Expanding Our Footprint

Recently we grew our Pulmonary Division by adding three excellent physicians (Dr. Aarti Grover, Dr. Marianne Barry, and Dr. Maureen Dziura) in order to accommodate our burgeoning relationship with Lowell General Hospital. Our Pulmonary Division is now providing coverage for their recent expansion of their ICU (from 12 beds to 23). This expanded coverage is in addition to coverage our physicians already provide at their affiliated hospital, Saints Medical Center. As more and more of these relationships develop and as we continue to nurture our affiliations with NEQCA and Hallmark Health, it got me thinking about how much we really have expanded the Department of Medicine’s footprint beyond the main campus. Take a look at the list (right) of all the off-campus care we are providing in the various divisions of Medicine. These relationships are not only enhancing our reputation in the referring provider community, but it is also elevating the quality of care available to those outside of Boston. I continue to be excited about our growth to date, but I am even more excited about the growth I know we will continue to experience in the future.
Members of the Department continue to be active in important Quality Improvement initiatives.

1. **Pain and Addiction Agreement**
   
   Our attendings, residents, and nurses report spending increasing time addressing pain and patient safety for those with addiction disorders. To address these issues, Alyssse Wurcel, MD (Infectious Disease) and Kimberly Schelling MD (Primary Care) have shown great leadership by piloting a project in the Proger and North 7 in-patient units to address the Opioid Crisis. The Agreement discusses pain management, visitor policy, leaving the floor and search policy.

   The Goals of the Agreement:
   
   • Increase safety to patients and visitors
   • Reduce unsafe practices
   • Reduce length of stay
   • Reduce stress on MDs, residents and staff

   Drs. Wurcel and Schelling continue to evaluate the use of the Agreement and obtain feedback from clinicians, as we roll out the project to all medicine services and floors. Thanks to Amy Lund RN, the nursing staff, security, and the Opioid / Addiction Task Force for help and input.

2. **Oral Chemotherapy Adherence**
   
   Jack Erban MD, Director of Quality improvement for the Division of Hematology/Oncology has developed an Oral Chemotherapy Adherence initiative. With an increasing number of chemotherapeutics available in oral forms, there is an increased need to monitor their use and adherence. Working with Doug Hackenyos from Pharmacy, oral chemotherapy care plans are created in the electronic medical record in order to improve patient education and adherence monitoring, and increase patient affordability by tracking insurance authorizations and decreasing copays. This project will provide a number of best practices for ambulatory care for other disorders.

3. **On-Time Starts in Endoscopy**
   
   Kathleen Viveiros, MD in the Gastroenterology Division presented her quality work to improve On-Time Starts in Endoscopy. The project seeks to improve the number of on-time starts for first cases of the day.

   The Goals for this project included:
   
   • Improvements in both patient and provider satisfaction
   • Reduce staff overtime costs.
   • Decrease length of stay for in-patient cases.

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**LENGTH OF STAY (LOS) and EARLY DISCHARGES**

Over the past several months the Department of Medicine has made some superb progress on discharging patients sooner and decreasing the costs overall for an inpatient stay. The current LOS for all Medicine patients is just under 5 days, which puts us nationally in the 90th percentile for performance! We measure LOS versus what the industry (other academic medical centers) says is the “expected” length of stay for a patient’s condition, based on their DRG. A LOS “index” rating of 1 means we are discharging patients in the expected timeframe. An index of <1 means we are performing better than the academic medical center expectation. Currently the Department of Medicine LOS Index rating is 0.88. A testament to all the hard work our inpatient services have been putting into discharging patients sooner.

Thanks to all the attendings, housestaff, nurses, and case managers who have remained keenly focused on this important metric.

<table>
<thead>
<tr>
<th>Overall Medicine Service Lines</th>
<th>Number of Discharges from this Service to Date this Year</th>
<th>Average Length of Stay</th>
<th>Average Expected Length of Stay (based on case-mix index)</th>
<th>Difference between Average and Expected (&lt;0 is better)</th>
<th>Length of Stay Index (&lt;1 is better)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI</td>
<td>483</td>
<td>3.78</td>
<td>4.9</td>
<td>-1.11</td>
<td>0.77</td>
</tr>
<tr>
<td>Gen Med/Gen</td>
<td>1278</td>
<td>4.68</td>
<td>5.35</td>
<td>-0.66</td>
<td>0.88</td>
</tr>
<tr>
<td>ID</td>
<td>451</td>
<td>6.57</td>
<td>5.84</td>
<td>-0.57</td>
<td>0.95</td>
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<tr>
<td>MICU</td>
<td>172</td>
<td>10.03</td>
<td>10.88</td>
<td>-0.65</td>
<td>0.92</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>452</td>
<td>5.87</td>
<td>5.68</td>
<td>-0.09</td>
<td>0.98</td>
</tr>
<tr>
<td>Renal</td>
<td>878</td>
<td>4.28</td>
<td>5.31</td>
<td>-1.03</td>
<td>0.81</td>
</tr>
</tbody>
</table>
Ron Lechan, MD, Chief, Division of Endocrinology, has been co-directing a multi-disciplinary team from Endocrinology, Neurosurgery, Gamma Knife, Ophthalmology, and Radiation Oncology to provide coordinated treatment options for patients with a wide range of neuroendocrine disorders. The team has committed to seeing patients within two weeks and can even schedule appointments with the endocrinologist and surgeons on the same day. Ophthalmologists, radiologists, surgeons, and physicians help collectively evaluate, diagnose and treat patients with individualized treatment plans. Ron has been working closely with Carl Heilman, MD, Co-Director of the newly branded “Neuroendocrine and Pituitary Program”. Carl and his team in Neurosurgery assist patients as needed in discussing surgical options, while less invasive options are also presented to patients when the best plan might be careful observation or perhaps hormone replacement. Some of the Neuroendocrine disorders the team specializes in treating include:

- Prolactinomas
- Cushing’s disease
- Acromegaly
- Thyrotroph adenomas
- Nonfunctioning pituitary tumors
- Recurrent pituitary adenomas
- Pituitary apoplexy
- Suprasellar tumors
- Craniopharyngioma
- Rathke’s cleft cysts
- Hypopituitarism
- Diabetes insipidus
- Hypophysitis
- Neurosarcoïdosis
- Langerhans cell histiocytosis
- Lymphoma and metastatic disease involving the hypothalamus
- Germinoma

The Neuroendocrine and Pituitary Program welcomes new patients for evaluations, consultations and treatments. To make an appointment or referral, please call 617-636-5860.

NEW FACULTY IN MEDICINE

- Shanthini Kasturi, MD, MS
  Rheumatology
- Michael Chin, MD, PhD
  MCRI and Cardiology
- Marianne Barry, MD
  Pulmonary
- Maureen Dziura, MD
  Pulmonary
- Aarti Grover, MD
  Pulmonary
- Margaret (Brenna) McNamara, MD
  Primary Care Boston
The Tufts Medical Center’s Antimicrobial Stewardship Team is one of the oldest and most established programs across the country. Not only have they consistently performed better than national benchmarks in antimicrobial utilization at Tufts, but now they are planning to share their expertise and tools with a broader community of healthcare providers. In recognition of their success in improving patient outcomes and reducing costs, the Geographic Medicine and Infectious Diseases Division at Tufts was asked by the Massachusetts Department of Public Health to assist in state-wide antimicrobial stewardship efforts. The group was asked to provide basic educational guidance to long-term care facilities with new stewardship programs. As a result of that collaboration, a strong desire and demand for additional assistance in developing and growing stewardship programs became evident across the Commonwealth.

Shira Doron, MD and Kirthana "Kira" Beaulac, PharmD, BCPS have been leading the effort to develop marketable services the Tufts team could provide to organizations that need assistance in developing a stewardship program. The need for developing these programs was made even stronger when the Centers for Medicare and Medicaid Services (CMS) proposed a rule requiring all long-term care facilities to establish an antibiotic stewardship program, including antibiotic usage monitoring. And this year the Joint Commission created a new standard requiring an antimicrobial stewardship program at all accredited sites.

The services the Tufts team will be marketing provide flexibility to organizations. 5 levels of service have been created that an organization can choose between.

### Level 1: Educate
- Provide on-site or webinar education for staff as well as documentation to use for future trainings
- Telephone consultation to discuss appropriate audience for scheduled training & education session
- Creating organization-specific materials to market planned webinars

### Level 2: Review and Assess*
- General review of current anti-microbial stewardship efforts in place with summary of recommendations
- One day sampling of antibiotic use
- Assessment of compliance with regulatory requirements regarding anti-microbial stewardship program
- Meeting with organizational leadership to discuss current requirements and ROI of a stewardship program

### Level 3: Analyze*
- One time detailed review of organization’s antibiotic utilization in last 12 months and benchmarking of performance
- One time retrospective medical record review to identify largest opportunities for improvement in past 12 months

### Level 4: Advise*
- Availability for weekly telephone or web conferences to discuss individual cases
- Quarterly record reviews to provide guidance on opportunities for improvement
- Quarterly progress reporting on antibiotic usage relative to benchmarks and financial impact to the organization

### Level 5: Manage*
- Full implementation and oversight of organization’s antimicrobial stewardship program
- Policy/Procedure/Protocol development with clinical staff
- Daily availability for record reviews and discussions that can include patient specific recommendations

* Also includes all services before this level

**Did you see the PBS NewsHour special that featured the TuftsMCAntimicrobial Stewardship Team? Check it out at:**
CODING Q & A

Q: What is a “Modifier”
A: Modifiers as two-character alpha-numerics reported with a CPT code when appropriate. They provide payers with additional information needed to adjudicate a claim correctly. The modifier is a means by which a clinician can signal to the payer that there are special circumstances surrounding the services provided.

Q: What is “Modifier 25”
A: Modifier 25 is appended to an E&M (Evaluation and Management) code to alert the payer that another significant, separately identifiable service was performed by the clinician on the same day.

Q: Where does the modifier 25 go?
A: The modifier is only added to the E&M code.

Q: What defines a “significant and separately identifiable” service
A: When an E&M service is provided on the same day as a minor surgical procedure.

Q: If a patient comes in for a procedure and I evaluate their condition prior to the procedure, can I add an E&M with the modifier 25?
A: No. The payment for evaluating the condition and deciding to perform the procedure is considered part of the payment for the procedure.

Q: What if they come in for the procedure and then present with an unrelated problem that requires a work-up? Can I use modifier 25?
A: Yes. That is appropriate so long as the problem being evaluated would not necessarily result in the procedure.

Q: Can you give an example of when it is appropriate?
A: An established patient is seen for periodic follow-up for hypertension and diabetes. During the visit, the patient asked the physician to address right knee pain which developed after recent yard work. The physician performed a problem-focused history and exam of the patient’s hypertension and diabetes, and adjusted medications. Then the physician evaluated the knee and performs an arthrocentesis. The correct codes to use in this case would be 99212-25 and 20610 for the arthrocentesis.

IN THE NEWS

A recent story regarding an amazing connection between a Bentley Professor (Jill Brown) and a member of our very own Department of Medicine (Dr. Iris Jaffe) has been garnering a lot of attention in the media lately...and we couldn’t be more proud.

Dr. Jaffe was attending a leadership course at Bentley University this summer when her attention was drawn to a few key observations that only a keen clinician would notice. Dr. Jaffe noticed the instructor seemed short of breath, her legs were swollen, and the veins in her neck were pulsing. Dr. Jaffe was brave enough to approach the instructor during a break and advised her to seek medical attention soon to rule out a blood clot in her lungs. A few days later Jill Brown did in fact go to an emergency room where she was diagnosed with a blood clot in both lungs and a deep vein blood clot in her leg.

The emergency room physicians explained to Jill Brown that she was, “lucky to be alive”. If Dr. Jaffe had not spoken up during that class, Ms. Brown admits she likely would have ignored her symptoms and it would have cost her life.

Check out one of the many news outlets that covered this heroic story:

The Boston Globe September 11, 2017, “How Do You Thank Someone for Saving Your Life”

CBS Boston September 12, 2017, “Life-Saving Advice: Student Recognizes Professor’s Health Symptoms”

Michele Esposito, MD, clinical fellow in Cardiology, received the Jay N. Cohn Young Investigator Award – Basic Science at the Heart Failure Society of America’s annual meeting in September. Michele completed her Acute Mechanical Circulatory Support (AMCS) Research Fellowship in June and worked closely with Lara Reyelt, Xiaoying Qiao, Kevin Morine, Peter Natov, and Yali Zhang from the laboratory of Navin Kapur, MD to complete pre-clinical and clinical research studies related to AMCS. During the oral competition, Michele presented the latest findings from the "Door to Unload" project which began in the Surgical and Interventional Research Laboratories and is now an actively enrolling clinical trial.

Congratulations to Dr. Wasif Saif who was named one of Castle Connolly Top Doctors. Wasif was also selected to become NUMS (National University of Medical Sciences) honorary faculty, PK

Rachel Buchsbaum, MD was named a Tufts University School of Medicine Outstanding Lecturer for 2016-2017

Congratulations to Michael Barza, MD for being awarded the Clinical Teacher Award by IDSA in recognition of his outstanding career as a medical educator in infectious disease and medicine. The award will be given during ID week October 2017.

DEPARTMENT OF MEDICINE APPOINTMENTS & PROMOTIONS

Congratulations to Guo-fu Hu and Iris Jaffe, both recently promoted to Professor!

Guo-fu Hu PhD  MORI  Professor of Medicine
Iris Jaffe MD PhD MCR1  Professor of Medicine

Other New Appointments/ Promotions

Janis Breeze MPH  ICRHPS  Promotion  Assistant Professor
Jatin Dave MD MPH  Palliative Care  Appointment  Assistant Professor
Sheeona Gorman PhD  ICRHPS  Appointment  Assistant Professor
Mercedes Lyson PhD  ICRHPS  Appointment  Assistant Professor
Gabriela Andujar Vazquez MD  Geographic Medicine and Infectious Disease  Appointment  Assistant Professor
Ping Zhou MD PhD  Hematology/ Oncology  Promotion  Research Assistant Professor
<table>
<thead>
<tr>
<th>PI</th>
<th>Division/Institute</th>
<th>Sponsor</th>
<th>Title</th>
<th>Award Dates</th>
<th>Total Award</th>
</tr>
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<tbody>
<tr>
<td>Freund, K. /Jaffe I.</td>
<td>ICRHPS/MCRI</td>
<td>NIH</td>
<td>Building Interdisciplinary Research Careers in Women's Health (BIRCHWH) Scholars Program (K12)</td>
<td>09/17-07/22</td>
<td>$2,692,000</td>
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<tr>
<td>Homoud, M.</td>
<td>Cardiac</td>
<td>Boston Scientific</td>
<td>Fellowship Training Award</td>
<td>07/17-07/18</td>
<td>$15,000</td>
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<tr>
<td>Homoud, M.</td>
<td>Cardiac</td>
<td>Medtronic</td>
<td>EP Fellowship Training Award</td>
<td>07/17-07/18</td>
<td>$30,000</td>
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<tr>
<td>Homoud, M.</td>
<td>Cardiac</td>
<td>St. Jude</td>
<td>EP Fellowship Training Award</td>
<td>07/17-07/18</td>
<td>$35,000</td>
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<tr>
<td>Vest, A.</td>
<td>Cardiac</td>
<td>Tufts Chariton Award</td>
<td>The Metabolomic Profile of Advanced Systolic Heart Failure and Change with Metabolic Recovery after Ventricular Assist Device Implantation</td>
<td>07/17-06/18</td>
<td>$10,000</td>
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<tr>
<td>Byhoff, E.</td>
<td>CCR/ICRHPS</td>
<td>Tufts U</td>
<td>Natalie V. Zucker Research Grant</td>
<td>07/17-06/18</td>
<td>$5,000</td>
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<tr>
<td>Byhoff, E.</td>
<td>CCR/ICRHPS</td>
<td>Tufts U</td>
<td>Jonathan M. Tisch College of Civic Life Faculty Fellow</td>
<td>07/17-06/18</td>
<td>$5,000</td>
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<tr>
<td>Byhoff, E.</td>
<td>CCR/ICRHPS</td>
<td>Blue Cross Blue Shield</td>
<td>The importance of CBO-Health Care partnerships</td>
<td>07/17-06/18</td>
<td>$50,000</td>
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<td>Chambers, J</td>
<td>CCR/ICRHPS</td>
<td>Juergen, J&amp;J, Novartis, Genentech, Takeda</td>
<td>Collaborative Funding: Are orphan drugs different? Comparing commercial payer coverage of orphan and non-orphan drugs</td>
<td>09/17-08/18</td>
<td>$250,000</td>
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<tr>
<td>Freund, K.</td>
<td>CCR/ICRHPS</td>
<td>NIH</td>
<td>Translating Research Into Practice: A Regional Collaborative to Reduce Disparities in Breast Cancer Care</td>
<td>09/17-05/22</td>
<td>$1,219,157</td>
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<tr>
<td>Kent, D.</td>
<td>CCR/ICRHPS</td>
<td>PCORI</td>
<td>How well do clinical prediction models (CPMs) validate? A large-scale evaluation of cardiovascular clinical prediction models</td>
<td>*03/17-01/21</td>
<td>$966,917</td>
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<tr>
<td>Kent, D.</td>
<td>CCR/ICRHPS</td>
<td>PCORI</td>
<td>Improving diabetes prevention with benefit-based tailored treatment: Disseminating patient-centered estimates of benefit</td>
<td>*05/17-07/10</td>
<td>$499,999</td>
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<td>Kent, D.</td>
<td>CCR/ICRHPS</td>
<td>PCORI</td>
<td>Predictive Analytics Pilot Study: Assessment of heterogeneity of treatment effects in two major clinical trials</td>
<td>*05/17-04/18</td>
<td>$525,526</td>
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<td>Parsons, S</td>
<td>CCR/ICRHPS</td>
<td>Avon Foundation for Women</td>
<td>Leveraging Patient Navigators as Medical Liaisons to Enhance Breast Cancer Treatment for Patients of Chinese Origin</td>
<td>07/17-06/18</td>
<td>$100,000</td>
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<td>Parsons, S</td>
<td>CCR/ICRHPS</td>
<td>Yawkey Foundation</td>
<td>Utilizing Patient Navigators to enhance adherence to oral anti-cancer medication for vulnerable patients: An education and support initiative</td>
<td>07/17-06/18</td>
<td>$50,000</td>
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<tr>
<td>Sieker, H.</td>
<td>CCR/ICRHPS</td>
<td>NIH</td>
<td>Network for Emergency Care Clinical Trials (SIREN)</td>
<td>07/17-06/22</td>
<td>$52,810</td>
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<tr>
<td>Wessler, B.</td>
<td>CCR/ICRHPS</td>
<td>NIH</td>
<td>Improving Care for Patients with Aortic Stenosis and Multimorbidity</td>
<td>08/17-05/19</td>
<td>$262,500</td>
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<tr>
<td>Doron, S</td>
<td>GeoMed ID</td>
<td>Diatherix Laboratories, LLC</td>
<td>Phenotypic Vs Genotypic Antimicrobial Resistance Profiles: Testing Characterized Samples Collected at TuftsMC on Diatherix ABx Panel and TEM-PCR Panels</td>
<td>06/17-ongoing</td>
<td>$85,609</td>
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<tr>
<td>Li, X.</td>
<td>GeoMed ID</td>
<td>Tufts Chariton Award</td>
<td>Uncovering the molecular mechanism(s) of a master regulator critical for the infectivity of the Lyme disease pathogen</td>
<td>07/17-06/18</td>
<td>$10,000</td>
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<td>Nierenberg, N.</td>
<td>GeoMed ID</td>
<td>Smith &amp; Nephew, Inc.</td>
<td>Pressure Injury Managed Solution Pilot Study</td>
<td>*02/17-01/18</td>
<td>$51,216</td>
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<tr>
<td>Vannier, E.</td>
<td>GeoMed ID</td>
<td>Dorothy Egan Foundation</td>
<td>Characterization of novel therapeutic targets for severe babesiosis</td>
<td>07/17-06/18</td>
<td>$20,000</td>
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<td>Chen, H.</td>
<td>MCRI</td>
<td>NIH</td>
<td>Multiplexed Molecular Imaging of Cell Death Pathways</td>
<td>08/17-07/20</td>
<td>$747,000</td>
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<td>Chin, M.</td>
<td>MCRI</td>
<td>NIH</td>
<td>Intracellular mitochondrial enzyme replacement therapy for heart and skeletal myopathy in Barth Syndrome</td>
<td>09/17-09/18</td>
<td>$1,010,625</td>
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<td>Esposito, M.</td>
<td>MCRI</td>
<td>Tufts Zucker Award</td>
<td>Primary Unloading: A New Approach to Limit Myocardial Damage and Subsequent Heart Failure after a Heart Attack</td>
<td>07/17-06/18</td>
<td>$3,460</td>
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<td>Huggins, G.</td>
<td>MCRI</td>
<td>Tufts Russo Award</td>
<td>Diagnosis of Heart Failure Status using Metabolomics</td>
<td>07/17-06/18</td>
<td>$10,000</td>
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<tr>
<td>Jaffe, I.</td>
<td>MCRI</td>
<td>NIH</td>
<td>Cerebral parenchymal arteriole dysfunction and cognitive decline in a life-long high fat feeding model</td>
<td>07/17-06/21</td>
<td>$100,266</td>
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<td>Kapur, N.</td>
<td>MCRI</td>
<td>Second Heart Assist, Inc.</td>
<td>Pre-Clinical Study: Phase 1 and Phase 2 Testing</td>
<td>08/17-02/18</td>
<td>$160,582</td>
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<td>Du, K.</td>
<td>MORI</td>
<td>NIH</td>
<td>Regulation of Akt Signaling by Detergent Resistant Membrane Associated Protein ClpR-59</td>
<td>09/17-06/20</td>
<td>$1,181,250</td>
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<td>Evans, A.</td>
<td>MORI</td>
<td>Tesaro, Inc.</td>
<td>Targeting PD1 pathway in Lymphoma with combinations of anti-PD1, anti-TIM3 and anti-LAG3 and Profiling checkpoint inhibitors PD1, TIM-3 and LAG-3 expression in the peripheral blood cells of lymphoma patients</td>
<td>09/17-07/20</td>
<td>$62,456</td>
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<td>Hu, G.</td>
<td>MORI</td>
<td>NIH</td>
<td>Protection and mitigation of bone marrow failure by angiogenin</td>
<td>08/17-05/21</td>
<td>$1,766,879</td>
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<td>London, C.</td>
<td>MORI</td>
<td>Sarcoma Foundation of America</td>
<td>Interrogating the regulation, function and therapeutic potential of monocarboxylate transporters in osteosarcoma</td>
<td>*06/17-05/18</td>
<td>$50,000</td>
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<td>Drew, D.</td>
<td>Neph</td>
<td>NIH</td>
<td>CKD Biomarkers Consortium Pilot and Feasibility Studies (SubK w/UI Penn)</td>
<td>09/17-08/18</td>
<td>$50,000</td>
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<td>Weiner, D.</td>
<td>Neph</td>
<td>NIH</td>
<td>Biological Determinants of Peritoneal Dialysis (Bio-PD) (SubK w/UI Wash)</td>
<td>*05/17-04/20</td>
<td>$20,569</td>
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<td>Wilson, J.</td>
<td>Pulm</td>
<td>Tufts Chariton Award</td>
<td>MS proteomic analysis of vascular smooth muscle cells from pulmonary hypertensive patients</td>
<td>07/17-06/18</td>
<td>$7,646</td>
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<td>Kalshe, R.</td>
<td>Rheum</td>
<td>Amgen</td>
<td>Fellowship Training Award</td>
<td>07/17-06/18</td>
<td>$50,000</td>
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<td>Kasturi, S.</td>
<td>Rheum</td>
<td>Rheumatology Research Foundation</td>
<td>Feasibility and Validity of PROMIS in SLE</td>
<td>08/17-09/18</td>
<td>$100,000</td>
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*Fully executed in FY 17 Qtr 4, though start date preceded 7/1.
What did the campus look like in 1950...Now you know. This is a poster for the hospital with a zoom of the campus map.


Jatin Roper1–3,12, Tuomas Tammela1,12, Naniye Malli Cetinbas1, Adam Akkad1, Ali Roghanian1,4, Steffen Rickelt1, Mohammad Almqvadi1, Katherine Wu1, Matthias A Oberli1, Francisco Sanchez-Rivera1, Yoona K Park1, Xu Liang1, George Eng1,5, Martin S Taylor1, Roxana Azim1, Dmitriy Kedrin1, Rachit Neupane1, Semir Beyaz1, Ewa T Scinska6, Yvelisse Suarez7, ames Yoo3,8, Lillian Chen8, Lawrence Zukerberg5, Pekka Katajisto9,10, Vikram Deshpande5, Adam J Bass6, Philip N Tsichlis3, Jacqueline Lees1, Robert Langer1, Richard O Hynes1,11, Ian Zhu1, Arjun Bhutkar1, Tyler Jacks1,11 & Ömer H Yilmaz1,5. In Vivo Genome Editing and Organoid Transplantation models of colorectal cancer and metastasis. Nature Biotechnology. May 1, 2017.