may ultimately correlate with disease outcomes.

#### Next page

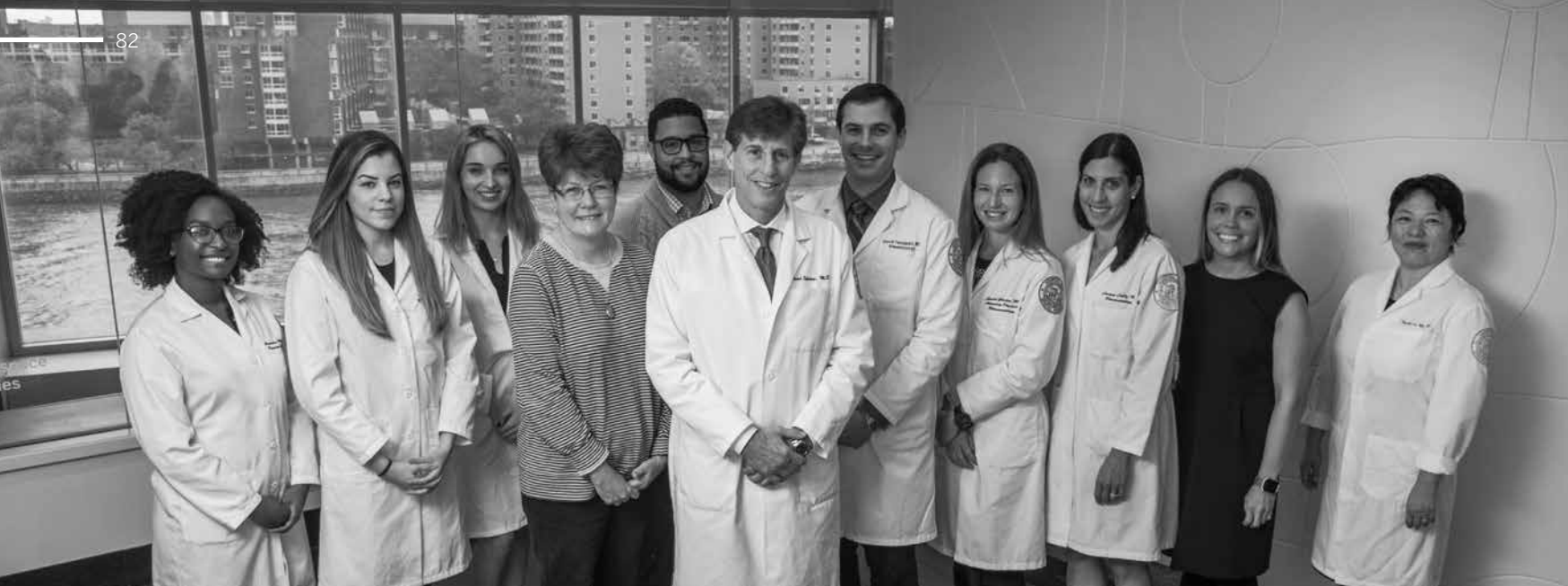
#### Left to right:

Alexandra Morquette  
Annel Fernandez  
Anna Yusov  
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Jaime Villar  
Robert F. Spiera, MD  
David Fernandez, MD, PhD\*  
Jessica K. Gordon, MD  
Lindsay S. Lally, MD  
Elizabeth Soto-Cardona, MPH  
Theresa Lu, MD

#### Not pictured:

Franck Barrat, PhD  
Juliette Kleinman  
Emily Reiss

\*New Physician



## New hope for giant-cell arteritis patients

For Robert F. Spiera, MD, Director of the Scleroderma, Vasculitis & Myositis Center of Excellence, clinical care and research often overlap. “With rare diseases, there are often limited therapeutic options and probably less new drug development by pharma than is pursued for more common diseases,” he says. “So we study drugs approved for other conditions that might make sense mechanistically for treating diseases like scleroderma or polymyalgia rheumatica, often in the context of investigator-initiated trials here at our Center or as part of larger investigator- or industry-sponsored trials in collaboration with other institutions.”

In March 2014, Carolyn Ouderkirk, 74, signed up for a clinical trial at HSS. For a month, she’d been experiencing mysterious symptoms — chronic headaches, jaw pain, intense fatigue and unexplained weight loss. Ouderkirk’s internist initially believed she might have a sinus infection; another physician wanted to send her to a headache institute. Finally, she saw a physician who

suspected she had temporal arteritis, also known as giant-cell arteritis. She had a biopsy and tested positive. Within 24 hours, she was in Dr. Spiera’s office. “He invited me to be a part of a clinical trial,” she recalls. Dr. Spiera told Ouderkirk that there was a new drug that might enable her to be treated with less steroid medication, the standard treatment for the condition. “I didn’t know which therapy I would be getting, but I was glad to participate,” she says.

The Center was a site for the GiACTA trial, a randomized, double-blind, placebo-controlled study investigating whether tocilizumab, an interleukin-6 receptor inhibitor that had been approved to treat rheumatoid arthritis, could bring about sustained remission in giant-cell arteritis patients who were taking prednisone.

Ouderkirk was given 60 milligrams (mg) of prednisone on a Friday. By Sunday, she was feeling much better. Over the following weeks and months, she tapered the steroid dose

and transitioned to the clinical trial. Dr. Spiera and the other investigators involved in the trial found that 56 percent of the patients who received tocilizumab injections weekly for 52 weeks, along with a 26-week course of prednisone, remained in sustained remission after tapering off the prednisone, compared with just 14 percent of patients who took the prednisone alone. The study was published in *The New England Journal of Medicine* in July 2017. The results were so impressive that they led to U.S. Food & Drug Administration approval of tocilizumab. The drug is the first medication approved to treat giant-cell arteritis. “I’m really excited about it,” says Dr. Spiera. “We are able to get patients off steroids much sooner.”

As for Ouderkirk, she no longer takes medication for giant-cell arteritis and is in complete remission. She and her husband recently cycled 375 miles along the Erie Canalway Trail. “I’m back to my old self,” says Ouderkirk. “I’d never been so sick in my life. Thank heavens I found Dr. Spiera.”

### EDUCATION

- Dr. Gordon developed a training curriculum to teach adult and pediatric rheumatology fellows how to evaluate nailfold capillary changes that could suggest a scleroderma spectrum illness. In a study published in *Clinical and Experimental Rheumatology* in 2017, we found that the curriculum improved healthcare providers’ ability to distinguish normal from abnormal nailfolds and to describe the changes in people with scleroderma. This is an important skill now that these changes have been incorporated into diagnostic criteria for scleroderma.
- In September 2016, Dr. Spiera gave presentations entitled “Polymyalgia Rheumatica” and “Therapeutic challenges in systemic sclerosis” at Harvard Medical School’s Advances in Rheumatology course.
- In September 2016, Dr. Lally was the course co-director of a webinar entitled “Approach to Otolaryngologic Manifestations of Granulomatosis with Polyangiitis.”
- Dr. Spiera co-chaired a Med Learning Group (MLG)-sponsored symposium held at the 2016 ACR Annual Meeting. It was entitled “Emerging Steroid-Sparing Biologics for the Treatment of Giant Cell Arteritis.”

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# About Hospital for Special Surgery

Founded in 1863, Hospital for Special Surgery (HSS) is a world leader in orthopaedics, rheumatology and rehabilitation. HSS is ranked #1 in the U.S. for Orthopaedics and #3 for Rheumatology by *U.S. News & World Report* "Best Hospitals" (2017–2018 rankings). It is the first hospital in New York State to receive the Magnet® designation for Excellence in Nursing Service from the American Nurses Credentialing Center four consecutive times. Located in New York City, HSS also serves patients in the regional area with outpatient centers in Westchester County, New York; Connecticut; New Jersey; Long Island and Queens. Patients

choose to come to HSS from across the U.S. and from around the world. HSS has one of the lowest infection rates in the country. The Hospital's Research Institute is internationally recognized as a leader in the investigation of musculoskeletal and autoimmune diseases. To learn more, please visit [www.hss.edu](http://www.hss.edu).

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"The State of the World of Musculoskeletal Health" is produced by the Communications Department at Hospital for Special Surgery.

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## In Memoriam

At HSS, we mourn the loss of the following colleagues and friends, who made a significant impact on the field of musculoskeletal medicine over the course of their distinguished careers: Adele Boskey, PhD, Senior Scientist, Program Director of the Musculoskeletal Integrity Program and Starr Chair in Mineralized Tissue Research; Dean G. Lorch, MD, Associate Attending Orthopaedic Surgeon; and Dean R. O'Hare, member and former Co-Chairman of the HSS Board of Trustees.

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