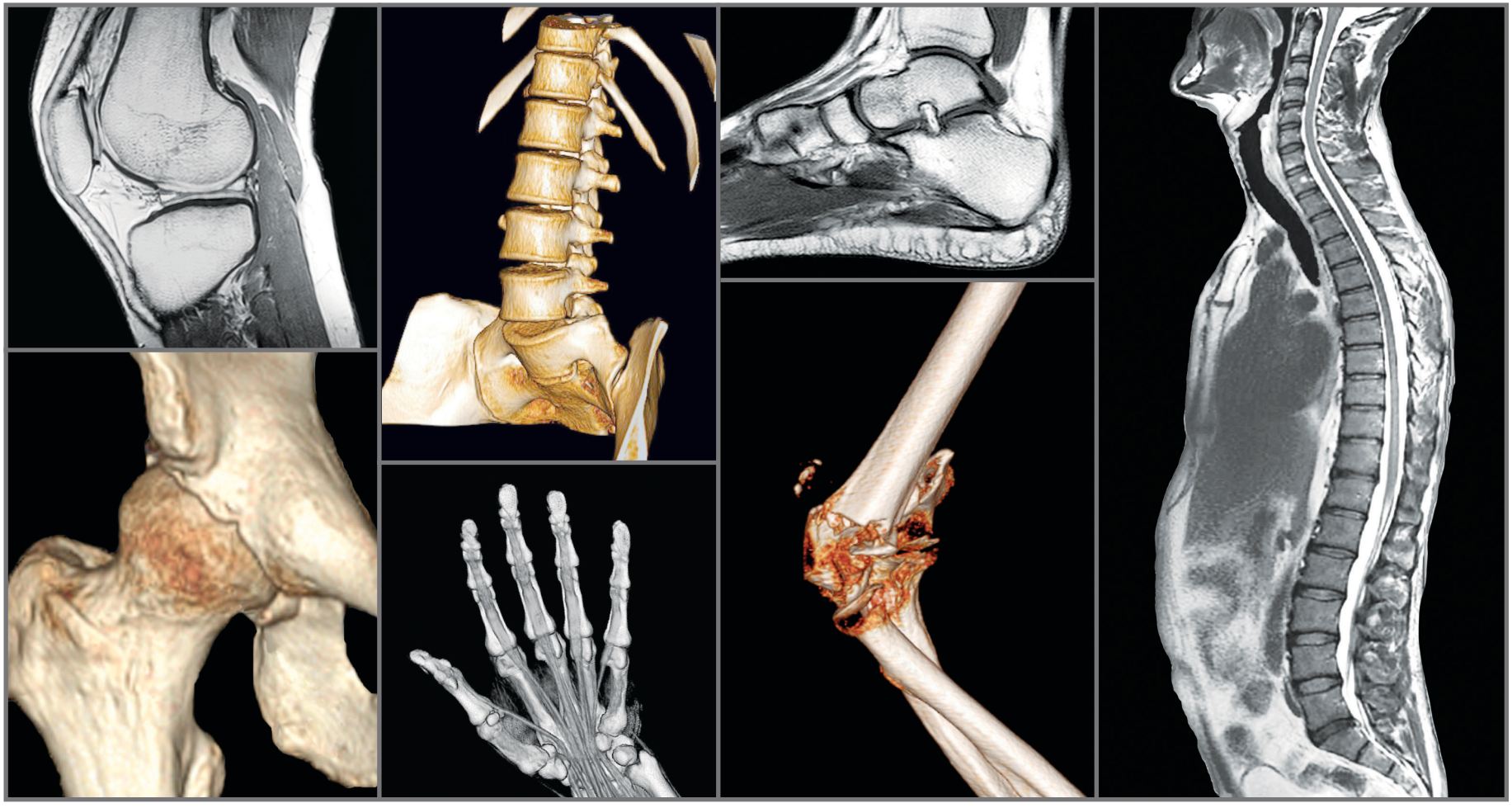
NewYork-Presbyterian Orthopedics
2017 Report on Clinical and Scientific Innovations



Weill Cornell Medicine | NewYork-Presbyterian | Columbia University Medical Center

BEST HOSPITALS U.S.News & WORLD REPORT HONOR ROLL 2017–18

New York's #1 Hospital
17 Years in a Row

NewYork-Presbyterian Orthopedics
2017 Report on Clinical and Scientific Innovations

For More Information
nyp.org/amazingadvances

Welcome

Dear Colleague:

We are pleased to bring you our *2017 Report on Clinical and Scientific Innovations in Orthopedics*. The strength of our orthopedic services is derived from the exceptional clinical, scientific, and educational resources made possible by the partnership of NewYork-Presbyterian, Columbia University Medical Center, and Weill Cornell Medicine.

Our orthopedic surgeons and clinical and basic researchers continue to build on an illustrious history of advances in the field of orthopedic surgery dating back more than 150 years. Their skills and expertise in the full range of orthopedic specialties are contributing to the quality of life for thousands of children, adolescents, and adults.

Individuals from around the world come to our medical center seeking relief from pain, recovery from injury, and a return to function and mobility. Here they find clinicians with specialized expertise in complex musculoskeletal diseases and disorders, from sports injuries to spinal deformity to degenerative joint diseases and major trauma.

At the same time, top-tier researchers in the basic, translational, and clinical arenas are singularly focused on identifying new surgical approaches, orthopedic devices, and biological solutions to some of the most challenging problems in orthopedics today.

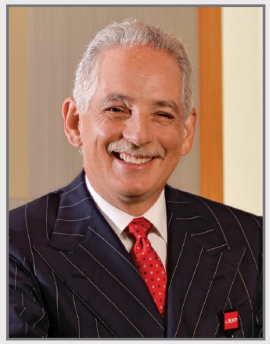
For the past 17 years, NewYork-Presbyterian has been ranked the #1 hospital in New York State by *U.S.News & World Report* and is continually named to the Honor Roll of America's Best Hospitals. We are proud of this enduring distinction, which represents the commitment of our physicians, healthcare teams, and scientists to the roles they play in delivering the highest quality, most advanced care to our patients.

Sincerely,

Steven J. Corwin, MD
President and
Chief Executive Officer
NewYork-Presbyterian

Lee Goldman, MD
Executive Vice President, Dean of
the Faculties of Health Sciences
and Medicine, and Chief Executive
Columbia University Medical Center

Augustine M.K. Choi, MD
Stephen and Suzanne Weiss Dean
Weill Cornell Medicine



Dr. Steven J. Corwin

Dr. Lee Goldman

Dr. Augustine M.K. Choi

Welcome

Dr. William N. Levine

Dear Colleague,

I am pleased to share with you the *2017 Report on Clinical and Scientific Innovations in Orthopedics*. This report – our inaugural issue – highlights our latest achievements and outcomes in musculoskeletal care that are elevating the field and dramatically improving the lives of patients. We are joined in these efforts by our colleagues in the Department of Orthopedic Surgery at NewYork-Presbyterian Lower Manhattan Hospital, led by Eli Bryk, MD, an alumnus of Columbia's orthopedic surgery residency program.

Continuing to build on a legacy of leading edge care and pioneering contributions to orthopedics, our internationally renowned specialists in nonoperative and operative approaches address all manner and complexity of orthopedic diseases and disorders for patients of all ages. The clinical acumen of our faculty is driven, in part, by robust research endeavors that center on expediting soft tissue healing, refining surgical techniques, and advancing nonoperative approaches to treating musculoskeletal conditions.

Treating elite athletes and sports enthusiasts is an extremely rewarding and challenging component of our orthopedic program. We are proud to serve as the Official Hospital and head team physicians for the New York Yankees and the New York City Football Club, as well as for a number of collegiate and high school athletic programs. Our faculty also serve as consultants and in leadership roles for major sports organizations that include the Major League Baseball Team Physicians Association, National Basketball Association, National Football League, and National Hockey League, among others.

Columbia is home to one of the country's oldest and most prestigious orthopedic training programs. Our residents and fellows learn from top orthopedic surgeons and benefit from extensive clinical experiences in all of the subspecialty services. In addition, our dedicated training centers incorporate simulation and in-depth review of videotaped surgeries to enable them to further hone their surgical skills.

In this report, you will also learn about our intensive efforts in maintaining and improving orthopedic quality, safety, and value for all patients who seek our expertise. From a patient's first visit through surgical or nonoperative treatment to healing and recovery, we are committed to providing the highest quality care and achieving outstanding outcomes.

William N. Levine, MD
Frank E. Stinchfield Professor and Chairman
Department of Orthopedics
Columbia University Medical Center
Orthopedic Surgeon-in-Chief
NewYork-Presbyterian/Columbia University Medical Center

Measures of Distinction

CLINICAL CARE

Orthopedic Surgeons
57

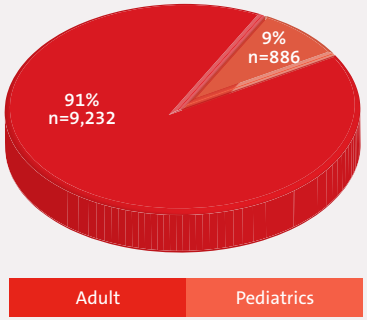
Orthopedic Procedures
10,900

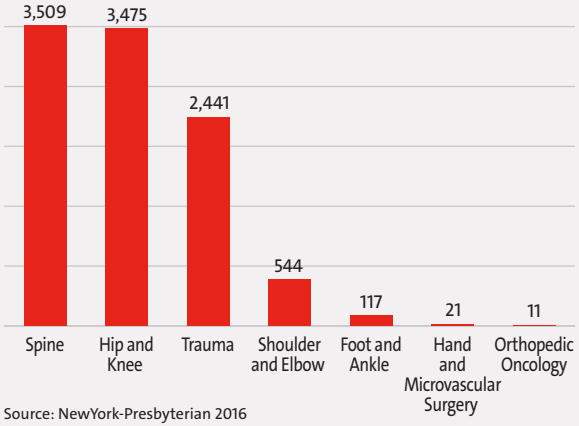
Dedicated Orthopedic Beds
44

Physical Therapy Treatments
>1,000/month

Inpatient Volume 2016

n=10,118





Source: NewYork-Presbyterian 2016
Data: Reflects orthopedic volume at NewYork-Presbyterian

Volume includes orthopedic cases at NewYork-Presbyterian/Columbia, NewYork-Presbyterian Allen Hospital, NewYork-Presbyterian/Weill Cornell, and NewYork-Presbyterian Lower Manhattan Hospital

RECOGNITION

- NewYork-Presbyterian is the **Official Hospital** and our orthopedic surgeons are **head team physicians** for the **New York Yankees** and **New York City Football Club (MLS)**
- The Hospital has **2 State-Designated Trauma Centers** and is verified as a **Level 1 Adult Advanced Trauma Center**

RESEARCH

- **Columbia Orthopedics** received over **$3.3 million** from the **National Institutes of Health** and other organizations
- **15 Columbia researchers** conducted **over 60 clinical trials** in specialties that include spine deformities, bone graft modifications, irreparable rotator cuff repairs, tissue reconstruction for trauma, imaging, and hip and knee arthroplasty

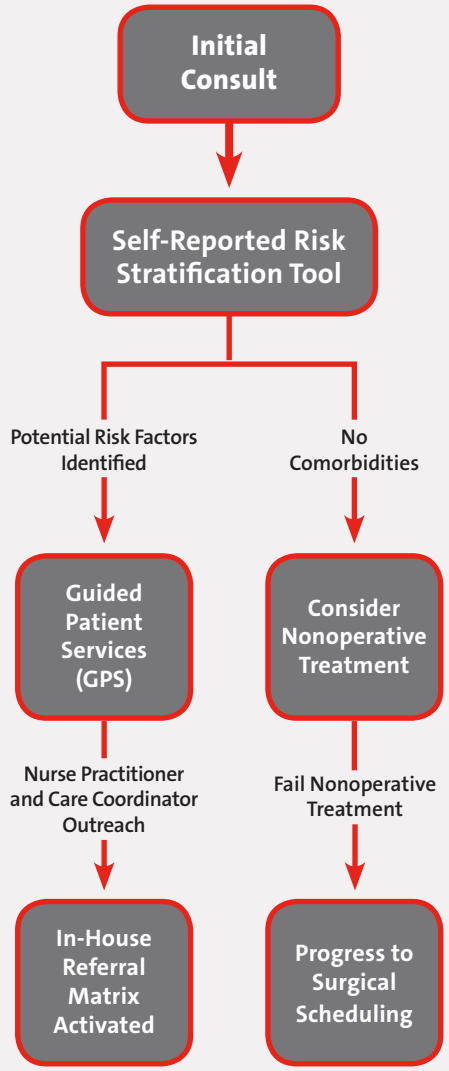
GRADUATE MEDICAL EDUCATION

At NewYork-Presbyterian/Columbia University Medical Center:

- **30 residents** make up the orthopedic surgery residency program
- **9 fellows** participate in fellowship programs in
  - Advanced Spinal Deformity
  - Comprehensive Spine
  - Hand, Elbow, and Microvascular Surgery
  - Hip and Knee Reconstruction
  - Pediatric Orthopedics
  - Shoulder and Elbow
  - Sports Medicine

Quality and Patient Safety Initiatives

Delivering Precision Medicine to Orthopedic Care



Systems-Based Approach to Quality and Safety in Orthopedic Care

Three years ago, the Department of Orthopedics at NewYork-Presbyterian/Columbia incorporated a quality and safety focus as a mainstay of the department's overall vision and strategy with the appointment of **Michael G. Vitale, MD, MPH**, as Chief Quality Officer and now Vice Chief of Quality and Strategy.

Under the leadership of **William N. Levine, MD**, Orthopedic Surgeon-in-Chief, and Dr. Vitale, the department has developed an organizational infrastructure that is transforming orthopedic healthcare delivery. The improvements are driven by a multidisciplinary approach to improving quality, safety, value, satisfaction, and the overall patient experience across adult and pediatric orthopedic subspecialties. The initiatives focus on a number of universal concerns in orthopedic care, as well as on challenges that are relevant to specific procedures. Their work is based on a number of precepts:

Variability Unexplained variability reflects suboptimal care
Infrastructure A chaotic work environment benefits from infrastructure
Group Better decisions are usually made in groups
Data Using data can move the bell curve
Culture Pivot the culture in order to sustain and scale change

"Our processes always involve using best available evidence, harnessing the power of the group, setting goals, working toward those goals, and making the work visible," says Dr. Vitale. "This five-step process is the foundation of what's called lean management, which we have incorporated not only as a quality improvement tool, but also as a management tool for our department."

QUALITY AND SAFETY PRACTICES

- **Risk stratification tools** and **risk severity scores** better **identify patients at highest risk** for surgical complications
- **Surgeon specific dashboards** detail performance for select quality, safety, value, and satisfaction metrics drilled down to the origin of the safety issue **to define actionable data**
- **Comprehensive Unit-Based Safety Program (CUSP)** AHRQ-funded multicenter program **improves patient safety and staff satisfaction** through team building and leadership engagement

Comprehensive Unit-Based Safety Program (CUSP): A Case in Point

The Department of Orthopedics uses the CUSP model to build a culture of teamwork across disciplines and inclusive of physicians, nurses, and other clinical team members with a goal of improving processes in a number of areas. Following is one example of CUSP in action.

CUSP Goal

Perform two spine cases in one day

The spine team set a goal of performing two spine surgeries in patients with adolescent idiopathic scoliosis in one day by 5 pm. The objective was to reduce the total time from the first-case scheduled start to the time the second case wheels out by 20%. A complementary goal was set to increase staff satisfaction by 25%.

Action Plan

After conducting staff interviews and observations, the CUSP team identified and implemented the following opportunities for improvement:

Quick Wins

- Installed whiteboards in the OR
- Working with vendors, OR nurses and scrub techs reduced the number of trays and instruments needed per case by one-third, decreasing the time allocated to opening instrument packs
- Scheduled nurses on the team to arrive earlier

Metrics

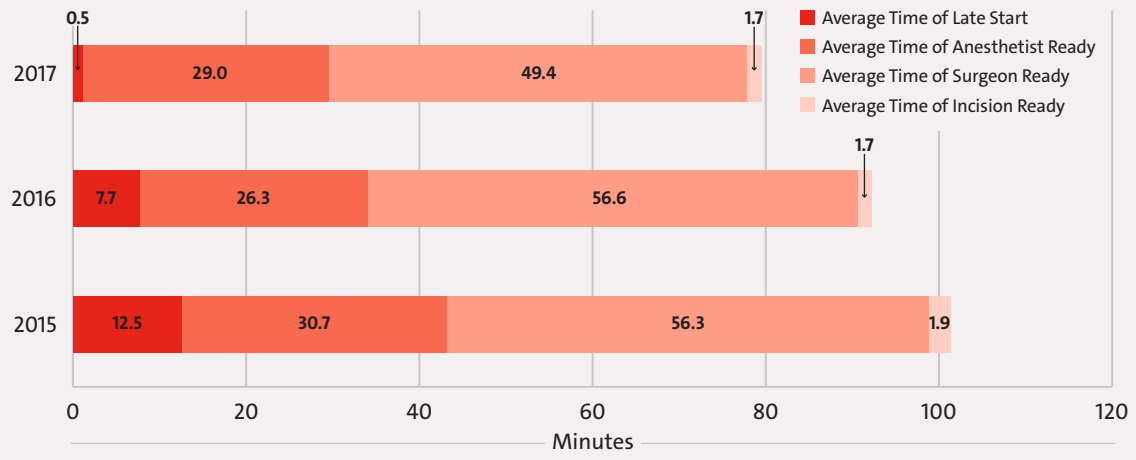
- Adopted a mechanism to track causes of delay
- Tracked time spent in each phase of the OR using swimlanes with timestamps

Results

- Average time of late start was reduced by 96% over a two-year period, with a current average of less than one minute
- Total time to making the incision was reduced by 21% from 102 minutes in 2015 to 81 minutes in 2017
- 35% improvement in OR efficiency versus 2015

Applying CUSP enabled the Department of Orthopedics to **increase OR efficiency** for adolescent idiopathic scoliosis surgery in 2016 by **35%** versus 2015.

Significant Improvement in OR Efficiency for Pediatric Spine Using CUSP



NewYork-Presbyterian Orthopedics

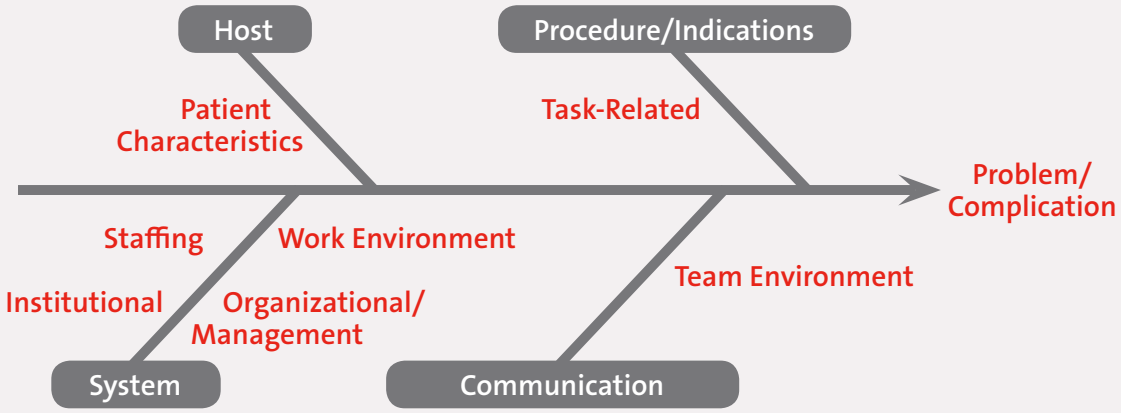
A high reliability organization caring for the most complex adult and pediatric patients while having much lower rates of adverse outcomes than the national average

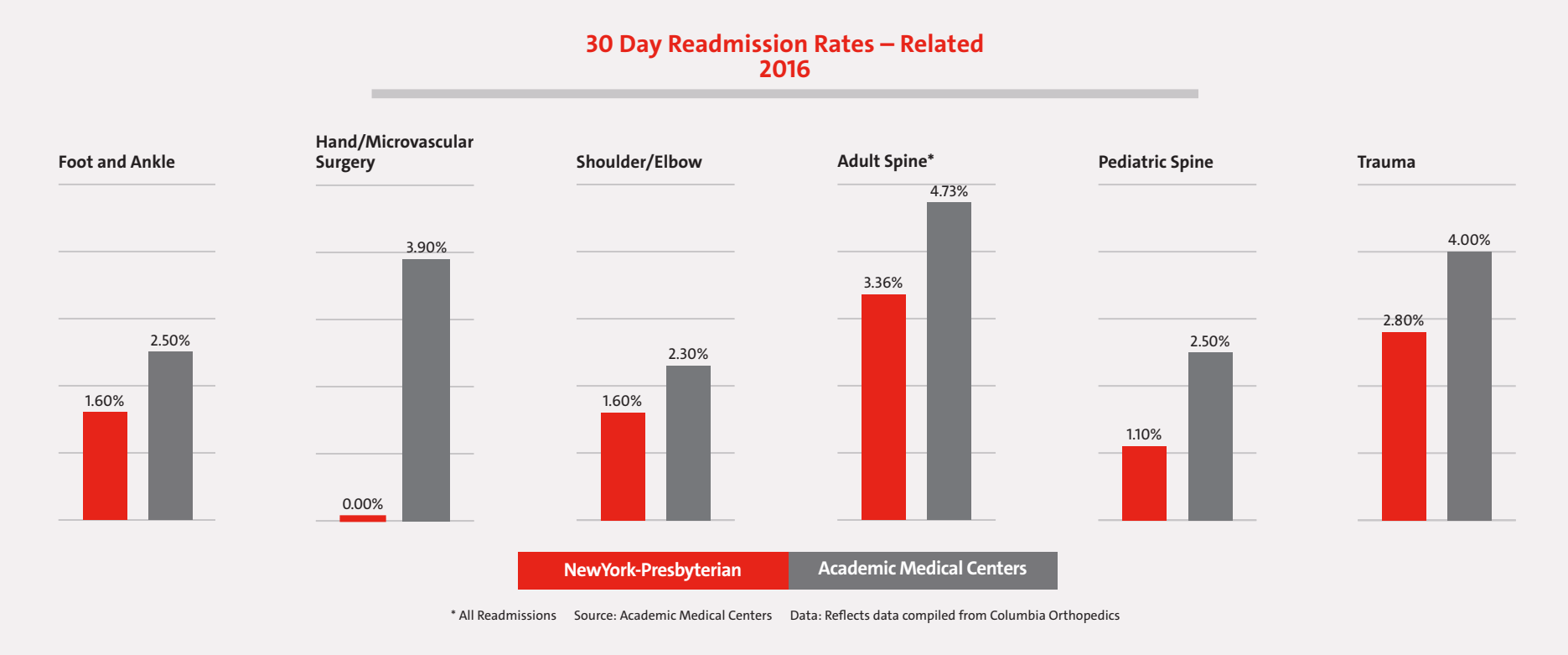
An Alternative Application of the Mortality and Morbidity Conference

In the reorganization of the quality infrastructure for the department, an opportunity materialized to use the monthly Mortality and Morbidity (M&M) conferences of each orthopedic service as a vehicle for department-wide adoption of new practices.

"Medical error is rarely the result of a single, sharp-edge problem and much more often a result of a combination of host, systems, culture, and technique issues," says Dr. Vitale. "Our M&M conferences are now presented in that structured light. In other words, we use a fishbone process where every suboptimal result or situation that occurs in the department is looked at with a lens of what we could have done differently from the point of view of systems, optimization of host, culture, and technique. When you do this you truly realize how complex the healthcare system is, but it also reveals the many opportunities for improving care that go far beyond the intervention and extend to the entire episode of care."

Optimizing Best in Class Outcomes Requires Examination of the Entire System of Care



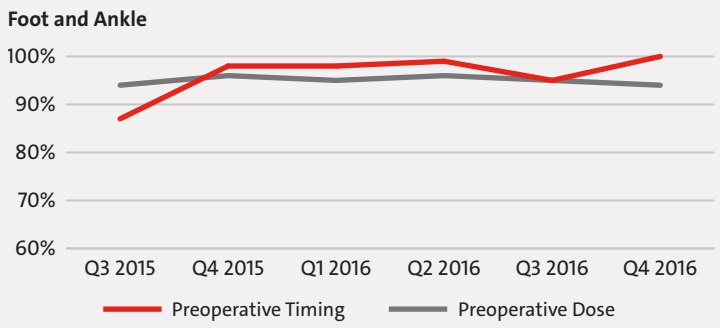


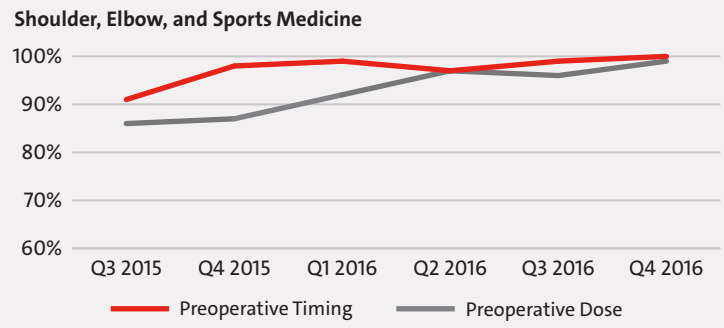
30-Day readmission rates

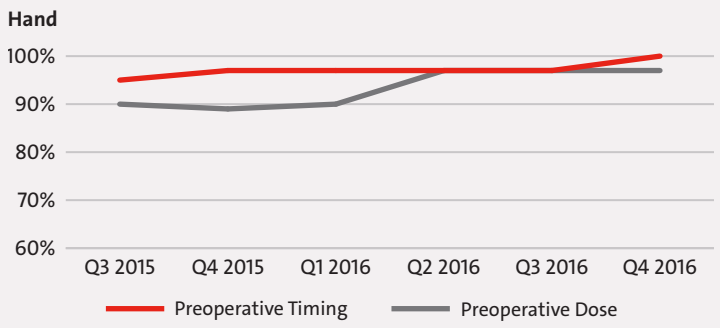
for **every orthopedic service** at NewYork-Presbyterian/Columbia are **below the national average.**

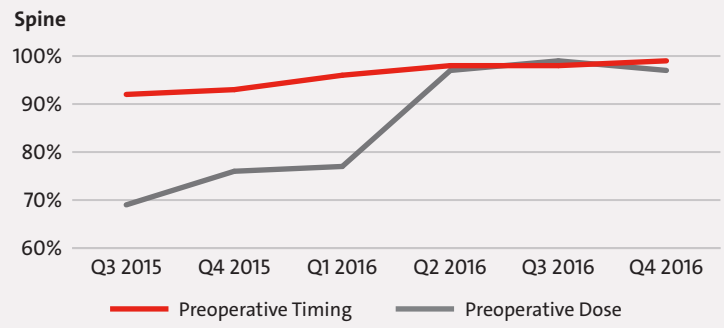
Meeting the Challenges of SSIs

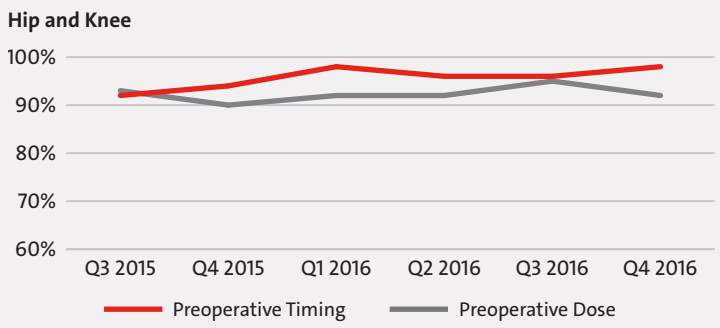
Antibiotic Usage
Q3 2015 - Q4 2016











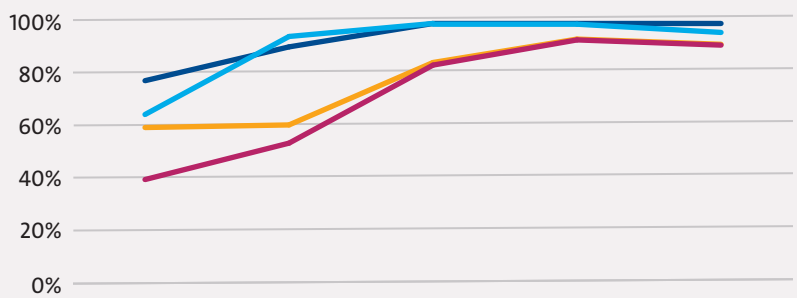
Constant attention and continuous quality improvement allow the Department of Orthopedics at NewYork-Presbyterian/Columbia to function with near 100% reliability.

Source: NewYork-Presbyterian Data: Reflects data compiled from Columbia Orthopedics

> "The quality team began monitoring antibiotic prophylaxis in 2015, displaying results in quarterly surgeon scorecards. Quarter after quarter saw increased compliance and surgical site infections that were far below the expected rates compared to national peers."
>
> — Kevin Wang, MHA

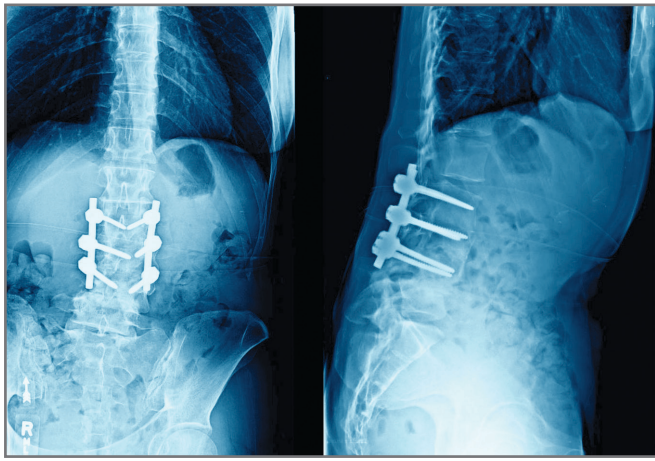
Kevin Wang, MHA
Director, Quality and Value

Spine Fusion SSI Prevention Measures Q1 - Q4 2016

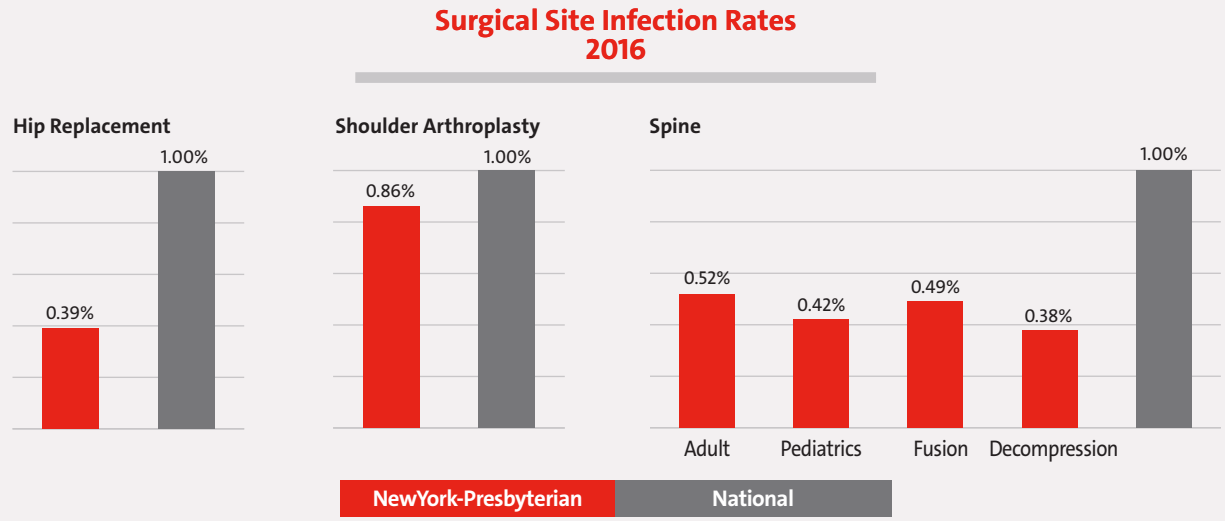


	Baseline (n=124)	Q1 2016 (n=99)	Q2 2016 (n=113)	Q3 2016 (n=83)	Q4 2016 (n=116)
Total Bundle Compliance	40%	54%	84%	94%	92%
Antibiotic Compliance*	60%	61%	85%	94%	92%
Preoperative CHG Use	65%	95%	100%	100%	97%
Intrawound Vancomycin Compliance	78%	91%	99%	100%	100%

*Antibiotic compliance includes timing, weight-based dosing, and re-dosing
Source: United Healthcare Pay-for-Performance Program (AAOS 2016);
Based on Best Practice Guidelines authored at NewYork-Presbyterian/Columbia University Medical Center
Data: Reflects data compiled from Columbia Orthopedics



Quality and Patient Safety Initiatives



Standardized Infection Ratio = Observed/Expected
Source: National Healthcare Safety Network/Department of Infection Prevention and Control
Data: Reflects data compiled from Columbia Orthopedics

We are proud to report that the **surgical site infection rates** of **Columbia Orthopedics** are **far below expected rates** compared to **national peers**.

Safety in Spine Surgery

The nature of spine surgery presents surgeons with its own set of challenges. A number of initiatives are underway at NewYork-Presbyterian to address some of the most pressing issues. These include:

- Dual surgeon approach for high-risk spine cases
- Dedicated intraoperative spine team checklist that details required steps from the preoperative stage to pre-incision, to post-incision and pre-instrumentation, to post-instrumentation
- Reviewing postoperative orders with the spine dedicated ICU team

In addition, our surgeons continue to develop best practices:

Preventing Wrong Level Spine Deformity Surgery Our spine surgeons have introduced a checklist representing a consensus on items to review before and during surgery in order to confirm the correct vertebral level.

Reducing Deep Vein Thrombosis and Pulmonary Embolism The establishment of a multidisciplinary team charged with developing best practices for reducing incidence of deep vein thrombosis and pulmonary embolism has facilitated data assessment and brought wide visibility to and incorporation of the team's goals and efforts. This, in turn, has led to major improvements in quality metrics related to these complications.

Making Surgical Site Infection a Never Event Preventing one single infection has dramatic effects on the patients, their morbidity, quality of life, and family unit. But it also has dramatic effects on healthcare costs. With an aspirational goal to have zero infections, our spine specialists have accomplished tremendous foundational work in this area through the implementation of:

- Preoperative bathing regimen
- Standardized protocols for preoperative and intraoperative antibiotic timing and dosing
- Requirement of new, clean scrubs for each spine case
- Terminal cleaning of ORs

Averting Neurological Problems Employing checklists for responding to intraoperative neuromonitoring changes in patients with a stable spine in the OR prevents major complications from occurring.

Preventing Wrong Level Surgery

PREOPERATIVE

- Use standard vertebral numbering (SDSG); exception: Use C2 (axis) for cervical level counting
- Document the operative plan, including levels, in the preoperative note
- Discuss aberrant anatomy and vertebral level selection at indications conference

INTRAOPERATIVE

- Communicate the preoperative plan, including levels, to OR staff in time-out
- Localize with opaque marker after exposure at level of the pedicle; do not rely on an opaque mark at the level of the skin
- Obtain ideal intraoperative images, including region of interest in center, a known anatomical landmark consistent with preoperative imaging, and orthogonal view
- Consider a radiographic time-out to obtain team consensus on the vertebral levels

IF LEVEL UNCLEAR

- Optimize and/or repeat intraoperative imaging with fluoroscopy or portable X-ray
- Consult another spine surgeon or radiologist

Dr. Michael G. Vitale
Vice Chief, Quality and Strategy

Leading the National Conversation

In addition to his work at NewYork-Presbyterian, Dr. Michael Vitale plays a major role in advancing the national agenda on quality and safety in orthopedic care. He leads the research arm of the Pediatric Orthopaedic Society of North America's Committee on Quality, Safety, and Value and is the Vice President of the Board of Directors for the Children's Spine Foundation, where he also has a leadership role in the Foundation's Children's Spine Study Group.

Preventing SSIs in EOS Surgery Dr. Vitale was a member of a focus group from two multicenter pediatric spine deformity study groups, which developed best practice guidelines for the prevention of SSIs in early onset scoliosis surgery. The guidelines were published in the October 23, 2017, online issue of the *Journal of Pediatric Orthopaedics*.

The Team Approach At NewYork-Presbyterian/Columbia, a large pediatric orthopedic case volume has made possible the development of dedicated teams, for example, a pediatric anesthesia spine team and a pediatric spine ICU that are among the only, if not the only, such specialized teams in the country. In addition, approximately one in four pediatric spine procedures is performed with a pediatric spine neurosurgeon. "Our experience shows that with the most complex cases, having two fully trained surgeons, especially one with a somewhat different experience and perspective, really makes a difference," says Dr. Vitale, who along with his colleagues was invited to author an article entitled, "The Team Approach: How to Achieve Best Outcomes in Pediatric Spine Surgery," for *The Journal of Bone and Joint Surgery*.

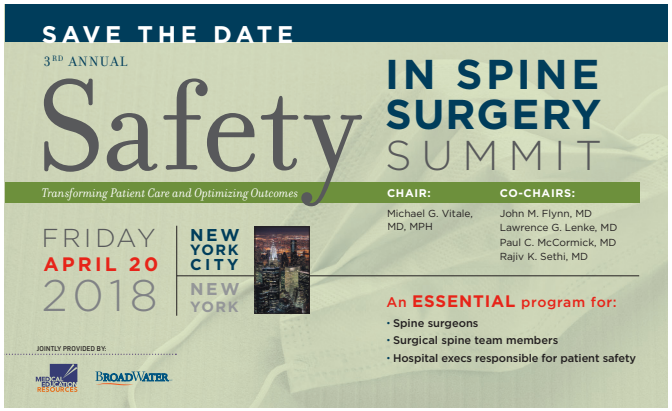
Our spine surgeons are **lead authors** on a number of peer-reviewed journal articles **presenting transformative recommendations** for improving **safety practices** in spine deformity surgery.

Safety in Spine Surgery Summit

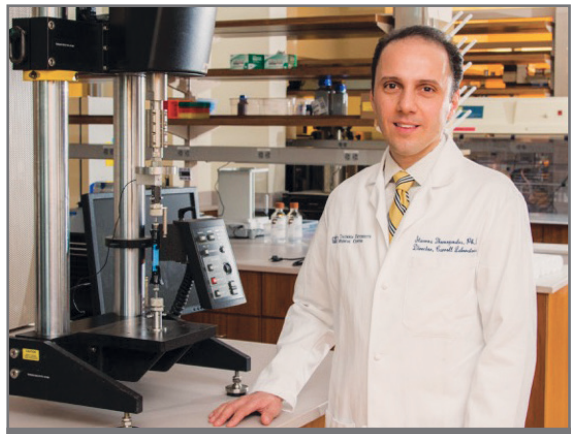
In 2014, Dr. Vitale founded the Safety in Spine Surgery Summit, which has become one of the most sought-after conferences in the field, providing an opportunity for leaders from all over the world to come together and talk about best practices. Most recently, Dr. Vitale has set up the **S³P – Safety in Spine Surgery Project** (safetyinspinesurgery.com), which is linked to the Safety in Spine Surgery Summit, so that continuing education and sharing of best practices in spine care can take place throughout the year.

In February 2017, New-York Presbyterian hosted the 2nd Annual Safety in Spine Surgery Summit for 200 spine surgeons, spine team members, and patient safety leaders from around the country who came together to discuss the numerous safety and quality advances being made in spine surgery for adults and children. The program emphasized that surgical expertise must be combined with strict protocols to minimize complications and to maximize safety. The course agenda was framed around two questions: How will the next patient be harmed? How far will you go to avoid it?

On April 20, 2018, the 3rd Annual Safety in Spine Surgery Summit will be held in New York City. The theme of the program is "Toward New Rules of Engagement for an Increasingly Complex Spine World" and features a keynote lecture on "Team of Teams" by General Stanley A. McChrystal, a four-star general and one-of-a-kind commander with a remarkable record of achievement. General McChrystal is widely praised for revolutionizing the way military agencies interact and operate. He will share his field-tested leadership lessons, stressing a uniquely inclusive model that focuses on building teams capable of relentlessly pursuing results. For more information or to register, visit http://broad-water.com/event/spinesafety/



> "Our efforts are not just here at NewYork-Presbyterian, but really span national organizations and groups that are affected by relationships with payers and which have the desire to exemplify best practices across the country."
>
> — Dr. Michael G. Vitale



Dr. Stavros Thomopoulos
Vice Chair, Basic Research

> "My lab uses developmental biology as inspiration for rebuilding the complex connection between tendon and bone. What we learn can be applied using tissue engineering and regenerative medicine strategies to eventually improve rotator cuff repair in patients."
>
> – Dr. Stavros Thomopoulos

The Department of Orthopedics at Columbia provides an environment in which clinician-scientists and basic scientists collaborate closely with orthopedic surgeons on multidisciplinary musculoskeletal research endeavors, facilitating the link between modern science and clinical care.

Tissue Regeneration: The Holy Grail of Healing

Stavros Thomopoulos, PhD, Vice Chair of Basic Research in the Department of Orthopedics, and Director of the Dr. Robert E. Carroll and Jane Chace Carroll Laboratories for Orthopedic Surgery, is a leader in regenerative medicine. Funded by several NIH R01 grants and an NIH U01 grant, Dr. Thomopoulos and his colleagues are pursuing biologic solutions to solve the challenge of attaching tendon to bone with a particular focus on the most relevant clinical challenge – rotator cuff repair in the shoulder.

Tendon attaches to bone across a specialized tissue called the enthesis. Over the last few decades, with the design of new suturing methods and devices, surgical repair can now create a secure connection of tendon back to bone. However, mechanical fixation is imperfect in the long term due to a scar-mediated response that fails to recreate the structure and composition of the healthy enthesis. Ultimate success lies in biological solutions that regenerate the enthesis to its pre-injury state and maintain this structure through local cell activity.

Dr. Thomopoulos' lab focuses on combining the basic building blocks for regeneration of tissue – a cellular component, signaling factors, and scaffolding. A number of studies are underway examining the developmental biology of the enthesis in order to learn how to drive the regenerative process. Their approach identifies stem cells and growth factors critical for fetal and postnatal development of the enthesis and applies them to repair using tissue engineering approaches.

A Unique Population of Stem Cells Using genetically modified mouse models, Dr. Thomopoulos and his researchers have discovered a particular population of stem cells necessary for building the complex transitional tissue between tendon and bone. By implanting these cells in animal models of tendon-to-bone repair, they are seeking to determine if those unique stem cells – when introduced in an adult healing attachment – will be able to regenerate tissue and provide a solution to the challenge of rotator cuff repair.

The Right Signal The formation of a functional tendon-to-bone attachment requires biologic cues. The researchers are exploring a number of growth factors that stimulate cells, with a particular focus on the signaling factors that promote mineralization and facilitate the formation of a connection between tendon and bone.

A Scaffold for Support In order to move closer to translation of these research ideas into clinical practice, Dr. Thomopoulos and his team are collaborating with biomaterials expert **Helen H. Lu, PhD**, a Columbia

bioengineer, and **William N. Levine, MD**, Orthopedic Surgeon-in-Chief, who have been collaborating to create complex scaffolding materials specifically for tendon-to-bone repair. Together, the three professors are now pursuing developmentally inspired solutions for enhanced tendon-to-bone repair. Their effort combines the scaffolds developed by Dr. Lu and her team with stem cells and growth factors identified by Dr. Thomopoulos and his team in order to drive the regeneration of a healthy enthesis.

Intervertebral Disc Degeneration: A Precision Medicine Treatment Paradigm

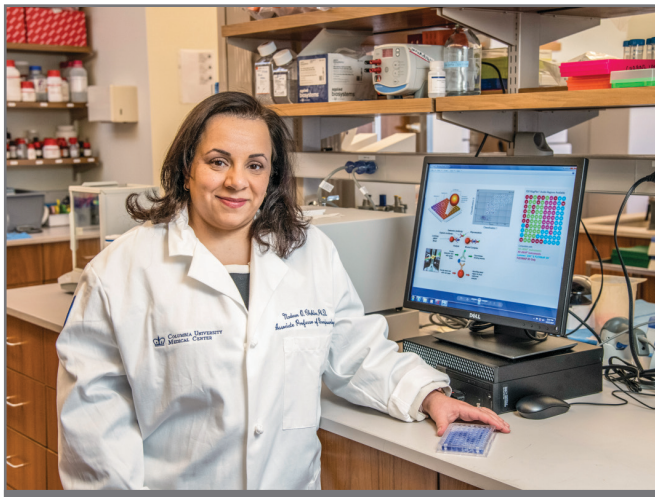
Nadeen O. Chahine, PhD, Associate Professor of Bioengineering in Orthopedic Surgery and Biomedical Engineering at Columbia University Medical Center, pursues research to understand how biomechanics and mechanobiology of cells and tissues cause a healthy spine to degenerate. Dr. Chahine seeks to understand the variability in the response of patients to treatment and what is present in the patient's circulation that is contributing to the disease state. Her goal is to identify biomarkers that stratify patients for treatment – medical or surgical – that will lead to better efficacy and outcomes for those patients.

The Inflammation Hypothesis A major focus of Dr. Chahine's basic research is on the hypothesis that inflammation is a driving force of spinal disc degeneration and associated pain propagation. Her studies have shown that adult patients who have disc disease also have systemic inflammation. Dr. Chahine believes there are consequences of inflammation that are detrimental to mechanical functions of the disc and therefore need to be addressed at the cellular and molecular level.

Predictive Biomarkers In collaboration with spine surgeons and rehabilitation medicine specialists at the Daniel and Jane Och Spine Hospital located at NewYork-Presbyterian Allen Hospital, Dr. Chahine is studying the potential for developing a predictive biomarker of pain and response to treatment. They are looking at patients with lumbar disc herniation whose treatments ranged from epidural steroid injections to surgery. The researchers are evaluating patient reported outcome measures, including severity of pain and level of disability, and modeling this information with levels of biomarkers measured in blood specimens pre- and post-treatment. Based on changes in specific profiles of inflammatory mediators, they are seeking to determine which factors are predictive of change in outcomes. Patients who move on to surgery will continue in the study and all patients will be followed longitudinally up to one year.

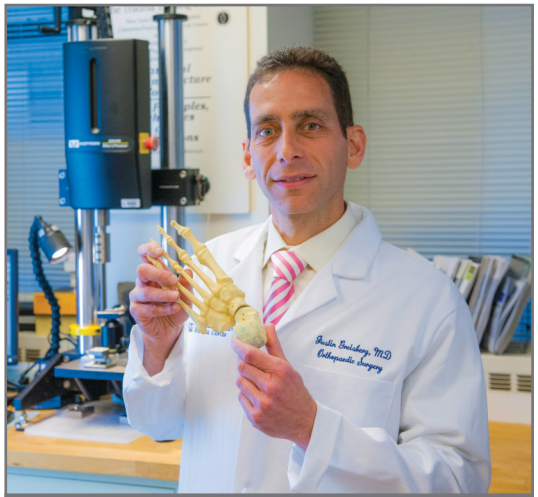
Inflammatory Profiles Dr. Chahine notes that by analyzing inflammatory biomarkers and phenotyping patients based on inflammation, they have already learned that the inflammatory profiles are very different in different kinds of spine conditions. For example, patients who have spinal stenosis and degenerative disc disease have a far higher inflammatory burden in their blood systemically compared to patients who have, for example, disc herniation. And all of the patients with low back pain have inflammatory levels that are far worse than a controlled cohort of patients with no history of back pain.

> "Our studies are identifying biomarkers to accurately predict response to treatment as an augmentation to commonly used spine radiological examinations."
> – Dr. Nadeen O. Chahine



Dr. Nadeen O. Chahine
Associate Professor of Bioengineering in Orthopedic Surgery and Biomedical Engineering

With strict **adherence to protocols**, the Foot and Ankle Service has achieved a **surgical infection rate** of about **1 percent** in the last **2,000 surgeries**.



Dr. Justin K. Greisberg
Chief, Foot and Ankle Service

Optimizing Clinical Outcomes

Always striving to improve surgical outcomes, the Department of Orthopedics has developed standard protocols for minimizing risk of infection. With strict adherence to protocols, the Foot and Ankle Service at Columbia has achieved a surgical infection rate of about 1 percent in the last 2,000 surgeries. This statistic includes patients with significant trauma and comorbidities, which traditionally carry much higher rates of infection.

Acquired Flatfoot

Perhaps the most powerful surgery for correcting the arch collapse in the adult acquired flatfoot is lateral column lengthening. This procedure can bring the arch back without the stiffness that accompanies a hindfoot fusion. With more than 15 years of experience performing this procedure, Columbia surgeons are looking for ways to make this good surgery even better. The standard technique requires structural bone graft from the pelvis. For many years, our surgeons have tried going to the proximal tibia, just above the foot, to avoid the morbidity of iliac crest harvest. When they looked back at their large database of patients, they found that the proximal tibia bone is not as durable. However, they also found that an allograft bone graft worked well and entirely eliminates the morbidity of graft harvesting.

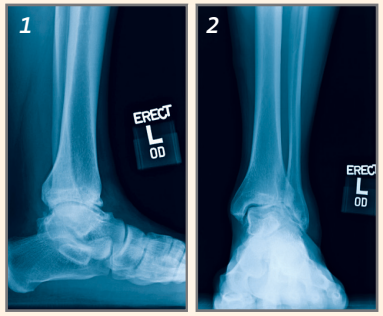
In the Biomechanics Laboratory, Columbia foot and ankle specialists are looking at the ramifications of altering the mechanics of the hindfoot joints with lateral column lengthening. Recognizing that lateral column lengthening is, at its essence, the creation of a second deformity to compensate for the collapsed arch, our surgeons are looking at developing a technique to reconstruct the spring ligament.

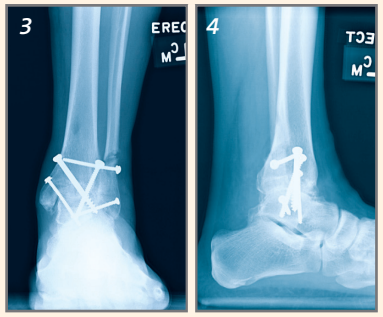
Trauma Sequelae

Many patients with articular fractures develop post-traumatic arthritis despite excellent treatment. Death of chondrocytes in the cartilage may be the cause. Columbia researchers are investigating the mechanisms of chondrocyte death in post-traumatic arthritis and developing strategies to preserve chondrocyte vitality. More than just restoring mechanical alignment, our surgeons are also seeking ways to grow the cartilage and promote recovery from injury.

Accelerating Return to Play

Foot and ankle injuries are some of the most common to sideline an athlete, yet there are no clear standards for determining safe return to competition. To this end, our surgeons have developed a series of ankle “tests” and defined normal ranges of performance. The tests can be performed quickly on the sidelines and do not require pre-injury baseline measurements. They are now developing standardized assessment criteria for return to play.





CASE STUDY

1 and 2

A 55-year-old man had progressive left ankle pain for years. X-rays showed end-stage arthritis with some valgus tilting, but healthy hindfoot joints.

3 and 4

The patient chose to undergo ankle arthrodesis, which healed uneventfully, with good pain relief and good function for years. Ankle morphology (including the fibula) was preserved, which is essential if ever considering conversion to ankle arthroplasty.

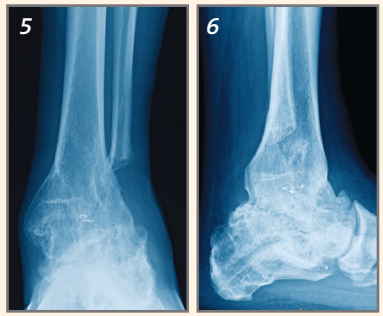
5 and 6

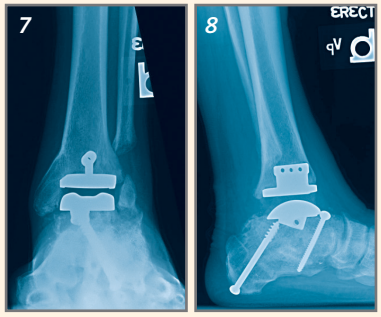
Ten years later, he presented to another institution with lateral hindfoot pain. Several rounds of surgery there left the patient with a segment of fibula resected (for unclear reasons) and a nonunion of a subtalar fusion. He had two failed attempts at subtalar fusion. Subtalar fusions heal well in general, but nonunions are definitely more common in the setting of previous ankle fusion.

7 and 8

With the patient frustrated by the increasing stiffness and pain, we chose for takedown of the ankle fusion and revision subtalar fusion. The resected bone from the ankle arthroplasty provided ample bone graft for the subtalar fusion, and the improved motion spared the talonavicular joint from further stress.

The patient is now three years out from ankle replacement and is back to hiking in the woods recreationally.



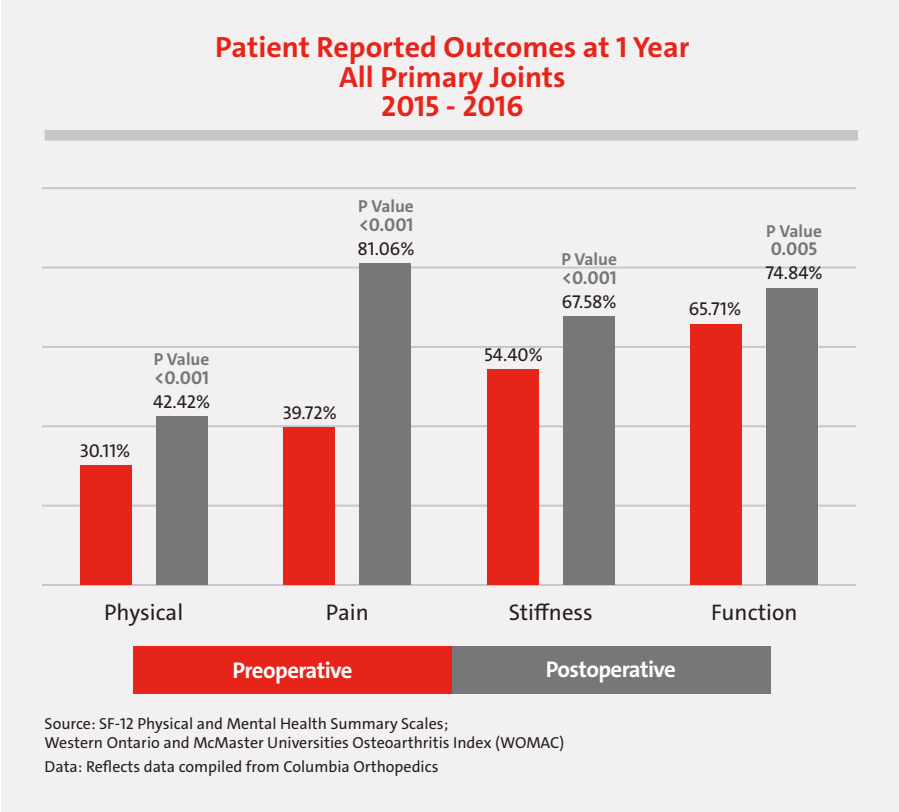


Dr. Jeffrey A. Geller
Chief, Division of Hip and Knee Reconstruction

At one year, our **joint replacement patients** report **postoperative improvements** in pain, stiffness, and function.

Innovative Surgical Techniques

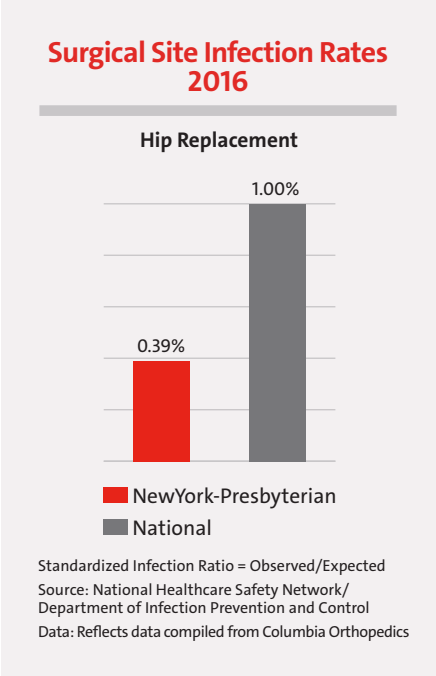
- Our hip arthroplasty specialists have particular expertise in anterior approach hip replacement, a muscle-sparing surgery in which the surgeon makes the incision toward the front of the hip joint. This approach can also facilitate the use of fluoroscopy to ensure the new hip is implanted in an optimal position specific for that patient. Our program performs a much higher percentage of anterior approach hip replacements than anywhere in the greater New York region and has been doing this approach for many years.



- In selected patients, our orthopedic surgeons emphasize natural anatomy-sparing knee replacement surgery that retains the posterior and anterior cruciate ligaments. This technique, while technically more complex than standard knee replacement surgery, potentially allows for a more stable and natural feel to the knee than is experienced with conventional techniques. They are currently participating in a multicenter trial to gauge the success of this approach and patients' ability to maintain full joint stability and a return to sports and normal living activities more quickly.
- To mitigate pain in joint replacement surgery – particularly in the knee – our orthopedic surgeons use a range of novel pain management approaches, including commencement of pain medication just prior to surgery followed by a combination of innovative nerve blocks and local anesthetics. Our team of experts place high priority on preventing pain before it starts to enable our patients to get up and resume walking immediately.

Research Highlights

- A study by Columbia surgeons published in the August 9, 2017 issue of the *Journal of Orthopaedics* showed that patients with isolated compartment radiographic disease but with bicompartmental symptoms can benefit from unicompartmental knee arthroplasty and simultaneous arthroscopy.
- Publishing widely on clinical outcomes and complications of hip and knee replacements, Columbia orthopedic surgeons have a particular focus on the diagnosis and management of periprosthetic joint infection, implant loosening, bearing surface wear, and osteolysis, as well as periprosthetic fractures. Their expertise on corrosion at modular junctions in total hip arthroplasty and the body's reaction to metal wear debris is frequently presented at national and international orthopedic meetings.
- In a study evaluating the use of an electronic sensor device during trialing of total knee arthroplasty, Columbia surgeons demonstrated improved ligamentous balancing with a statistically significant reduction in the rate of manipulation under anesthesia for patients with early arthrofibrosis. Results were published in the May 2017 issue of the *Journal of Arthroplasty*.



Our **surgical site infection rate** for **hip replacement** is **60% less** than the national benchmark.

Dr. Lawrence G. Lenke
Chief, Spine Division
Surgeon-in-Chief
Daniel and Jane Och Spine Hospital

Dr. K. Daniel Riew
Co-Chief, Spine Division
Director, Cervical Spine Surgery

Dedicated Facility for Spine Treatment

The Daniel and Jane Och Spine Hospital at NewYork-Presbyterian Allen Hospital provides an integrated, multidisciplinary approach to the treatment of spine disorders. Here, renowned orthopedic spinal surgeons, physiatrists, and pain management specialists offer comprehensive care for patients in a single facility, ensuring the coordination of all aspects of preoperative, intraoperative, and postoperative treatment. The Daniel and Jane Och Spine Hospital features:

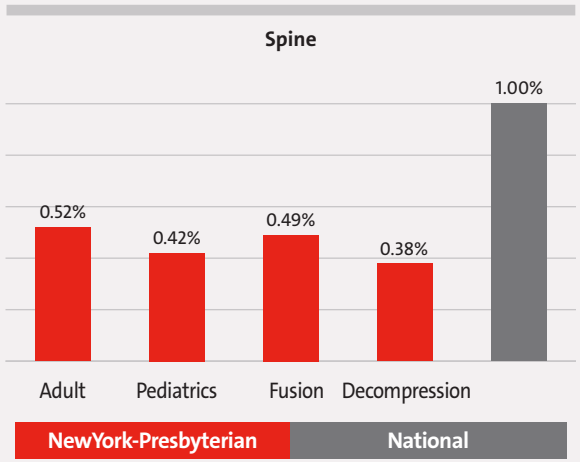
- 5 operating rooms custom built for spine surgeries
- ICU beds attended by spine-specific intensivists
- Low radiation technology for imaging the entire skeleton
- Robotics system
- Real-time OR video feed to observation rooms

Progressive Techniques and Technologies

- Our surgeons are trained in the most advanced, least-invasive surgical techniques, including microsurgical and endovascular options. For the most complex spinal deformity surgeries – many of which can be performed at only a few hospitals in the world – they use CT imaging data to create 3-D models that they can use before surgery in order to precisely plan the placement of screws and other aligning instruments.
- Robotic technology is now being used as a tool to enhance positioning accuracy, minimize invasiveness, and reduce radiation exposure to the patient and surgical team during spine surgeries. The bone-mounted, miniature robotic system guides the accurate placement of implants, offering surgical tool guidance while leaving the actual procedure in the surgeon's hands.

Visiting surgeons from **all over the world** come to the **Daniel and Jane Och Spine Hospital** to benefit from **training by expert surgeons** with the knowledge, technique, and resources to treat the **most complex disorders and deformities**.

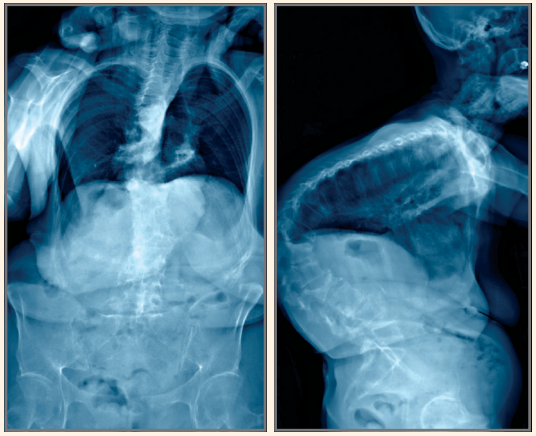
The **surgical site infection rate** on average for adult and pediatric **spine procedures** is **less than 50%** of the **national baseline.**

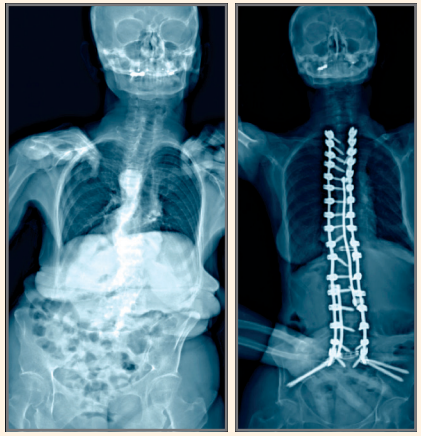


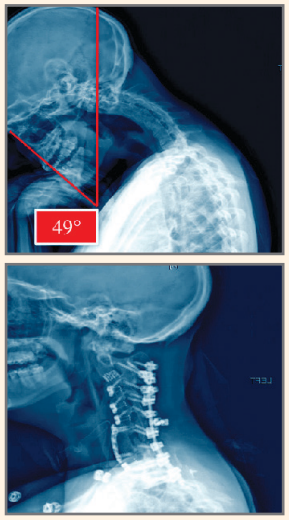
Standardized Infection Ratio = Observed/Expected
Source: National Healthcare Safety Network/ Department of Infection Prevention and Control
Data: Reflects data compiled from Columbia Orthopedics

CASE STUDIES

A patient presented with severe kyphosis due to multilevel osteoporotic compression fractures. She was treated with posterior spinal instrumentation and fusion from T2-sacrum with a T11 vertebral column resection in a nine-hour surgery.



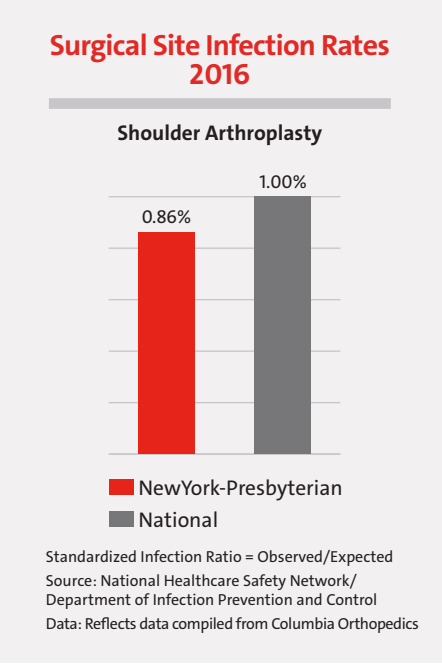




A 28-year-old female with a seven-year history of kyphoscoliosis and dystonia also presented with psoriatic arthritis, ankylosing spondylitis, and cervical dystonia. A three-hour anterior surgery was first performed followed by asymmetric osteotomies to correct the scoliosis at C3-4-5-6-7-T1, with anterior fusion from C2-T1. Posterior osteotomies were then performed in a more than five-hour surgery at all the same levels with a fusion from C2-T2.

The patient is now ambulating normally and expected to resume all normal activities better than she could preoperatively since her alignment is now nearly normal.

Dr. Christopher S. Ahmad
Chief, Sports Medicine



Surgical Expertise

- Our surgeons have particular expertise in femoroacetabular impingement, incorporating preoperative three-dimensional CT that allows for accurate mapping of the joint to localize the range of motion and source of impingement. This enables them to precisely recontour the ball and socket and reattach the labrum using advanced arthroscopic techniques.
- Our sports medicine specialists are experts in ulnar collateral ligament reconstruction, more commonly referred to as Tommy John surgery. They have also developed a technique for repair when the UCL is intact but is torn off a landmark. In this instance they use an internal brace that helps suture the ligament back to the bone. The native ligament is used and no other tissues are needed to perform the surgery.

A Focus on Elite Athletes

- Our physicians and surgeons have extraordinary expertise in treating injuries of elite professional athletes and serve as head team physicians and provide medical coverage for professional and collegiate teams that include the New York Yankees, New York City Football Club (MLS), and Rockland Boulders.
- **Christopher S. Ahmad, MD**, serves as President of the Major League Baseball Team Physicians Association, and **William N. Levine, MD**, serves as a consultant to both the National Football League and the National Hockey League Players' Association.
- Our long-established concussion program comprises highly experienced sports injury specialists in orthopedics, neurology, and neuropsychology, as well as the head athletic trainer for Columbia University varsity athletics. Our specific expertise and experience, along with results of cognitive, balance, and neuro-psychological testing, are key to determining when an athlete can safely return to play.

Advances in Shoulder Arthroplasty

Our surgeons have led the way in shoulder arthroplasty dating back to the early days of Dr. Charles Neer. Revered as the "father of modern shoulder surgery," Dr. Neer founded Columbia's original Shoulder Service in the 1950s. Dr. Neer's contributions include the first total shoulder replacement, the classification system for proximal humerus fractures, and the acromioplasty procedure for impingement syndrome.

Now, under the leadership of Dr. William N. Levine, Chief of the Shoulder Service, Dr. Christopher S. Ahmad, **Dr. Charles M. Jobin**, and Dr. Levine continue to lead research and product design efforts to minimize pain, improve patient safety and outcomes, and increase durability of shoulder prostheses. The implementation of a multimodal pain management program by our surgeons has led to a dramatic decrease in postoperative pain following shoulder replacement surgery.

Wrist Denervation

Our specialists in hand, elbow, and microvascular surgery routinely perform wrist denervation as a palliative approach to managing chronic wrist pain and as an adjunct to other procedures. This technique has evolved from more extensive denervations to more limited approaches preferred by our physicians.

Wrist denervation can delay or eliminate the need for more invasive and functionally limiting salvage procedures. Pain relief is achieved by resecting the nerve fibers that conduct pain from the wrist joint without interfering with any function of the hand. The wrist is protected in a splint for three to four weeks, and recovery of functional tasks is much easier than after traditional salvage wrist procedures, which distort the anatomy. A successful outcome is an 80 percent pain decrement, which results in high patient satisfaction rates.

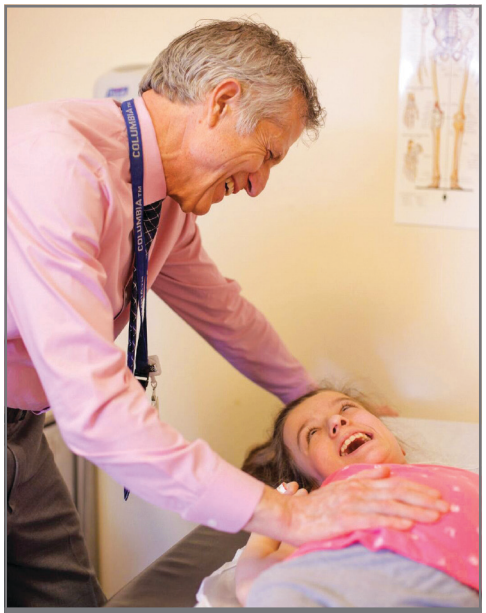
Device Development

Our physicians have pioneered innovative solutions through medical technologies that are advancing the field of hand, elbow, and microvascular surgery and improving quality of life for patients.

- Under development is a new device for simpler, stronger, and faster tendon repairs that uses stapling instead of standard suture-based techniques. Advantages of stapling repair include greater strength with less bulk that enhances tendon gliding and can permit earlier active motion rehabilitation, thereby lessening adhesion formation and repair failure. Strength of repair with a device that minimizes the potential for flexor tendon adhesions and the need for secondary surgery for tenolyses may increase the likelihood for successful repair of flexor tendons in the hand.
- Current treatments for osteoarthritis of the thumb and fingers relieve pain but fail to restore full function and strength for patients. Our physicians and bioengineers, in collaboration with the Columbia Biomedical Technology Accelerator, have developed an implantable osteochondral allograft, which is curved to mimic the normal curvature of the joint. The cartilage replacement – called Cartibend ™ – may prove to be a true joint replacement in this common condition and replace the standard procedure of just resecting the arthritic bone.

Dr. Melvin P. Rosenwasser
Chief,
Hand, Elbow, and Microvascular Surgery

Our program in **infantile casting**, one of the largest in the region, treats a large number of children **under 18 months of age**. The majority of these infants have their **scoliosis cured**.



Dr. David P. Roye, Jr.
Co-Director, Pediatric Orthopedics

Spine and Scoliosis

Our pediatric orthopedic surgeons have long employed techniques and developed technologies in the treatment of early onset scoliosis (EOS) and adolescent idiopathic scoliosis (AIS) that have dramatically improved outcomes.

- Our surgeons were among the first in the country to correct EOS using magnetic technology, a noninvasive alternative to traditional growing rods. The MAGEC® (MAGnetic Expansion Control) device allows surgeons to straighten and correct the spine gradually using a remote-controlled device.
- The Conservative Care for Spine and Scoliosis clinic specializes in the nonoperative treatment of scoliosis, kyphosis, and spine deformity throughout the lifespan.
- Columbia physicians and physical therapists are also involved in a multicenter study of physiotherapeutic scoliosis-specific exercises to assess their benefit for individuals with small curves in slowing the progression of scoliosis.

Adolescent Sports Medicine

- Our program in adolescent sports medicine emphasizes osteochondral allograft transplantation surgery (OATS) and ACL surgery that respect the growth plate and physis and employs the MacIntosh extra-articular knee stabilization procedure for skeletally immature patients.
- Specialization has been linked to overuse injuries, burnout, and decreased satisfaction. The results of a study by Columbia physicians of collegiate athletes at Fordham University and Columbia University about factors that influenced their age of specialization in team or individual sports found that young athletes are increasingly specializing in a single sport before starting high school. The results were published in the November/December 2017 issue of *Sports Health*.

Cerebral Palsy

The Weinberg Family Cerebral Palsy Center is the first program on the East Coast dedicated to transitional care for children with childhood-onset neuromotor disabilities. The Center is one of the first in the country to establish a Cerebral Palsy Patient Registry. Through research made possible by the registry, Columbia physicians have identified that cervical spinal stenosis is eight times more common and occurs two decades earlier in patients with CP, and therefore they recommend that patients with CP be screened with MRI and CT.

In 2017, **Wakenda K. Tyler, MD, MPH**, was named Chief of the Orthopedic Oncology Service, bringing expertise in the treatment of benign and malignant tumors that leverages the latest advances in nonoperative therapies and minimally invasive and reconstructive surgical techniques. Under Dr. Tyler's leadership, the service specializes in the diagnosis and management of primary soft tissue and bone cancers, sarcomas, and metastatic bone cancer in children and adults. The strength of the program lies in a multidisciplinary approach for the care of each patient in which orthopedic surgeons collaborate with medical and radiation oncologists to determine and carry out the optimal course of treatment.

Targeted Therapies

Dr. Tyler and her colleagues are pursuing targeted therapy for patients requiring chemotherapy. Genetic testing is conducted on malignant tumors and some benign tumors to identify the genetic abnormality within that tumor that will allow our physicians to target it with some of the newer therapeutic agents being developed. Collecting these gene analyses will enable them to identify specific genes in the future that either allow for a good response or a poor response to therapy and then potentially alter therapy with greater precision based on that analysis.

Research Pursuits

- For patients with metastatic disease to the bone, many of the current therapies do not work. Dr. Tyler and her colleagues are currently looking at antiangiogenic and anti-vascular tumor therapies to block tumor angiogenesis in the bone, with a goal to restrict the blood supply to those tumors and inhibit the cancer cells from spreading. They are also studying the effect of the bone environment on these cancer cells that makes them impervious to chemotherapy. For a variety of reasons, the bone environment allows cancer to grow, rather than allowing the chemotherapy to have the same impact on the cells as it does in other parts of the body.
- Other research interests focus on conditions that lead to osteolysis, as well as the effectiveness of medication in penetrating the site of bone grafts and strengthening the bone and prosthesis union.

Dr. Wakenda K. Tyler
Chief, Orthopedic Oncology

42
CLINICAL TRIALS

In 2016, Columbia University Medical Center opened 42 clinical trials across both pediatric and adult sarcoma programs. More than 1,150 visits were made for this rare cancer that grows in connective tissue.

CASE STUDY

A 45-year-old man struck by a car sustained a closed left femoral shaft fracture. He was treated at a regional trauma center with intramedullary nailing. One year after injury, he presented to our trauma experts at NewYork-Presbyterian/Columbia with ongoing left thigh pain. Although X-rays suggested healing and the patient was told his fracture had healed, CT scan showed a nonunion.

On exam, the patient had a large soft tissue fluid collection on the left lateral thigh consistent with a Morel-Lavallée lesion. Once the nonunion was identified by CT, the surgical plan for exchange nailing was straightforward. However, the huge cystic soft tissue lesion was more challenging.

In surgery, an exchange nailing with reaming was performed, bringing the nail up 2mm in diameter. A huge fluid collection was seen, debrided, and sutured closed over a drain. Both the nonunion and the Morel-Lavallée lesions healed quickly after revision surgery. Postoperative X-ray at one year shows excellent bone healing. The patient has resumed his career as a construction contractor.

Protocol-Based Management for Geriatric Hip Fracture

A multidisciplinary team with representatives from orthopedics, anesthesiology, geriatrics, nursing, physical therapy, and social work is establishing a standardized protocol in the management of hip fracture in the elderly to be implemented throughout NewYork-Presbyterian. Recommendations include expediting surgery within 24 to 48 hours of presentation and using anterior approach hip arthroplasty for displaced femoral neck fractures that minimizes soft tissue damage, allowing patients to mobilize more quickly.

Medical-Orthopedic Trauma Service

Through its Medical-Orthopedic Trauma Service (MOTS), NewYork-Presbyterian continues to serve as a model to ensure optimal outcomes for geriatric patients with hip fractures. MOTS, an innovative partnership between the Department of Medicine and the Trauma Service at NewYork-Presbyterian/Weill Cornell Medical Center, is designed to improve care through a coordinated plan of treatment involving orthopedic surgeons and general internists, as well as orthopedic and medical house staff, nurse practitioners, physician assistants, social workers, physical therapists, and nursing staff. Their goal is to operate on the patient swiftly to minimize the risk of hip fracture disease, as well as to identify and manage all other medical and social issues that may have contributed to the fall.

Trauma Training Center

Established 25 years ago by **Melvin P. Rosenwasser, MD**, the Trauma Training Center at Columbia draws orthopedic surgeons and researchers from around the world to learn principles and techniques from our trauma specialists. The Center also serves as a research laboratory for orthopedic trauma, hand, and upper extremity surgery, and has been enormously successful at conducting prospective and retrospective clinical studies and clinical and biomechanical basic science research with the goal of developing new surgical techniques to optimize outcomes for injured patients.

Columbia Orthopedics

William N. Levine, MD
Frank E. Stinchfield Professor and Chairman
Department of Orthopedics
Columbia University Medical Center
Orthopedic Surgeon-in-Chief
NewYork-Presbyterian/Columbia University Medical Center

Foot and Ankle
Justin K. Greisberg, MD
Chief
J. Turner Vosseller, MD

Hand, Elbow, and Microvascular Surgery
Melvin P. Rosenwasser, MD
Chief
R. Kumar Kadiyala, MD, PhD
Susanne M. Roberts, MD
Robert J. Strauch, MD

Hip and Knee Reconstruction
Jeffrey A. Geller, MD
Chief
H. John Cooper, MD
Ohannes A. Nercessian, MD
Roshan P. Shah, MD, JD

Orthopedic Oncology
Wakenda K. Tyler, MD, MPH
Chief

Pediatric Orthopedics
David P. Roye, Jr., MD
Co-Director
Michael G. Vitale, MD, MPH
Co-Director
Joshua E. Hyman, MD
Charles A. Popkin, MD
Lauren H. Redler, MD
Benjamin D. Roye, MD, MPH
Christen M. Russo, MD

Shoulder, Elbow, and Sports Medicine
William N. Levine, MD
Chief, Shoulder Service
Christopher S. Ahmad, MD
Chief, Sports Medicine
Nicole S. Belkin, MD
Charles M. Jobin, MD
T. Sean Lynch, MD
Charles A. Popkin, MD
Lauren H. Redler, MD
George J. Zambetti, Jr., MD
Primary Care Sports Medicine
Thomas S. Bottiglieri, DO
Natasha N. Desai, MD
Elan L. Goldwaser, DO
Benjamin L. Oshlag, MD

Spine
Lawrence G. Lenke, MD
Chief
K. Daniel Riew, MD
Co-Chief
Michael G. Vitale, MD, MPH
Chief, Pediatric Spine and Scoliosis Surgery
Marc D. Dyrszka, MD
Yongjung (Jay) Kim, MD
Ronald A. Lehman, Jr., MD
Mark Weidenbaum, MD

Trauma
Jeffrey A. Geller, MD
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R. Kumar Kadiyala, MD, PhD
Ohannes A. Nercessian, MD
Melvin P. Rosenwasser, MD
J. Turner Vosseller, MD
George J. Zambetti, Jr., MD

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Vice Chair, Basic Research
Nadeen O. Chahine, PhD

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Sports Therapy
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Rommel Dolar, PT, DPT
Joscelyn Shumate, PT, DPT
Adrian Yenchak, PT, DPT
Schroth Therapy
Prachi Bakarania, DPT
Hagit Berdishevsky, PT, MSPT, DPT, MDT
Kelly Grimes, DPT

NewYork-Presbyterian Today

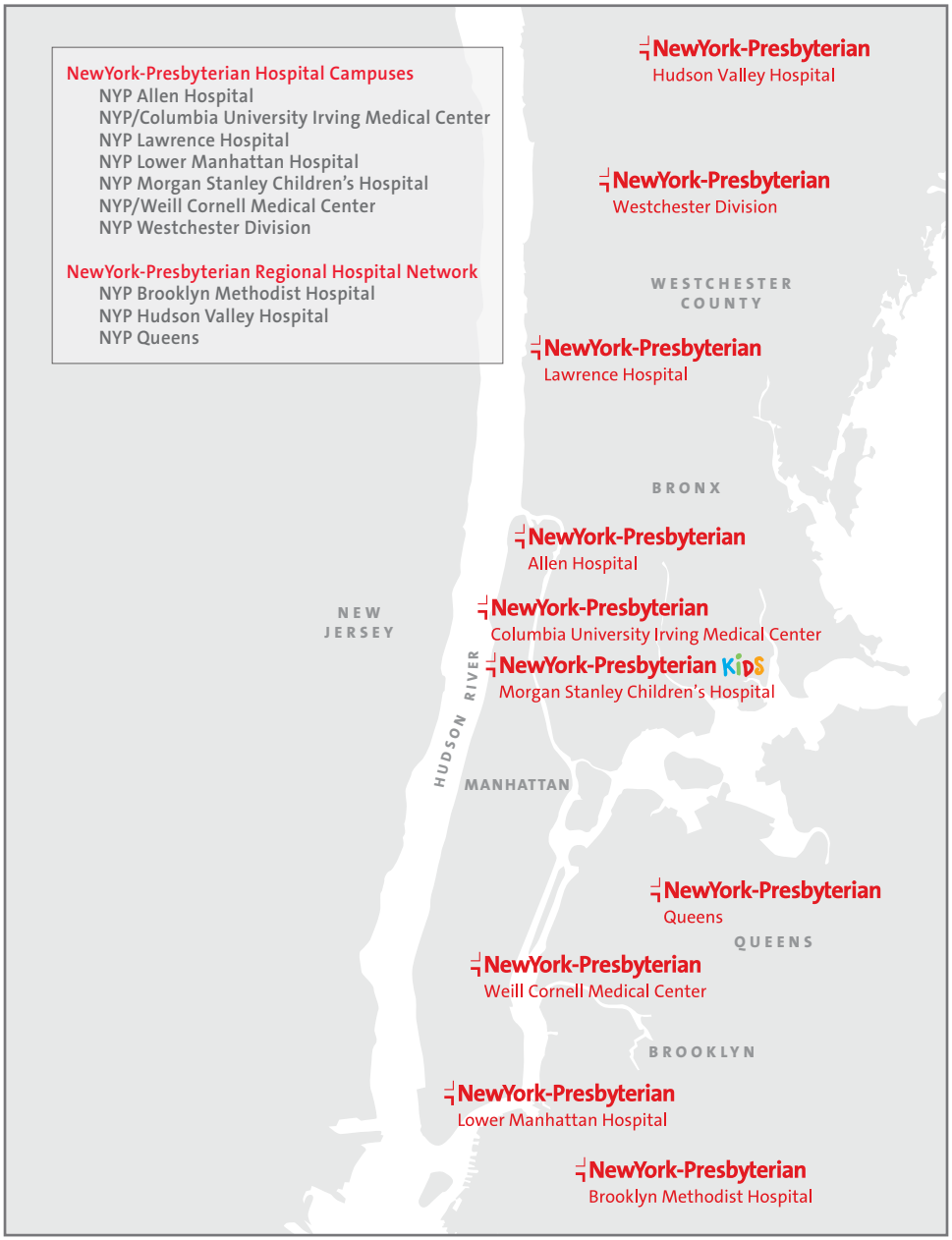
New York's #1 Hospital
17 Years in a Row

Two decades ago, on January 1, 1998, The New York Hospital announced its full-asset merger with The Presbyterian Hospital to create NewYork-Presbyterian Hospital. In this unprecedented event, two world-class academic healthcare institutions combined to become one of the highest quality medical, teaching, and research institutions in the country. Each hospital shared illustrious histories as providers of exemplary healthcare services, having made innumerable contributions to the field of medicine. The merger resulted in an improved quality of healthcare provided to patients, enhanced availability of clinical services to an expanded population, and lowered costs of services through improved efficiencies.

Today, NewYork-Presbyterian is one of the nation's most comprehensive, integrated academic healthcare delivery systems dedicated to providing the highest quality, most compassionate care and service to patients in the New York metropolitan area, nationally, and throughout the globe. In collaboration with two renowned medical schools, Weill Cornell Medicine and Columbia University Medical Center, NewYork-Presbyterian is consistently recognized as a leader in medical education, groundbreaking research, and innovative, patient-centered clinical care.

NewYork-Presbyterian has four major divisions:

- NewYork-Presbyterian Hospital is ranked #1 in the New York metropolitan area by *U.S.News and World Report* and repeatedly named to the Honor Roll of "America's Best Hospitals."
- NewYork-Presbyterian Regional Hospital Network comprises hospitals and other facilities in the New York metropolitan region.
- NewYork-Presbyterian Physician Services connects medical experts with patients in their communities to expand coordinated healthcare delivery across the region. It includes the NewYork-Presbyterian Medical Groups in Westchester, Queens, and Brooklyn, which increase access to primary care in collaboration with Weill Cornell Medicine Physicians and ColumbiaDoctors, which deliver specialty care.
- NewYork-Presbyterian Community and Population Health encompasses ambulatory care network sites and community healthcare initiatives, including NewYork Quality Care, the Accountable Care Organization jointly established by NewYork-Presbyterian Hospital, Weill Cornell Medicine, and Columbia University Medical Center.



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Weill Cornell Medicine | NewYork-Presbyterian | Columbia University Medical Center