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AZIENDA OSPEDALIERO-UNIVERSITARIA
Città della Salute e della Scienza di Torino

**GIORNATE
CARDIOLOGICHE
TORINESI**

**TURIN,
October
25th-27th
2018**
Starhotels Majestic

Remote PCI

Amir Lerman, MD

Barbara Woodward Lips Endowed Professor
Director Cardiovascular Research Center
Department of Cardiovascular Diseases
Mayo Clinic, Rochester, MN

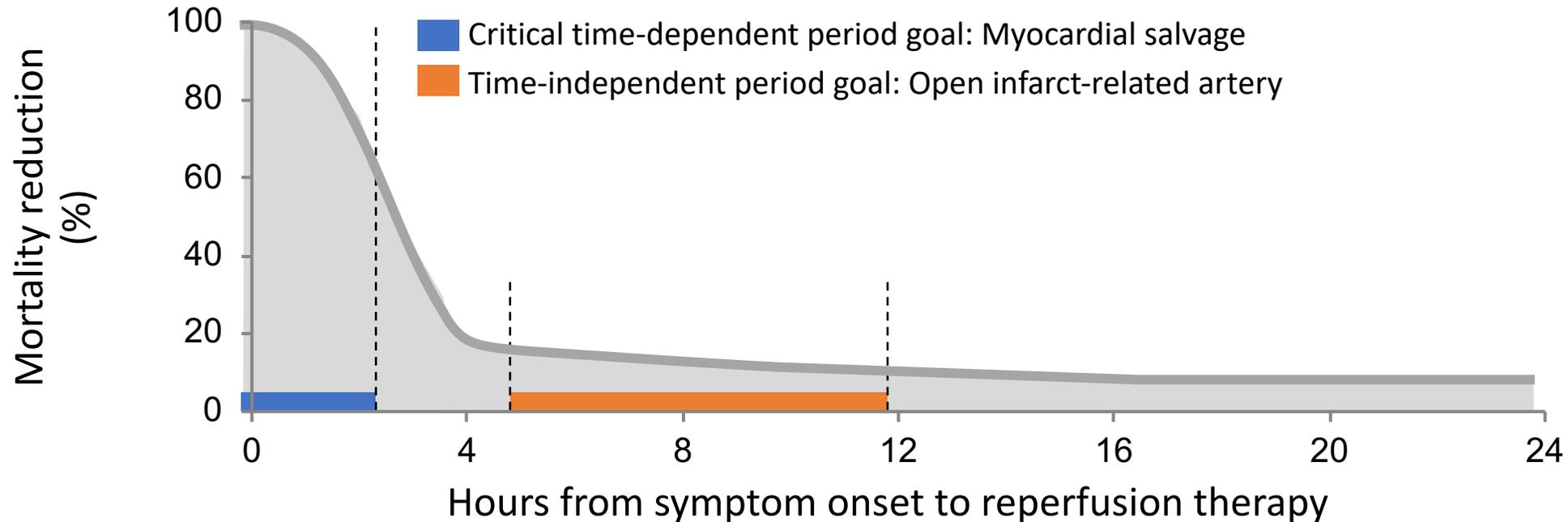
Disclosures

Consultant: Corindus

Background

- Estimates on annual incidence of AMI
 - ~ 595,000
- Longer ischemic time is associated with increased cell death and adverse outcomes
- Accelerating the process of restoring flow
 - Key goal of ACC and other professional societies
 - D2B now a metric of success and quality of care

Why is It Important to Address this Problem?



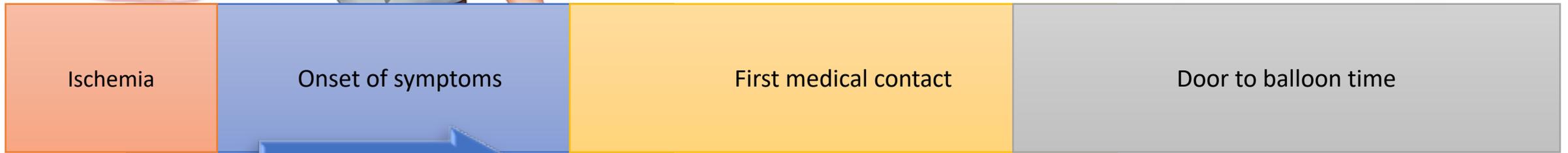
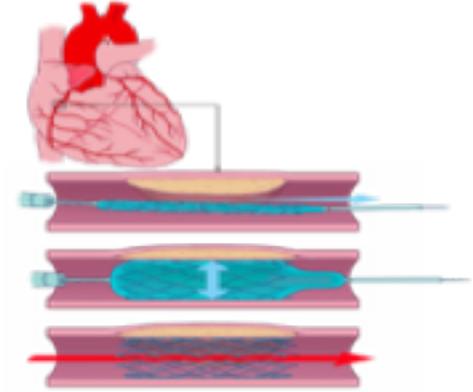
For every 30-minute delay in time to treatment

- 7.5% increase in mortality
- 8.7% increase in low EF leading to CHF (rate almost doubles post recurrent MI)

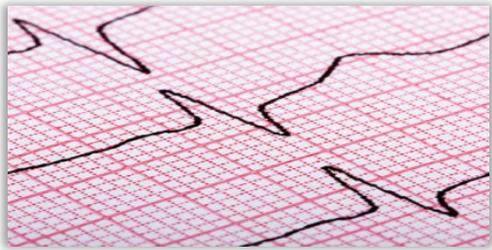
HF is the most costly DRG in the USA

- Late arrival is costly not only to patient's life and heart but to our country's health care system

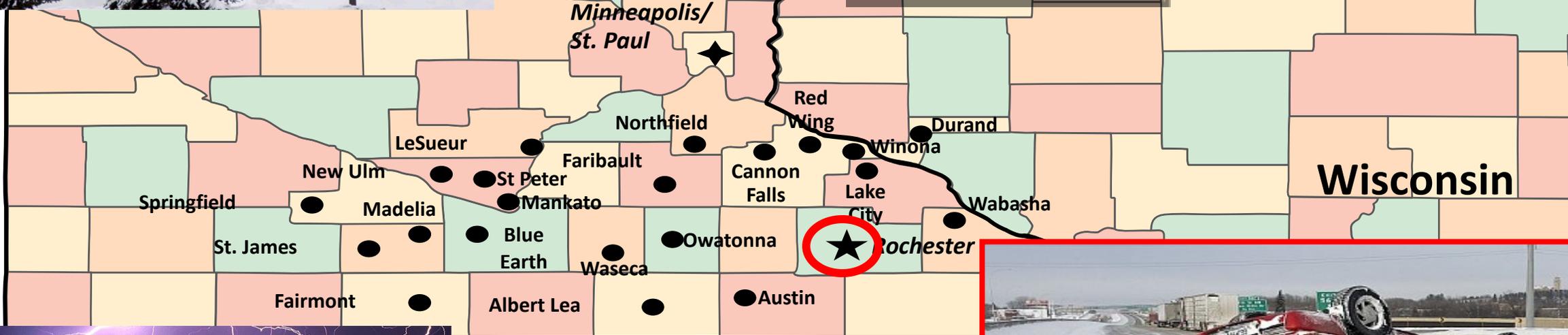
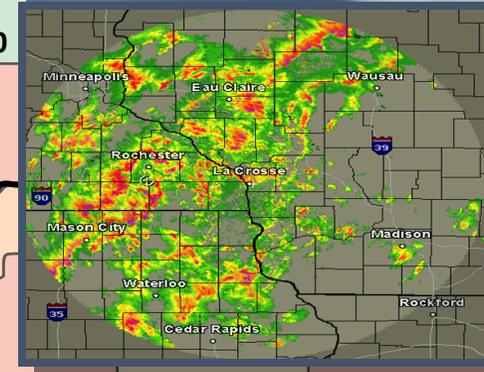
Ischemia to Balloon Time



ECG changes

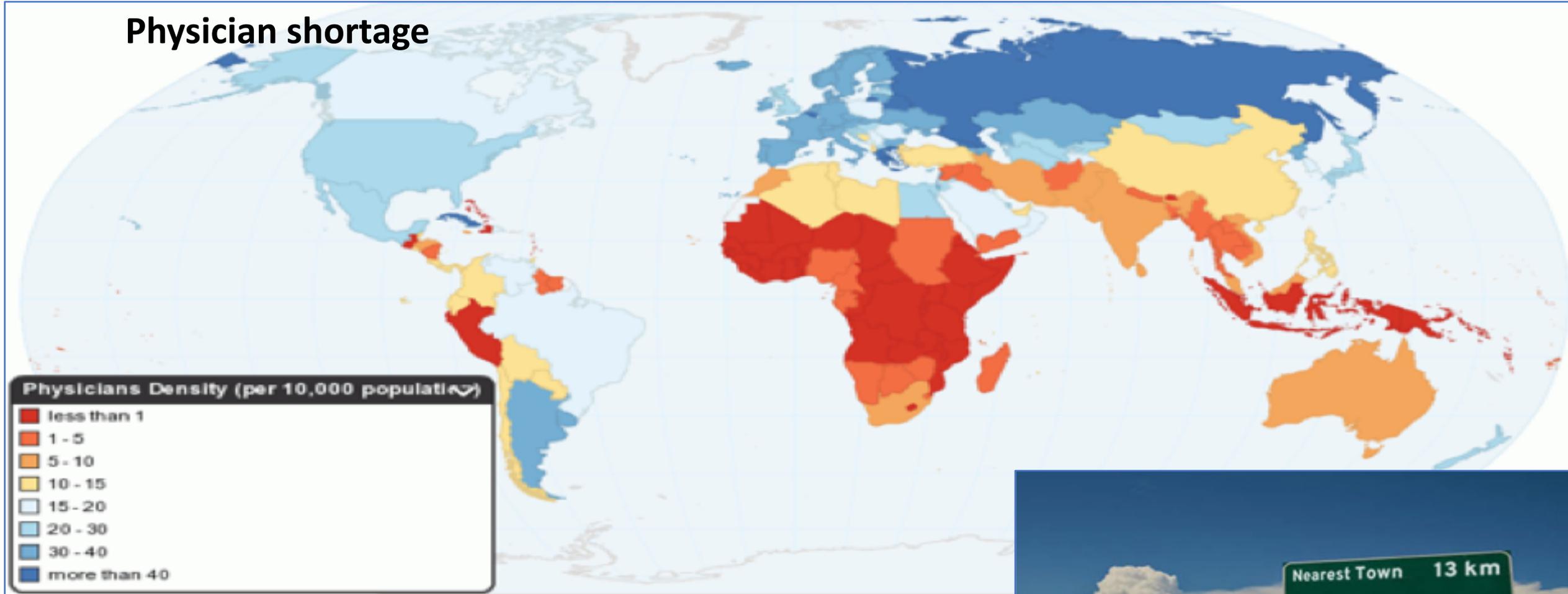


Rochester, Minnesota – December and January and February and March and April



Standardization and equalizing Access to care

Physician shortage



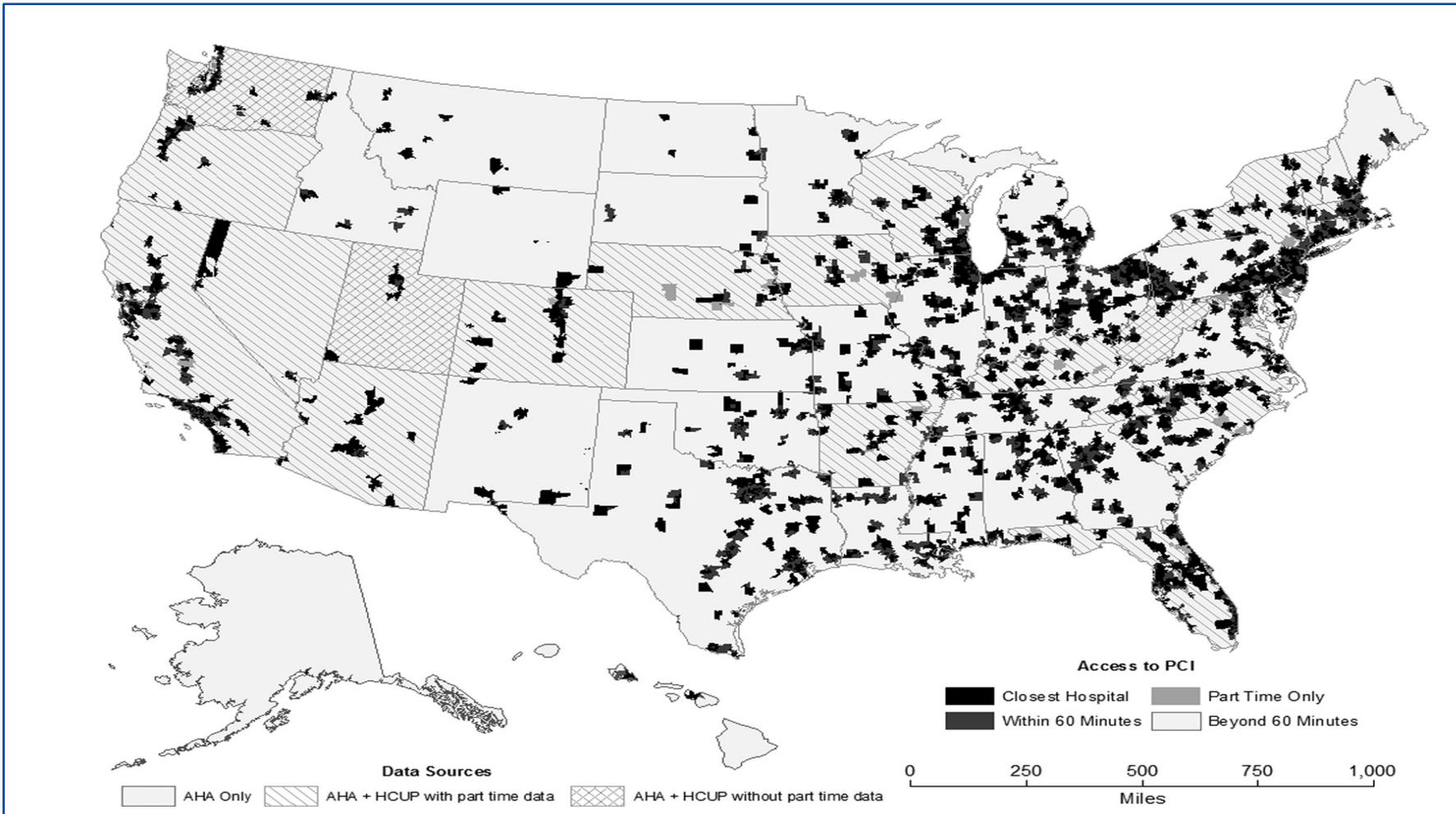
Anticipated 90,000 physicians shortage in the US until 2025



A Percutaneous Coronary Intervention Lab in Every Hospital?

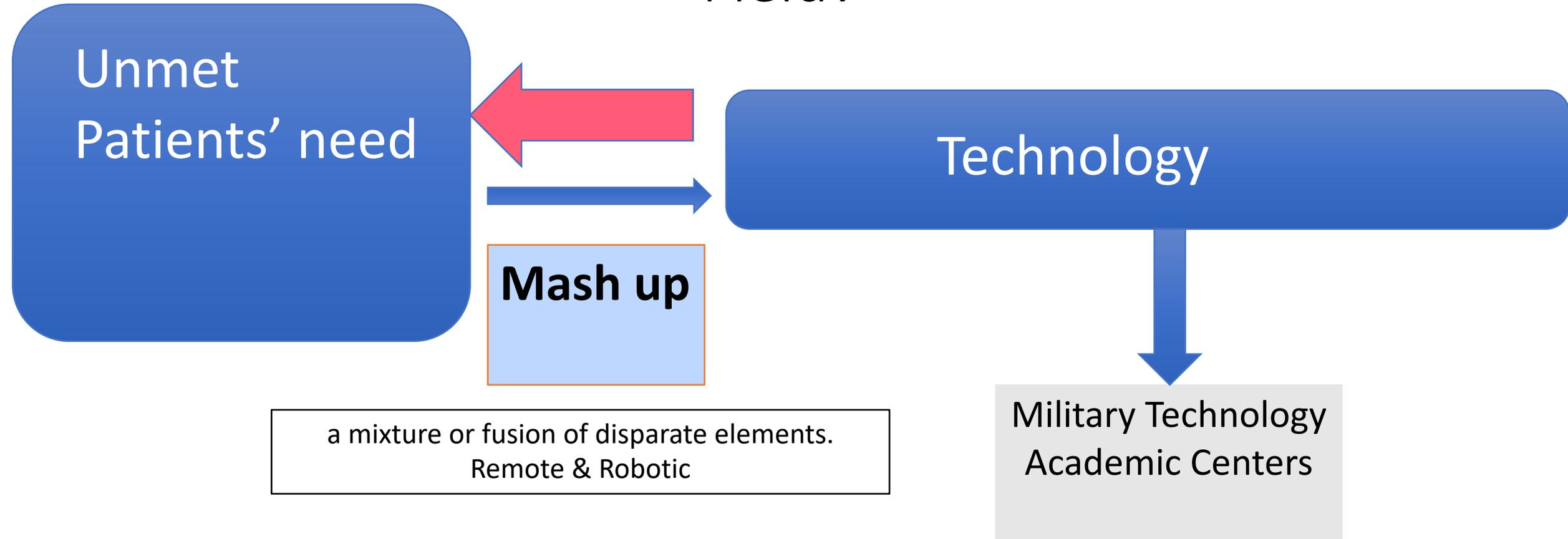
Thomas W. Concannon, PhD; Jason Nelson, MPH; Jessica Goetz, MPH; John L. Griffith, PhD

Dark Areas: <60-min Drive to PCI Hospital



From 2001 to 2006, hospital capability to perform PCI grew by 44%, whereas timely access to the procedure grew by only 1%.

Where are the Future Opportunities in the Cardiovascular Field?

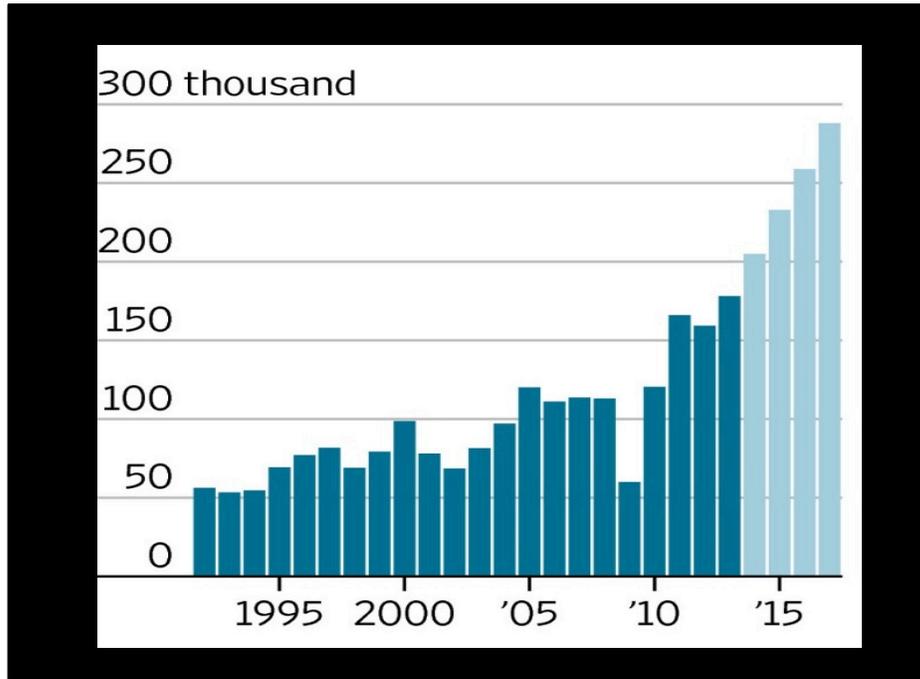


If you can not bring the patients to the cath lab: bring the cath lab to the patients

- Challenges
- Mash up: Remote Robotic
- Robotic
 - Safety and Feasibility
 - Reaction time
- Remote
 - Face to face interaction

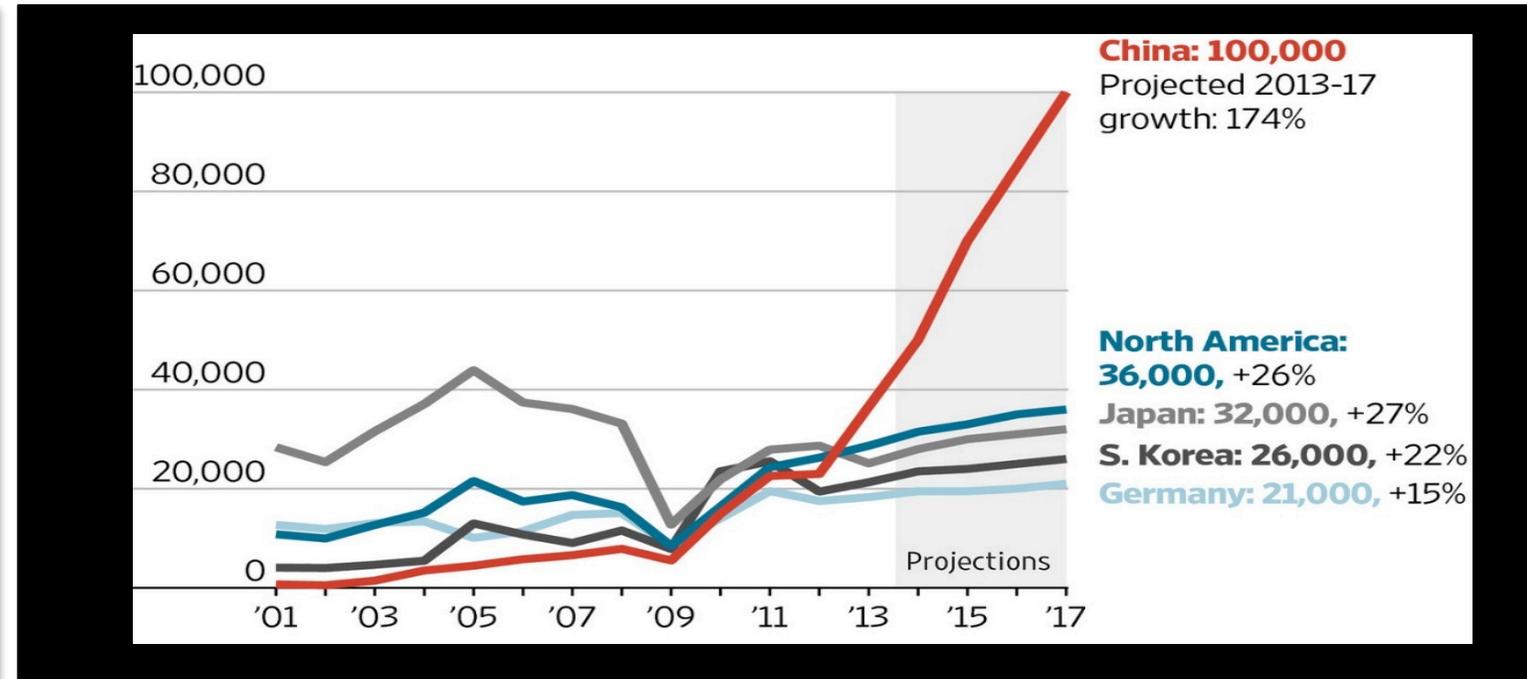
Robotic Revolution; across all industries

World-wide industrial robot installations



Automatic Nations

Top 5 markets for industrial robot sales



We now drive cars, have vision & vacuum robotically...we will not be manually controlling catheters in the future...



Robots can now assemble an IKEA chair in 20 minutes—without fighting

Caroline Purtil | April 19, 2018



Robotics in the Cath Lab

Second Generation Robotic-assisted PCI System

CorPath® GRX System

BEDSIDE UNIT

Optimized bedside unit for radial access

Simple setup & in-procedure workflow

Devices fixed during intervention

Imaging and device agnostic



INTERVENTIONAL COCKPIT

Precise robotic control of
Guide catheter
Guidewire
Balloon/stent catheter

Radiation-shielded workstation

4K resolution monitor

The synchrony of imaging and catheter movement ...practice, plan and perfect...

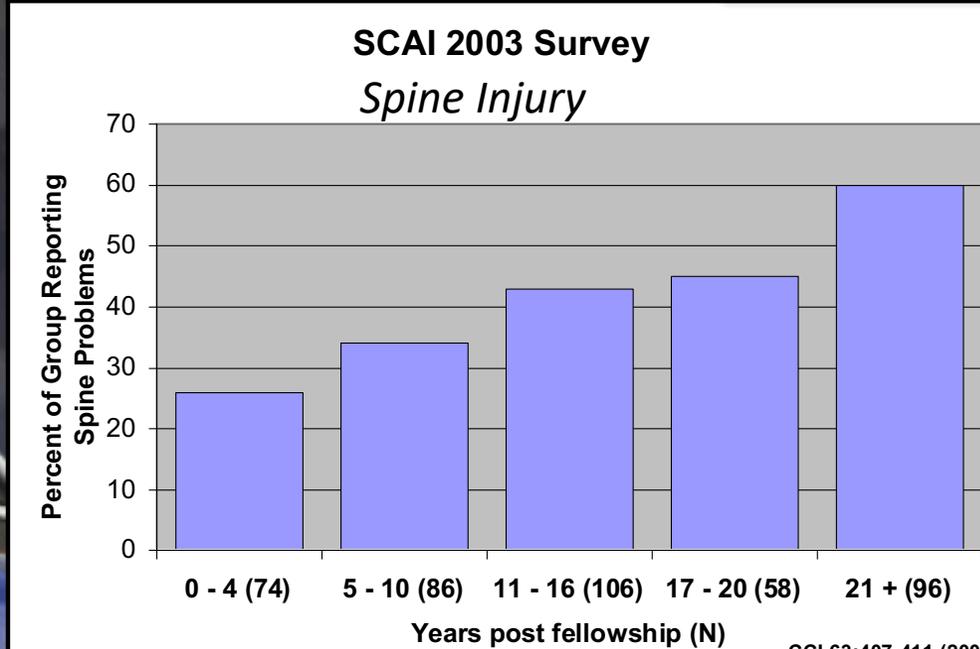
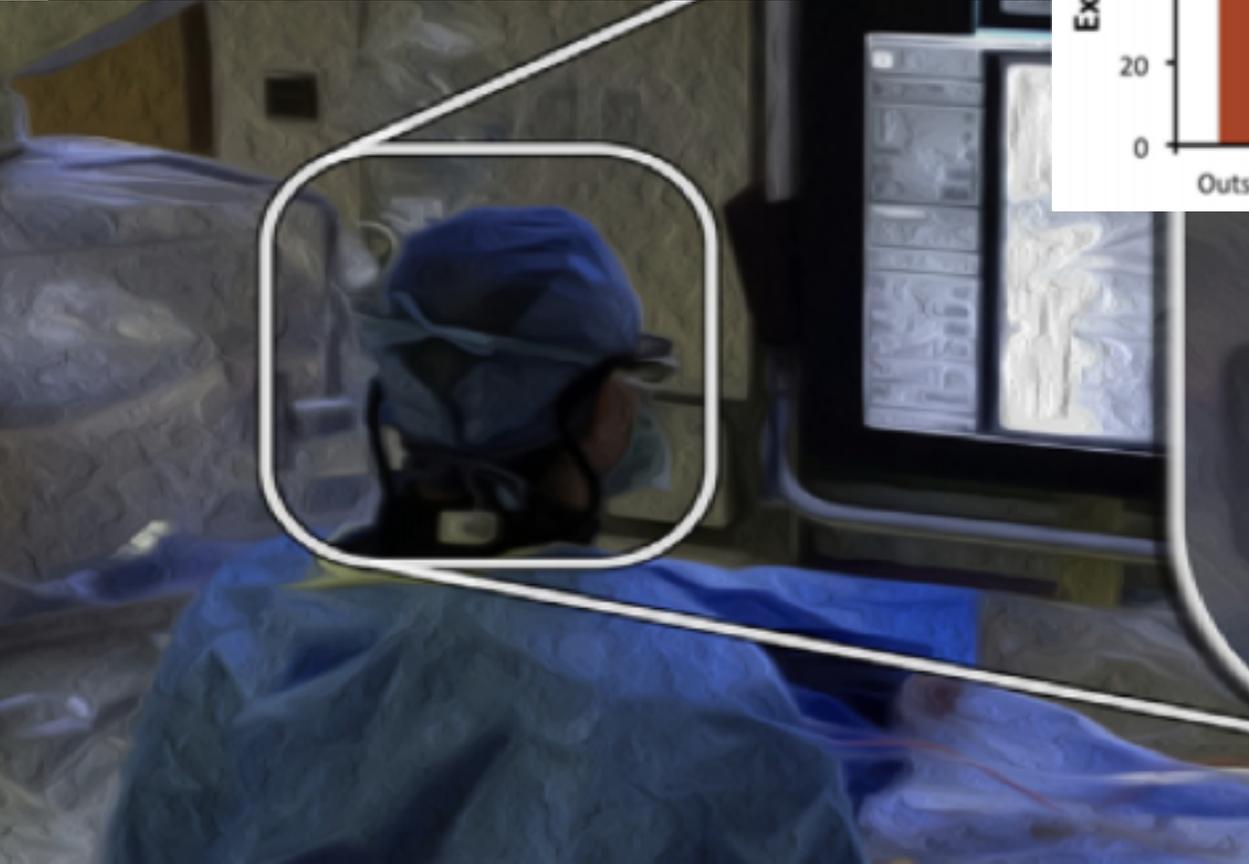
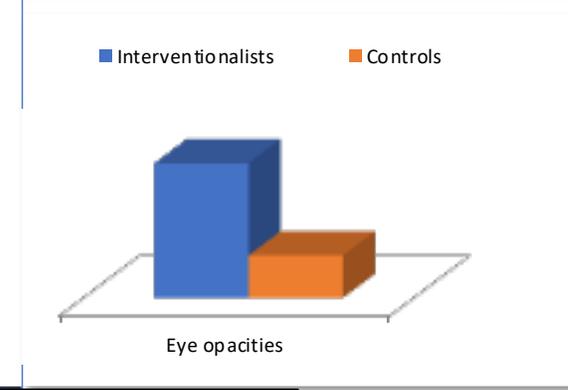
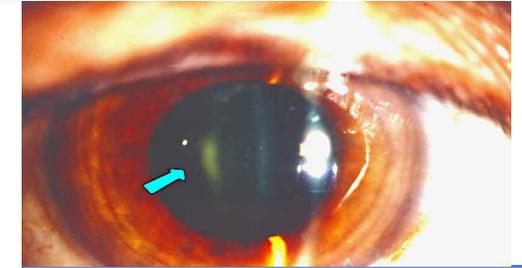
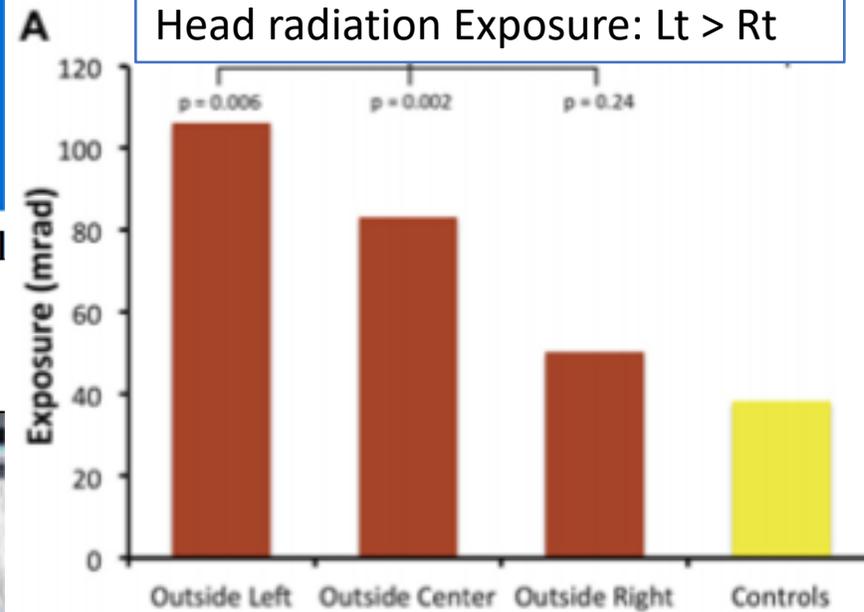


Operators and patients' safety

The
American Journal
of
Cardiology

Brain and Neck Tumors Among Physicians Performing Interventional Procedures

Ariel Roguin, MD, PhD^{a*}, Jacob Goldstein, MD^b, Olivier Bar, MD^c, and James A. Goldstein, MD^d



Robotically Assisted PCI: Feasibility and Safety

Safety and Feasibility of Robotic Percutaneous Coronary Intervention

PRECISE (Percutaneous Robotically-Enhanced Coronary Intervention) Study

Giora Weisz, MD,* D. Christopher Metzger, MD,† Ronald P. Caputo, MD,‡ Juan A. Delgado, MD,§ J. Jeffrey Marshall, MD,|| George W. Vetrovec, MD,¶ Mark Reisman, MD,# Ron Waksman, MD,** Juan F. Granada, MD,§ Victor Novack, MD, PhD,†† Jeffrey W. Moses, MD,* Joseph P. Carrozza, MD‡‡
New York and Syracuse, New York; Kingston, Tennessee; Medellin, Colombia; Gainesville, Georgia; Richmond, Virginia; Seattle, Washington; Washington, DC; Beersheba, Israel; and Boston, Massachusetts

Demonstration of the Safety and Feasibility of Robotically Assisted Percutaneous Coronary Intervention in Complex Coronary Lesions

Results of the CORA-PCI Study (Complex Robotically Assisted Percutaneous Coronary Intervention)

Ehtisham Mahmud, MD, Jesse Naghi, MD, Lawrence Ang, MD, Jonathan Harrison, MD, Omid Behnamfar, MD, Ali Pourdjabbbar, MD, Ryan Reeves, MD, Mitul Patel, MD

Contrast Media Volume, ml



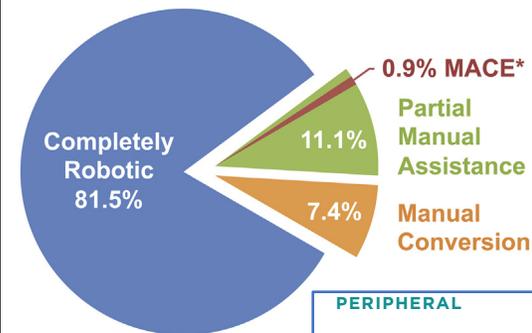
Fluoroscopy Time, min



Radiation Dose, mGy



FIGURE 3 Technical Success of Robotic Percutaneous Coronary Intervention



PERIPHERAL

Feasibility and Safety of Robotic Peripheral Vascular Interventions

Results of the RAPID Trial

Ehtisham Mahmud, MD,^a Florian Schmid, MD,^b Peter Kalmar, MD,^b Hannes Deutschmann, MD,^b Franz Hafner, MD,^c Peter Rief, MD,^c Marianne Brodmann, MD^c

If you can not bring the patients to the cath lab: bring the cath lab to the patients

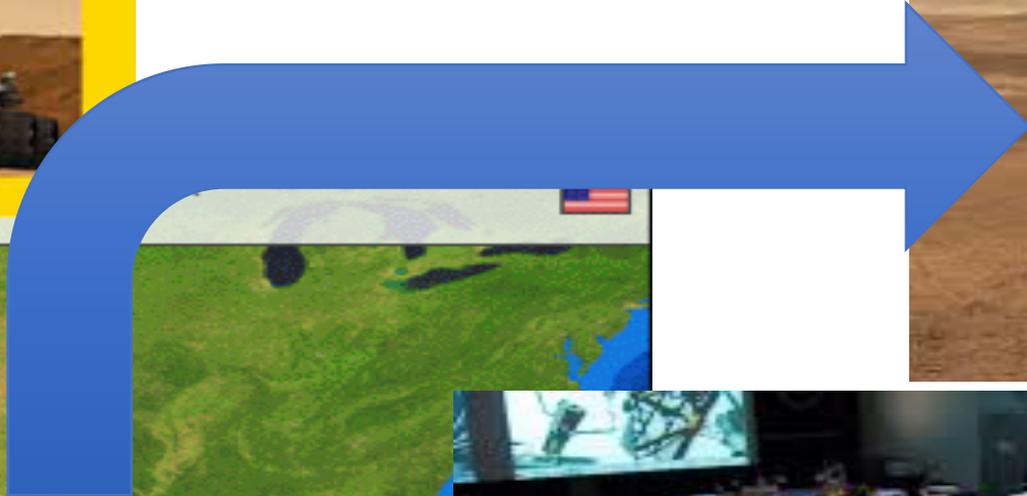
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MARS LANDING 2012

MARC KAUFMAN



distance from the Earth to Mars is about 54.6 million kilometers
the communication time delay between Earth and Mars, which is about 20 minutes
on average.



Houston, United States



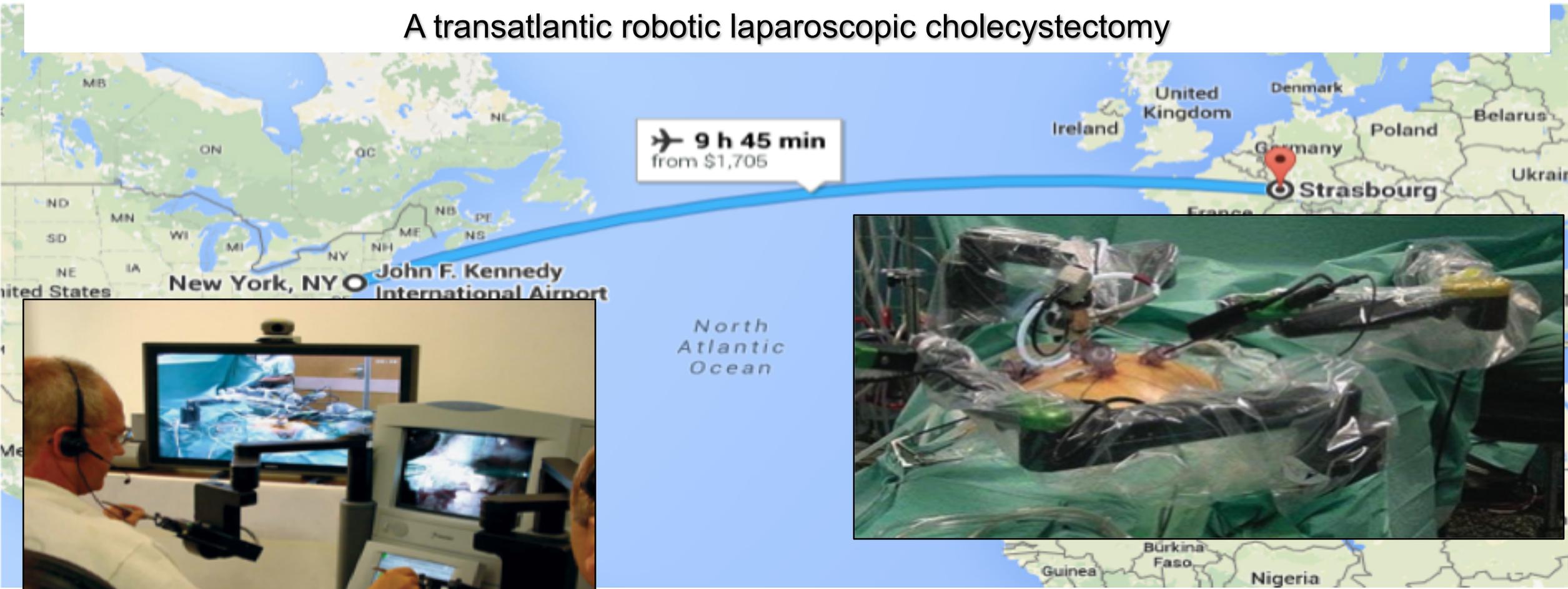
The operation was carried out successfully in 54 minutes without difficulty or complications. Despite a round-trip distance of more than 14,000 km, the mean time lag for transmission during the procedure was 155 ms.

Transcontinental Robot-Assisted Remote Telesurgery: Feasibility and Potential Applications

Jacques Marescaux, MD, Joel Leroy, MD, Francesco Rubino, MD, Michelle Smith, MD, Michel Vix, MD, Michele Simone, MD, and Didier Mutter, MD

From the IRCAD-EITS (European Institute of Telesurgery), Louis Pasteur University, Strasbourg, France

A transatlantic robotic laparoscopic cholecystectomy



If you can not bring the patients to the cath lab: bring the cath lab to the patients

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Is Telestenting Even Feasible?

The REMOTE-PCI Study

Percutaneous coronary intervention using a combination of robotics and telecommunications by an operator in a separate physical location from the patient: an early exploration into the feasibility of telestenting (the REMOTE-PCI study)



Ryan D. Madder*, MD; Stacie M. VanOosterhout, MEd; Mark E. Jacoby, MD; J. Stewart Collins, MD; Andrew S. Borgman, MS; Abbey N. Mulder, BSN, RN; Matthew A. Elmore, BA; Jessica L. Campbell; Richard F. McNamara, MD; David H. Wohms, MD

Frederik Meijer Heart & Vascular Institute, Spectrum Health, Grand Rapids, MI, USA

KEYWORDS

- robotic percutaneous coronary intervention
- telemedicine
- telestenting

Abstract

Aims: The present study explores the feasibility of telestenting, wherein a physician operator performs stenting on a patient in a separate physical location using a combination of robotics and telecommunications.

Methods and results: Patients undergoing robotic stenting were eligible for inclusion. All manipulations of guidewires, balloons, and stents were performed robotically by a physician operator located in an isolated separate room outside the procedure room housing the patient. Communication between the operating physician and laboratory personnel was via telecommunication devices providing real-time audio and video connectivity. Among 20 patients who consented to participate, technical success, defined as success...

Madder et al EuroIntervention
2017;12:1569-1576

A photograph of a hospital operating room. In the background, a person in blue scrubs is seated at a workstation with multiple monitors. The room is filled with medical equipment, including a large white machine on the right and various cables hanging from the ceiling. A blue callout box with white text is overlaid on the image, pointing to a messy pile of white and black cables on the floor. The text inside the box reads "Still connected with cables".

Still connected
with cables

REMOTE-PCI: Primary Endpoints

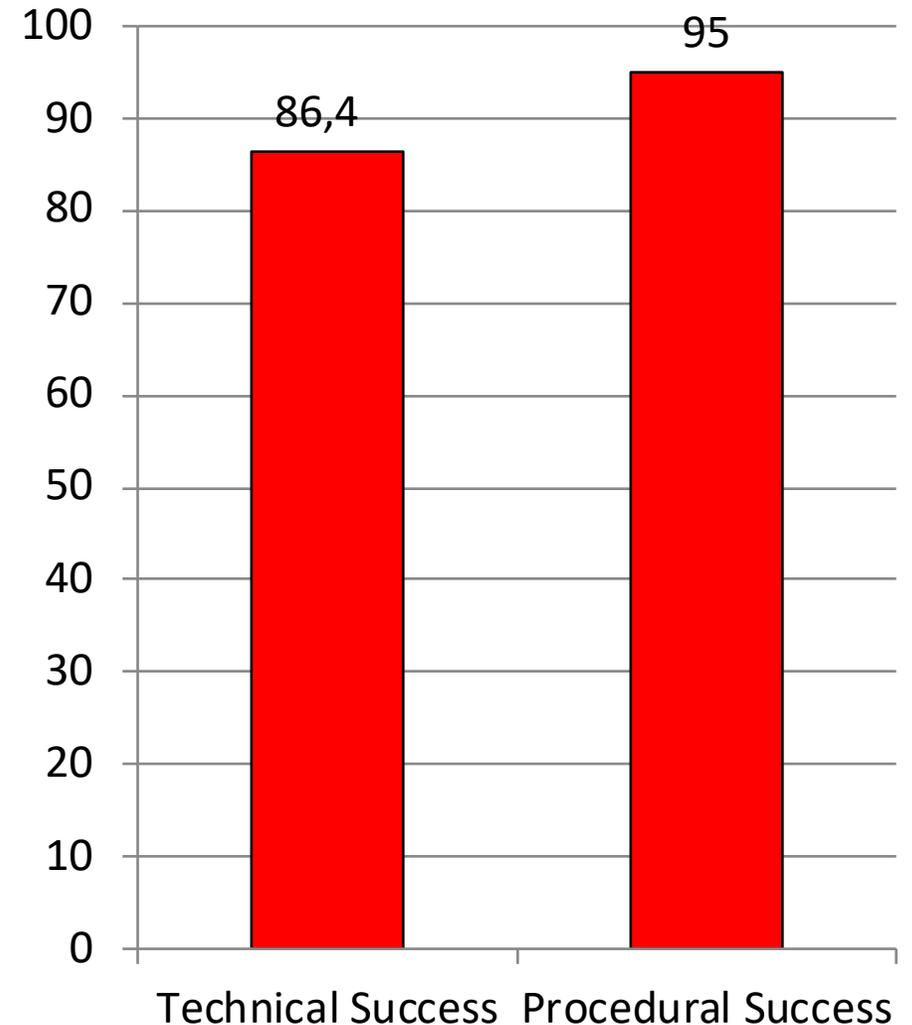
Pre-specified primary endpoints:

1) Technical success

- successful intracoronary advancement and retraction of guidewires, angioplasty balloons, and stents by the robotic system without conversion to manual operation

2) Procedural success

- <30% residual stenosis upon completion of the procedure in the absence of death or repeat revascularisation prior to hospital discharge



The Need for Robotics in the Cath Lab



Consistency & Reliability

Reduce variability in operator skills and clinical outcomes
(best clinical practices)



Access for all patients

Medical care at all times at any [rural] location



Protection for Staff

Physician and staff health concerns are rising as more evidence is generated on cath lab occupational hazards



**Improve
patient
care**



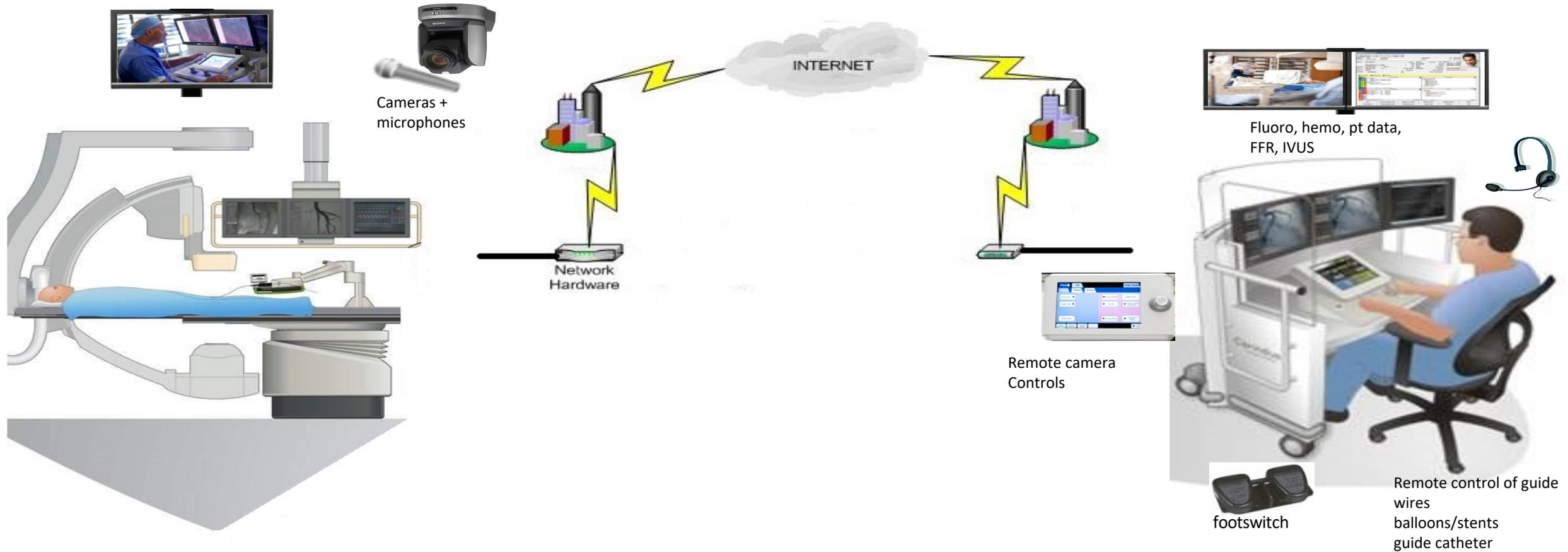
Building a remote PCI

PI: Dr. M. Eleid

- Multi stage protocol
- Distancing the consul form the patient
- First case via intranet
- Building a cloud base interphase
- First over the cloud case



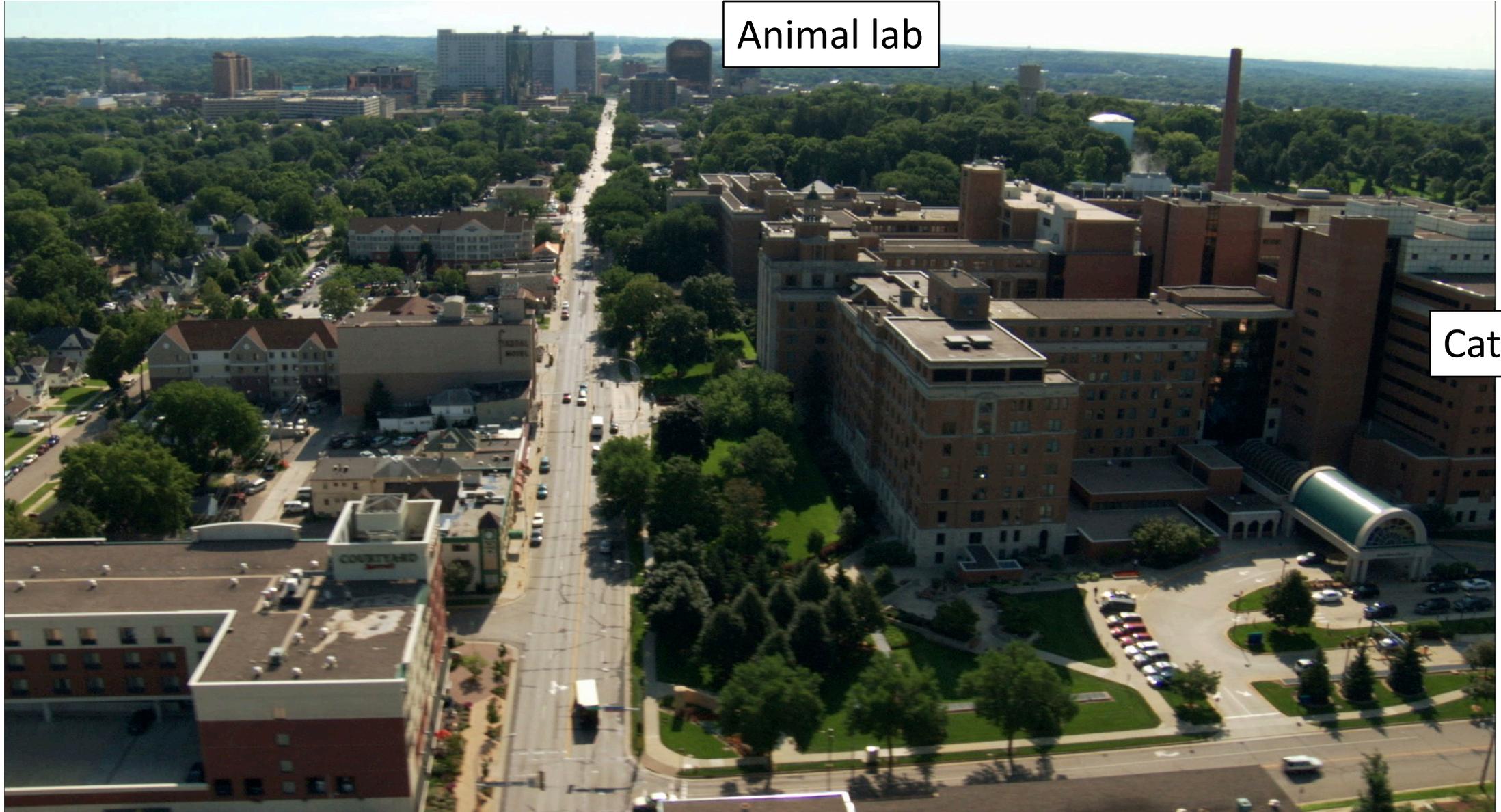
Remote PCI



Cath lab – at the patient

Immerse IC virtually into the cath lab
Education

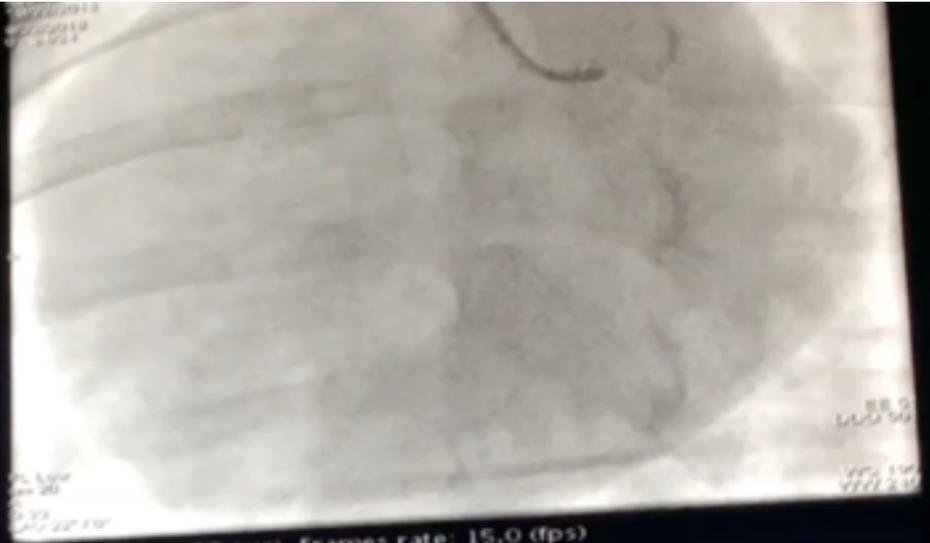
Live from TCT 2018



Animal lab

Cath lab

5 AM



Total Delay: 39 (ms), Frames rate: 15.0 (fps)

UP NEXT
Martin
30th An



Remote PCI

