MAYO CLINIC

ENHANCED CRITICAL CARE

Tele-ICU and Other Tele-Medicine Models

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As a healthcare provider, I have used tele-medicine technology in my practice:

1. Yes
2. No

As a patient, I have been exposed to tele-medicine technology:

1. Yes
2. No

Outline

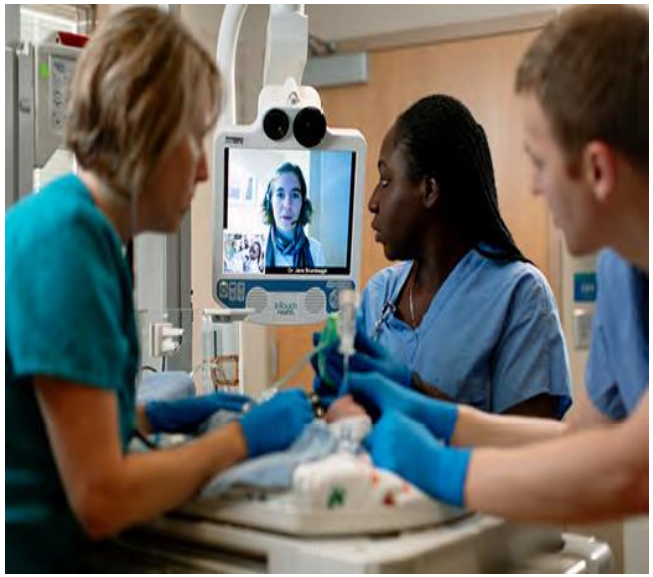
- Overview of telemedicine care models
- More detail about tele-ICU
- Other telemedicine lines

Digital nihilists: Telemedicine is coming to a practice near you

- Tele-Stroke, Tele-Radiology, Tele-Neonatology, Tele-ED, Tele-Derm, Tele-Pathology, Tele-Dialysis, Tele-Neuro, Tele-Psychiatry

Telemedicine

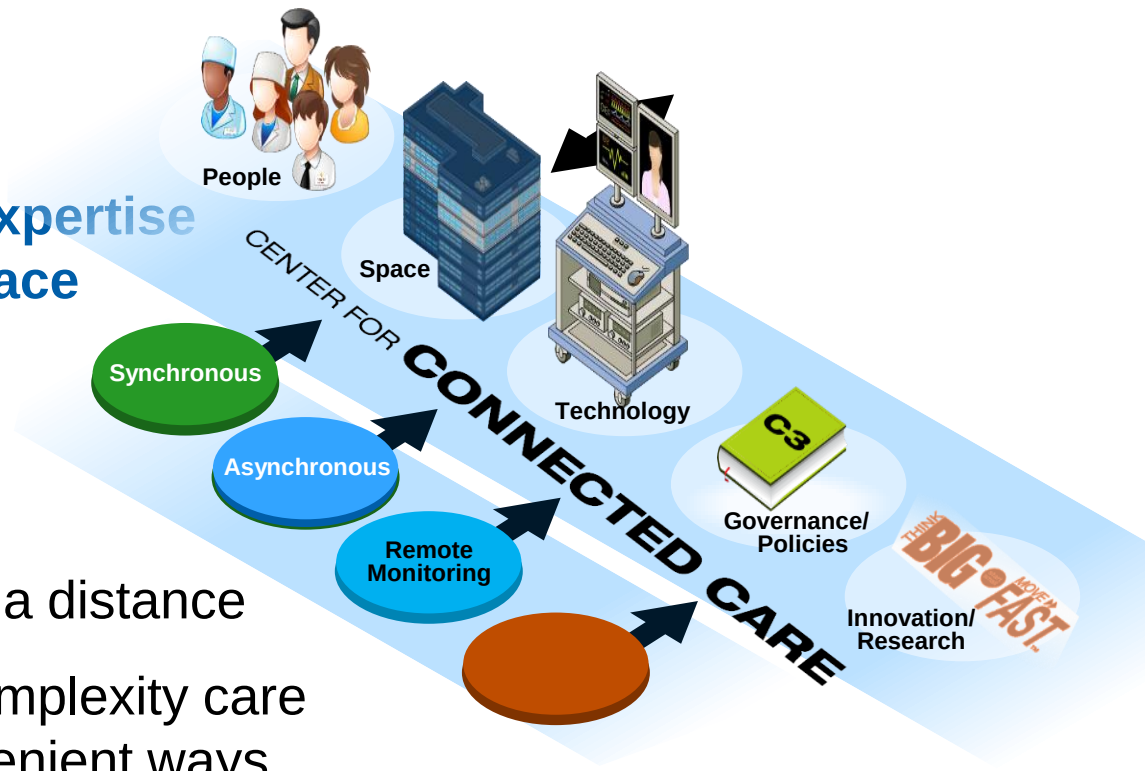
- The **remote delivery** of health care services and clinical information **using telecommunications** technology.
- A significant and rapidly growing component of health care in the United States.
  - **200** telemedicine networks
  - **3,500** service sites
- **Over half** of all U.S. hospitals now use some form of telemedicine.



http://www.americantelemed.org

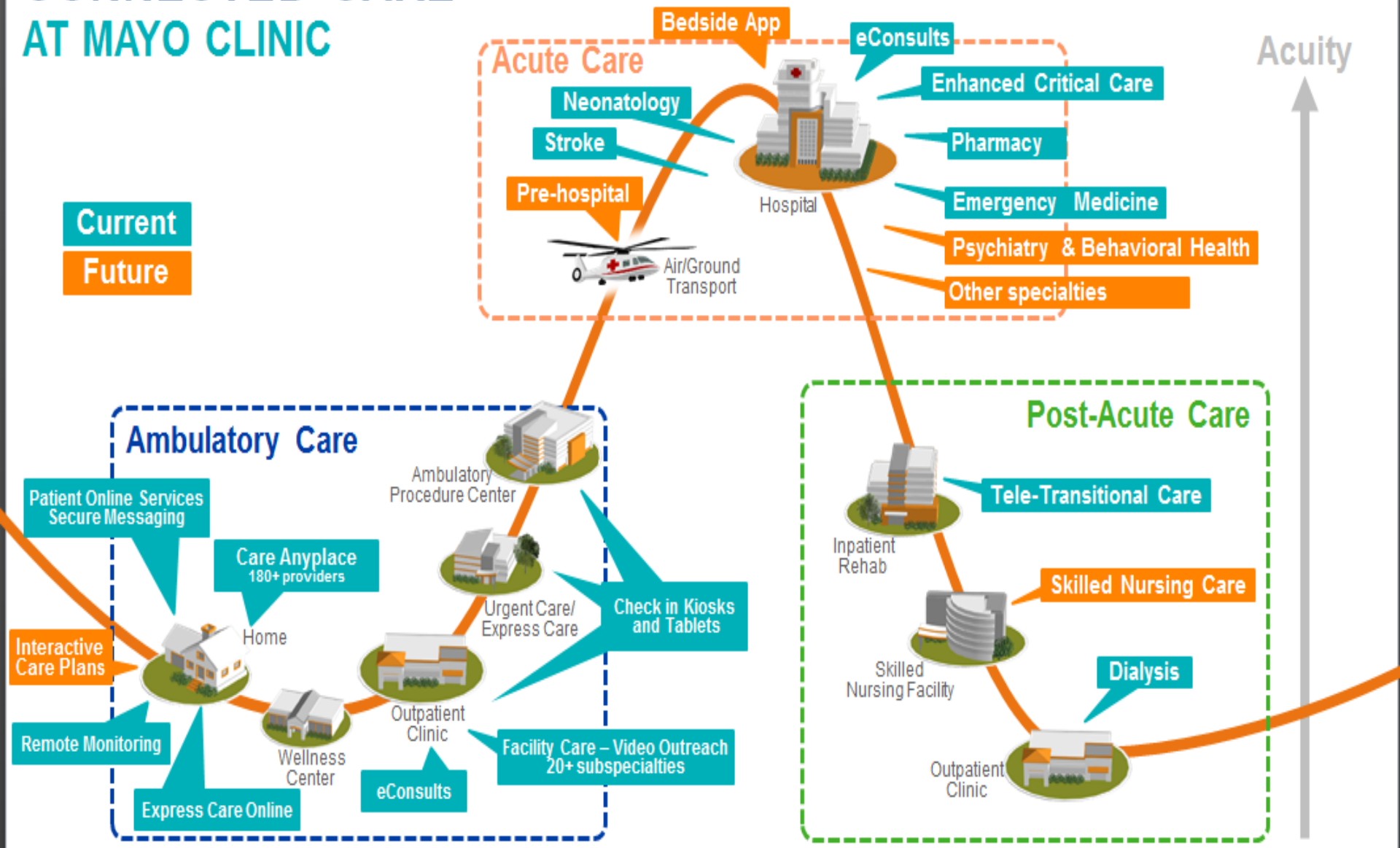
VALUE PROPOSITION

- **Extend knowledge and expertise to patients in the right place using the right channel**



- Increase patient access to clinical care services at a distance
- Assist in delivering low-complexity care in more efficient and convenient ways
- Assist in decreasing overall cost of care

CONNECTED CARE
AT MAYO CLINIC



Tele-ICU

Critical Care in the USA

- Movement over the past decade to augment the physical presence of the intensive care specialist (team) in the hospital (i.e. 24/7 in-house)

- Based upon the belief that real-time availability brings value to the care of the critically ill and improves important outcomes

24/7 Intensivist Coverage Model

- Conceptually has strong face validity
- A marker of quality care
  - Leapfrog
  - USNWR Hospital Rankings
- Most hospitals can’t staff 24/7
- Many hospitals don’t have a single intensivist

Bridging the Gap: Tele-ICU

- Provision of care to critically ill patients by remotely located specialists
  - Intensivists
  - CC RN's
  - Processes (EBM, bundles, charting)
  - Culture change

- Core concept: integration of patient care across a network

Supply and demand

- The percentage of ICUs in the US that are staffed by a bedside intensivist is ?
  - 5
  - 15
  - 35
  - 55

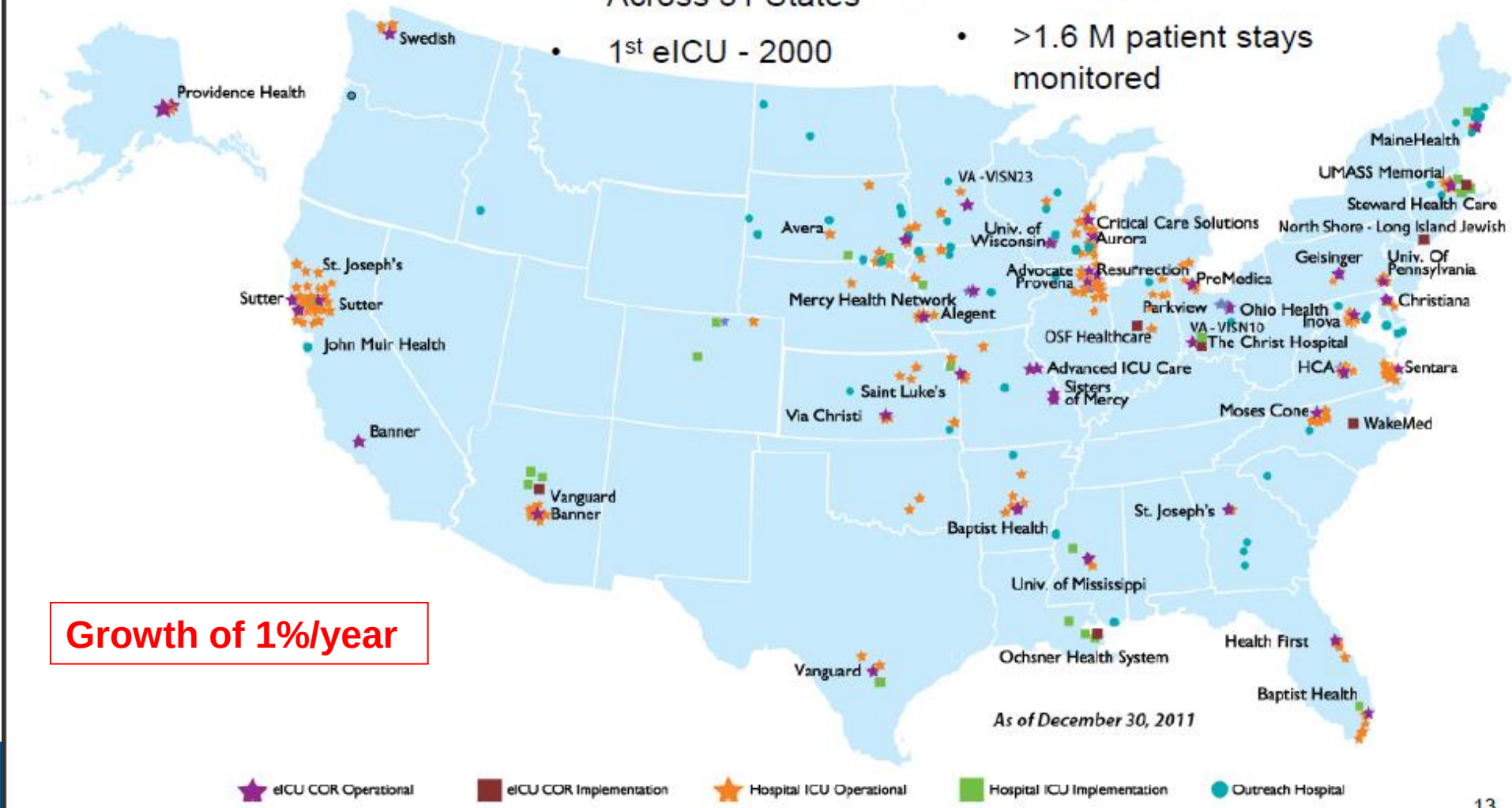
PHILIPS

MAYO CLINIC HEALTH SYSTEM

eICU Programs

- 300+ hospitals
- 40+ health systems
- Across 31 States
- 1st eICU - 2000

- ~~10~~ 15% of adult ICU beds
- Monitoring >500,000 patient stays/year
- >1.6 M patient stays monitored



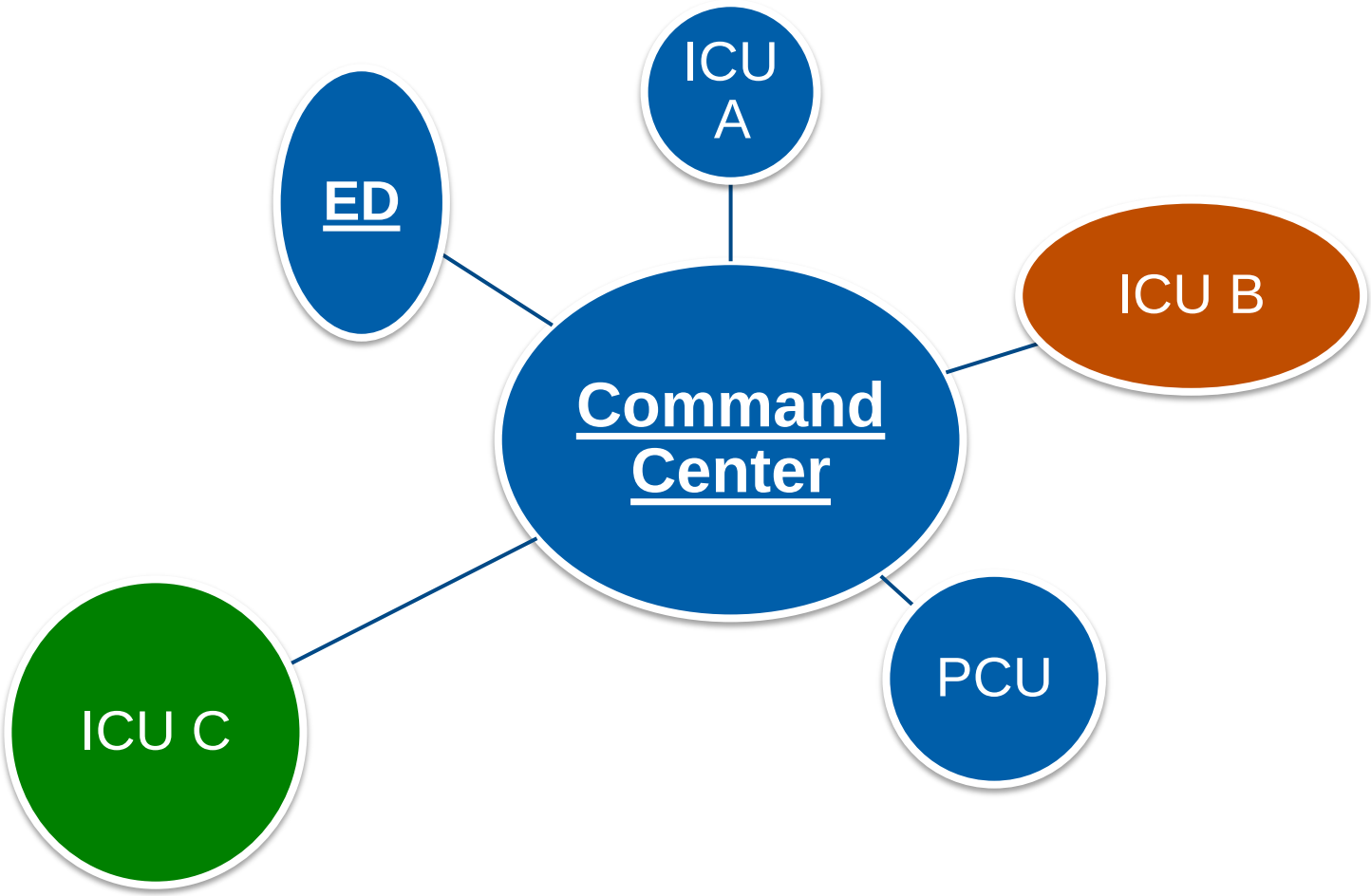
Growth of 1%/year

Tele-ICU:

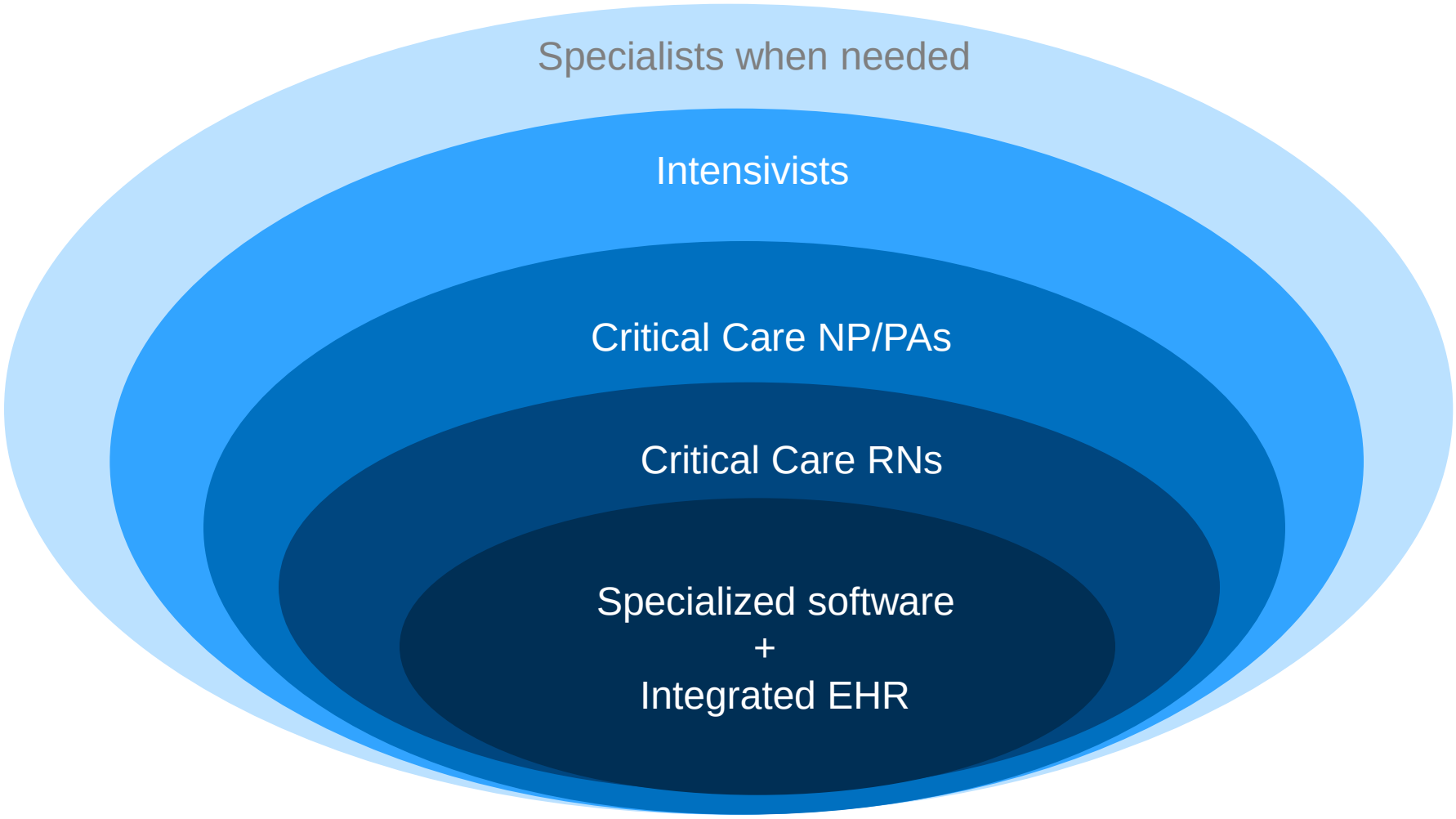
- Supplemental monitoring and care of ICU patients in remote hospitals
- Partner in care with local providers
- How?

1. Monitoring for physiologic deterioration
2. Promoting evidence based practices
3. Resource for expert advice and guidance
4. Collecting performance data for feedback

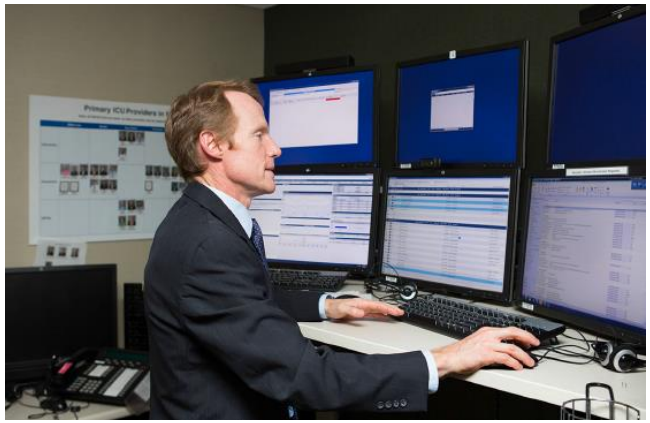
Hub and Spokes

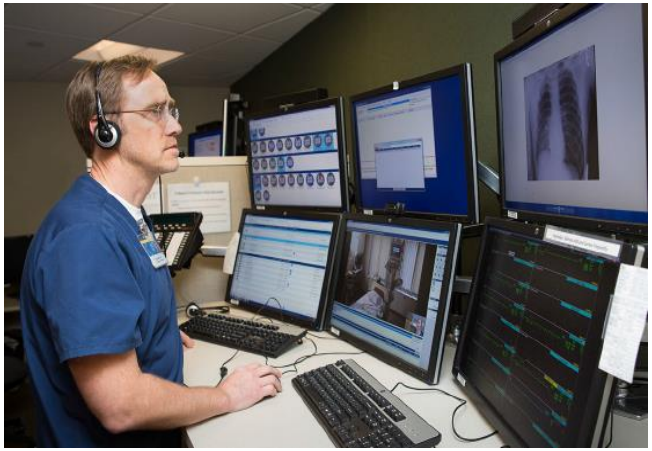


The Hub
Layers of Support



Centralized (vs. De-centralized)





Clinical Operations Center

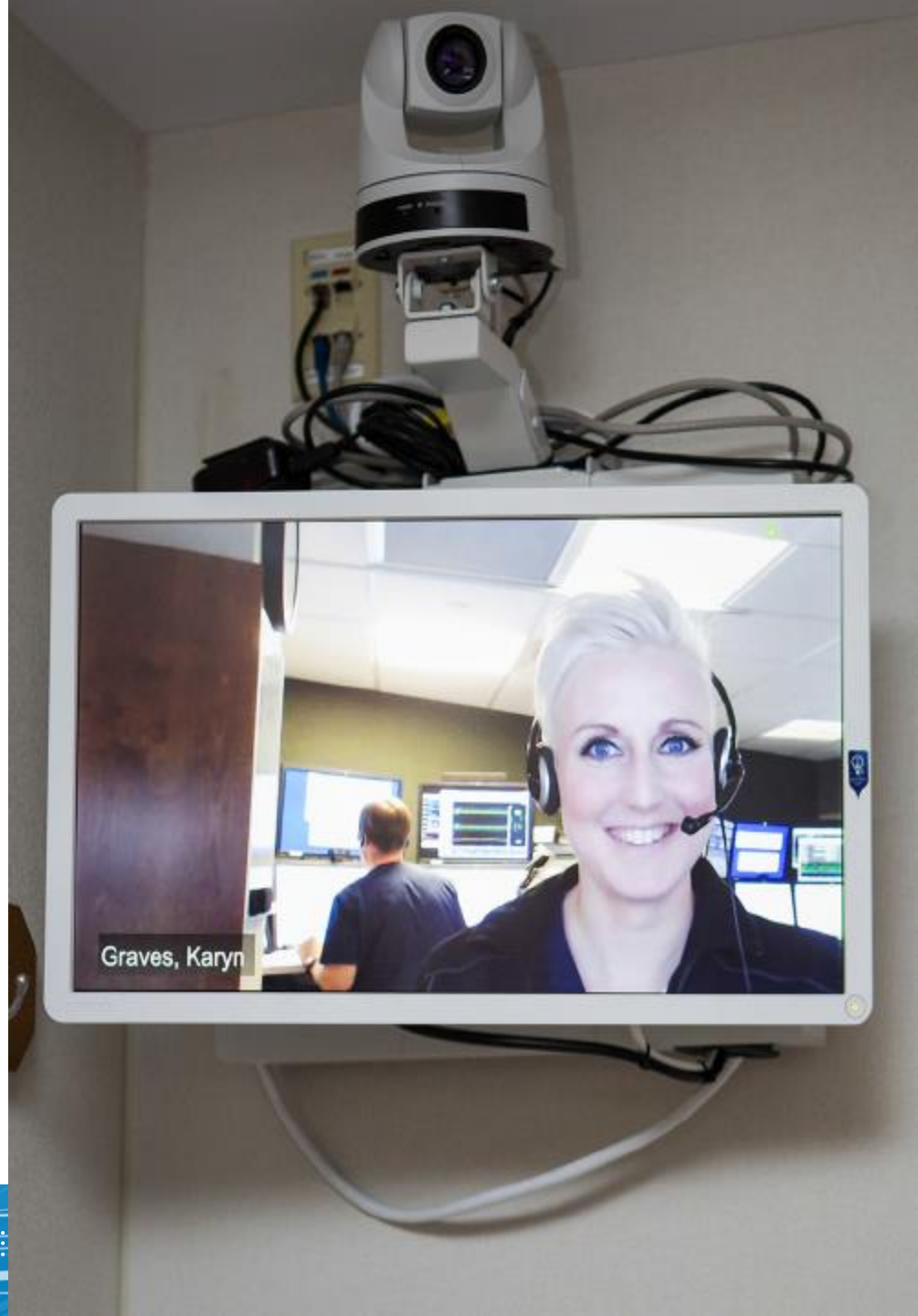
- 24 x 7
  - Intensivist
  - 2 CC RNs
- 6p-6a
  - 1 NP/PA

The Spokes—remote ICUs Synchronous, continuous

- High definition audio-visuals
- Real-time, bi-directional interaction

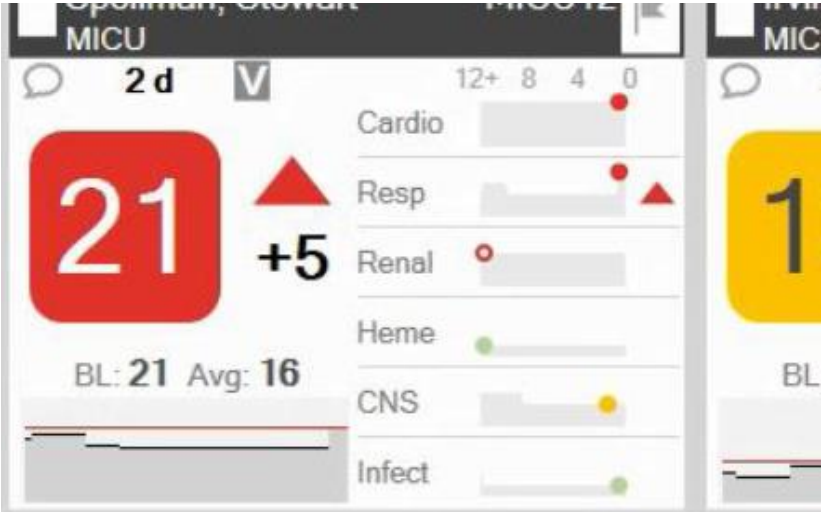
Video Camera

- Proactive: Evaluation of new admissions; nursing assessments
- Reactive: Patient deterioration
- A major cultural shift



eICU Software

- Interfaced with vital signs and labs from local EHR
- Synchronous, continuous feed



- Detects trends in patient condition
- Alerts for deterioration

Time	Unit	Bed	Patient Name	Triggered Alerts		
12:53	MICU	MICU10	Demo 1, PatientMICU	O2/RR: O2 [95] 92, RR 22	HR-▲: [93] 116	MAP-H: [160] 163
12:51	MICU	MICU12	Spellman, Stewart	HR-H: [75] 121	MAP-L: [60] 56	O2/RR: O2 91, RR [6] 5
12:50	MICU	MICU11	Demo 5, PatientMICU	O2/RR: O2 94, RR [40] 43		

eICU—models, functions, capabilities

Reactive

- Identify the deteriorating patient
- Real-time intervention
  - Meds, vent orders, communication with local staff
- Code/CPR support
- Procedural support
- Patient/family
- Culture Change

Proactive

- Bedside rounds
- Patient/familuy
- Progress notes
- Bundle compliance
- QI/Sepsis initiatives
- Nurse mentorship
- Consulting (RT)
- Practice integration
- **Culture change**

Published outcomes

Hospital Mortality, Length of Stay, and Preventable Complications Among Critically Ill Patients Before and After Tele-ICU Reengineering of Critical Care Processes

Lilly, et al. *JAMA*, 2011

- Univ of Mass. 6,290 patients in 7 ICU's
- 3 Med, 3 Surg, 1 CV
- Closed, integrated system, with a culture of quality improvement
  - No opt-out, full discretion of the eICU team
- Tele-ICU Hub → "Logistics Center"

Eye-opening results

- Reduced overall mortality
  - 13.6%→11.8%
- Reduced Hospital LOS
  - 13.3 days→9.8 days

Particular impact on off-hour (night) admissions

	Before		After	
Outcome	Daytime Admission	Off-hours Admission	Daytime Admission	Off-hours Admission
Hospital Mortality	11.5	16.1	11.1	12.7
ICU Mortality	9.1	12.6	8.29	8.96
Hospital LOS	12.4	14.2	10.0	9.6
ICU LOS	5.5	7.7	4.4	4.6

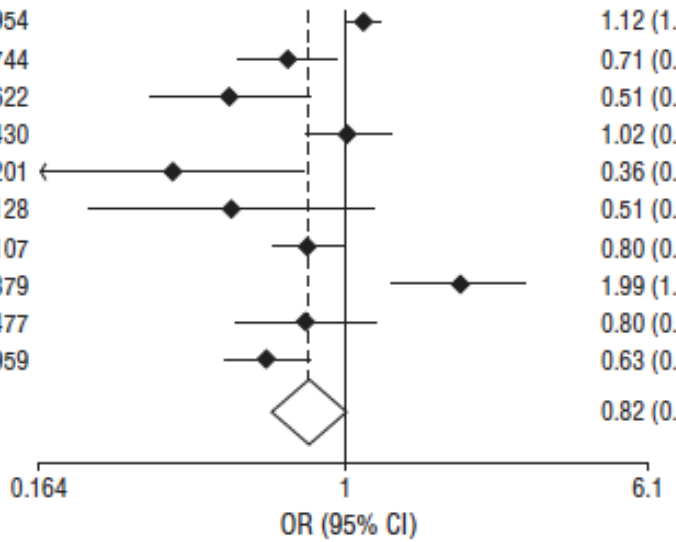
Lilly et al: JAMA 305, 2011

Impact of Telemedicine Intensive Care Unit Coverage on Patient Outcomes

A Systematic Review and Meta-analysis

Lance Brendan Young, PhD, MBA; Paul S. Chan, MD, MSc; Xin Lu, MS; Brahmajee K. Nallamothu, MD, MPH; Comilla Sasson, MD, MS; Peter M. Cram, MD, MBA

	Preintervention		Postintervention		
Source	**No. of Deaths**	**No. of Patients**	**No. of Deaths**	**No. of Patients**	**OR (95% CI)**
Shaffer et al,[42] 2005	1563	6205	1083	3954	1.12 (1.02-1.23)
Breslow et al,[51] 2004	180	1396	71	744	0.71 (0.53-0.95)
Kohl et al,[40] 2007	21	189	157	2622	0.51 (0.31-0.82)
Morrison et al,[52] 2010	136	1371	144	1430	1.02 (0.79-1.30)
Rosenfield et al,[28] 2000	26	225	9	201	0.36 (0.16-0.79)
Siek et al,[43] 2008	19	148	9	128	0.51 (0.22-1.18)
Thomas et al,[53] 2009	245	2034	209	2107	0.80 (0.66-0.98)
Zawada et al,[32] 2009	28	696	491	6379	1.99 (1.35-2.94)
Norman et al,[41] 2009	51	356	56	477	0.80 (0.53-1.20)
McCambridge et al,[29] 2010	204	954	141	959	0.63 (0.50-0.80)
Overall ($I^2 = 84.9\%$, $P < .001$)					0.82 (0.65-1.03)



Examples of process breakdown

CNN Health » Food | Fitness | Wellness | Parenting | Live Longer Live TV U.S. Edition +

A doctor in California appeared via video link to tell a patient he was going to die. The man's family is upset

Tele-Stroke

TELE-STROKE

Metrics

- **Service**
  - >10,000 patients served
- **Effectiveness**
  - 98% accuracy for diagnosis and correct clinical decision making
  - 10-fold increase in thrombolysis rates (from 2% to 20%)
  - 20 min median consult time
- **Performance**
  - 1 min median stroke neurologist response time
- **Safety**
  - 3% post thrombolysis symptomatic intracranial hemorrhage
- **Disposition**
  - 65% reduction in patient air/ground ambulance transfers from spoke to hub site
- **Morbidity & Mortality**
  - Tele-stroke treated patients have approximately the same outcomes as those treated at Mayo Clinic campus stroke centers

Demaerschalk B M et al: Stroke 2012;43:3271-3277

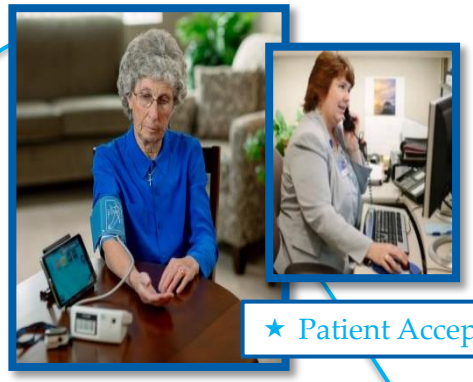
Ambulatory Monitoring at Home

- Post hospital discharge monitoring
- High frequency conditions (COPD, CHF)
- To reduce re-hospitalization, cost and to improve quality of life

Measures

- Phone calls
- Upload of compliance logs
- Portable monitors
  - Fit Bit, Apple, etc

REMOTE MONITORING WORKFLOW-

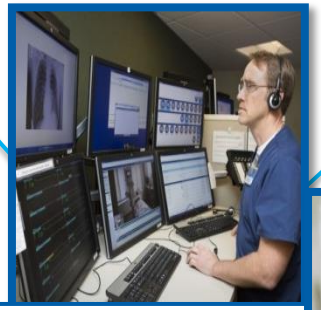


★ Patient Acceptance

★ Patient Graduation

- Data and notes available to care team that direct overall care plan
- Patient meets criteria for graduation
- Hand-off to Care Team

★ Patient Enrollment



★ Action on Alerts & Trends

- CC RN monitors alerts/trends
- Works with patient to assess needs& provide education

PRELIMINARY OUTCOMES (COPD, HTN, CHF, heart disease)

Reduced unadjusted 30-day readmissions

48%

when compared to a like control.

84%
Reduction in COPD readmission rate

49%
Reduction in CHF readmission rate

Avoided

68

30-day readmissions

estimated based on reductions in unadjusted readmissions

Reduced unadjusted 60-day readmissions

25%

when compared to a like control.

69%
Reduction in COPD readmission rate

29%
Reduction in CHF readmission rate

Monitoring on the Ward

Identify the deteriorating patient earlier


ViSi
MOBILE
MENU
69
120
80
(93)
14
97
98.6


Not FDA

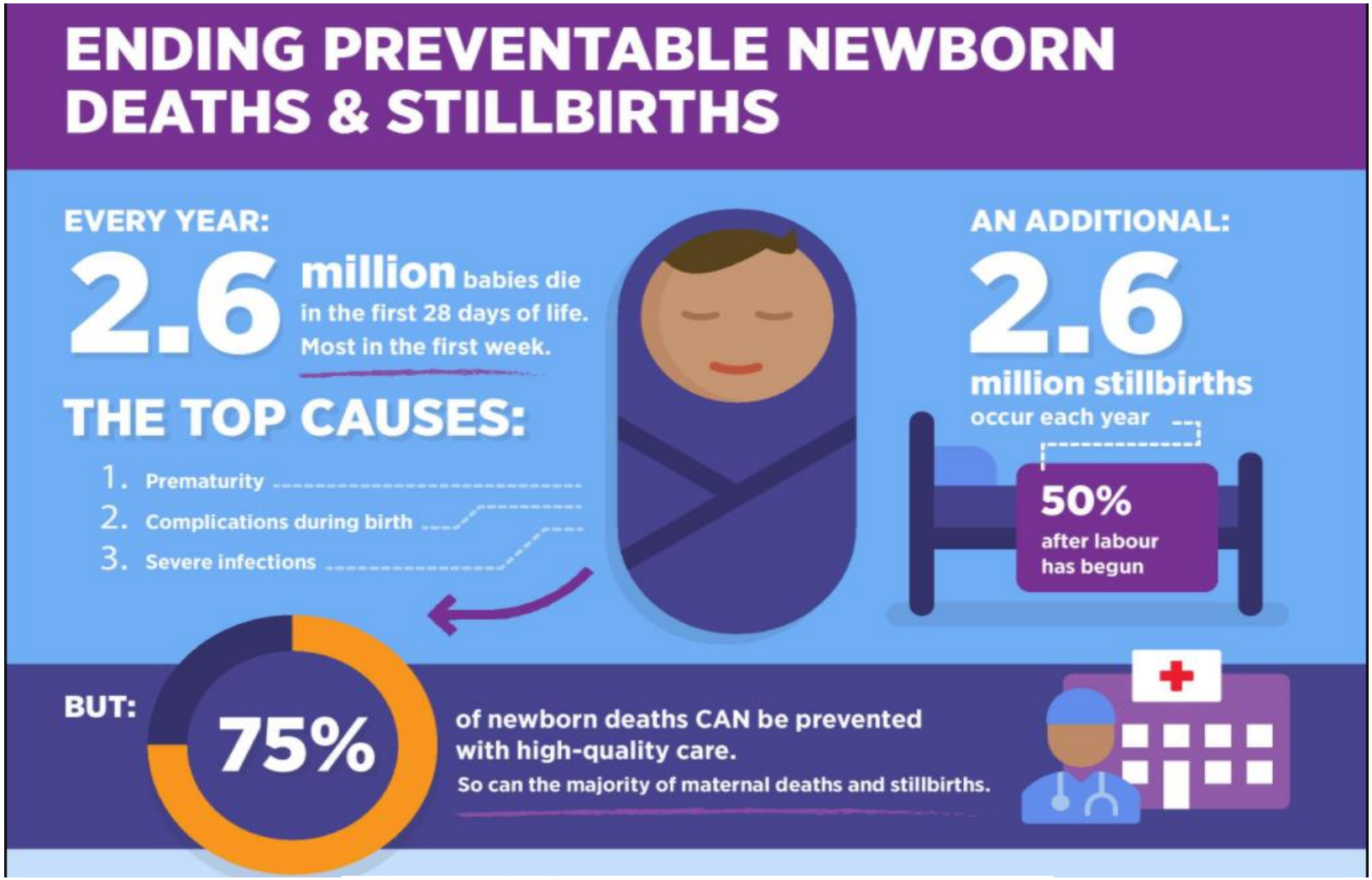
Visi Mobile Device

- 4 ounce ICU-grade monitor

- Continuous Vital Signs
  - ECG/PR
  - SpO2
  - Respiratory Rate
  - Skin Temp
  - NIBP/cNIBP

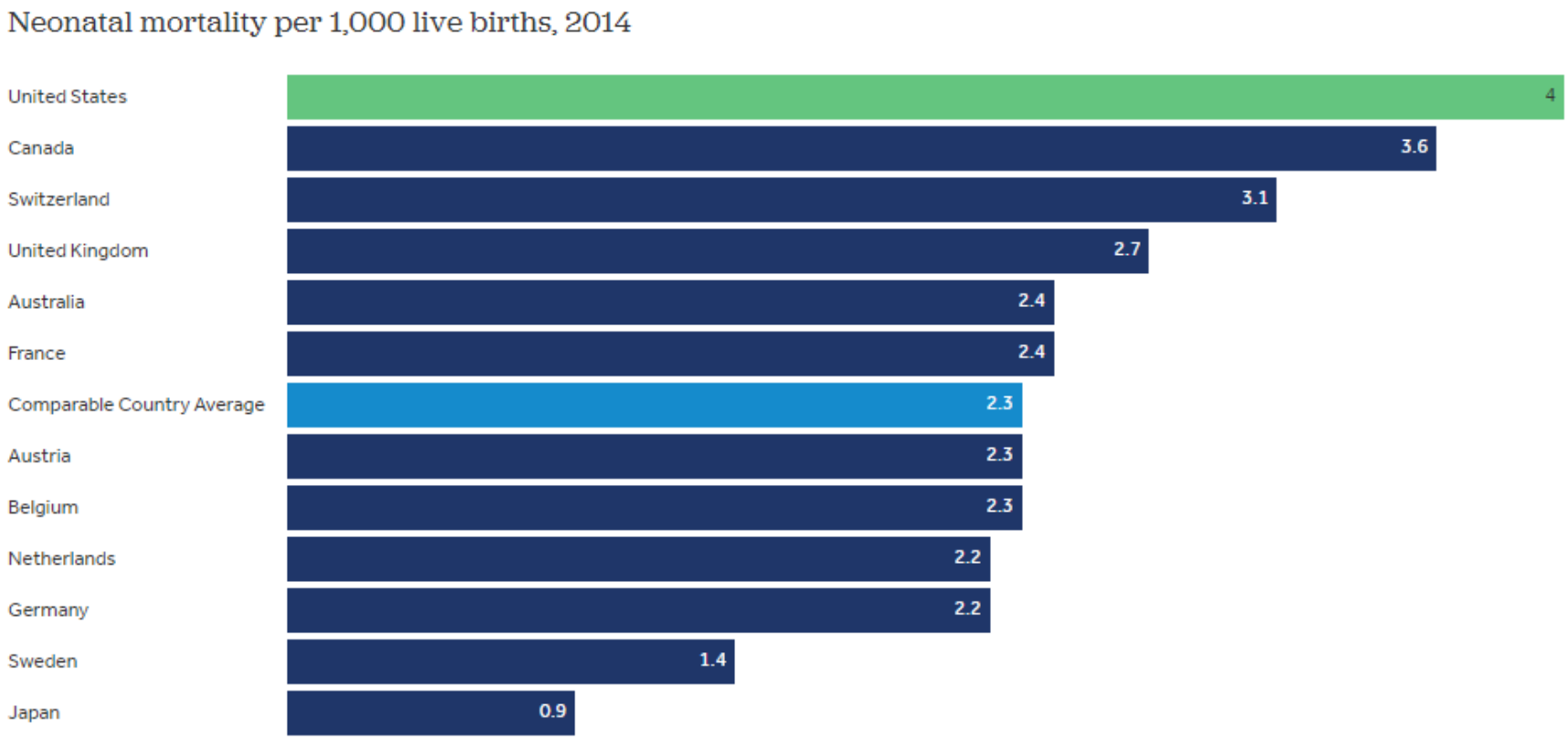
- Wi-Fi connectivity
  - Epic compatible

Tele-Neonatology



World Health Organization unicef

Neonatal mortality in the U.S. is higher than in comparable countries



Comparable countries are defined as those with above median GDP and above median GDP per capita in at least one of the past 10 years. In cases where 2014 data were unavailable, data from the last available year are shown.

Source: Kaiser Family Foundation analysis of data from OECD (2017), "OECD Health Data: Health status: Health status indicators", OECD Health Statistics database. (Accessed on July 5, 2017). • Get the data • PNG

Peterson-Kaiser
Health System Tracker

Tele-Neonatology at Mayo Clinic

- Pre: 43% of newborns had access to a neonatologist
- Post: 100%

- Reduction in mortality and emergent transfers

Post-Operative Visits

Thoracic surgery

Thoracic Surgery Video Visits
Demographics

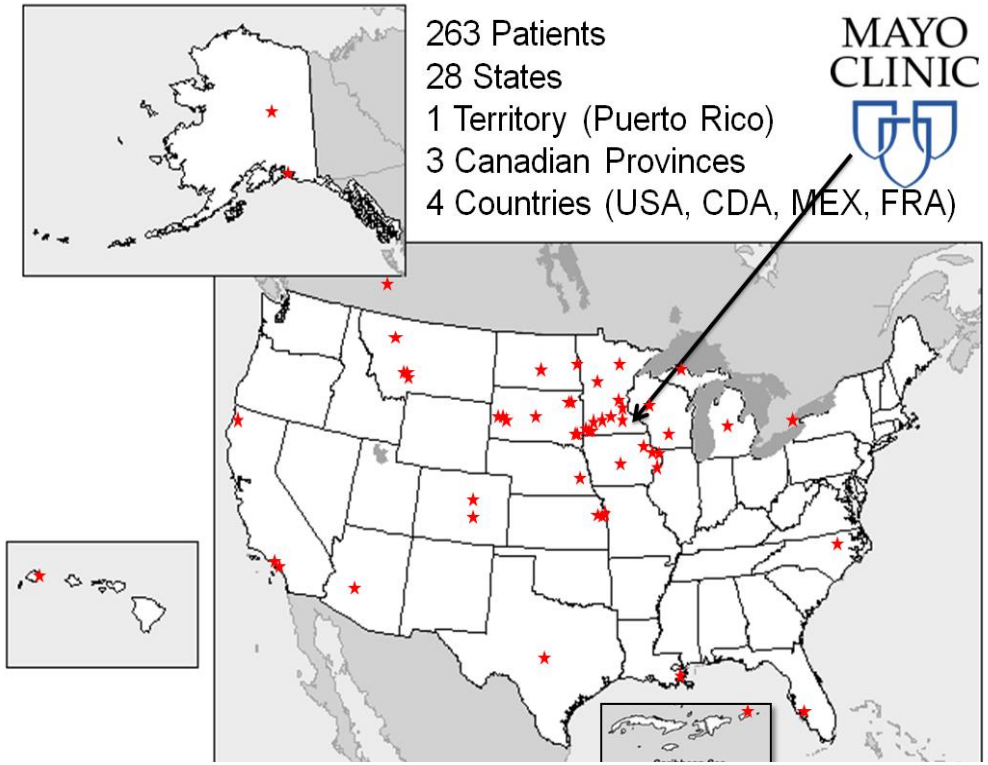
Men
46.8%

263 Patients

Median Age – 65y
(range 17 – 87)

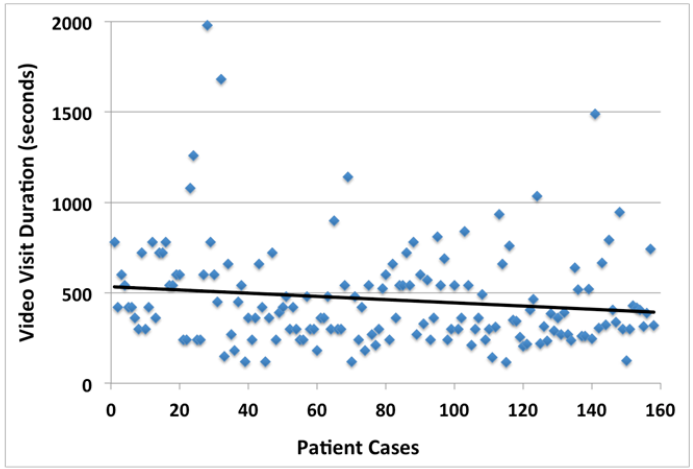
Median Interval from
D/C to Video Visit
47 days

Women
53.2%



Thoracic Surgery – Video Visits
Appointment Metrics

- Median Duration = 6.5 minutes (2-33m)



Thoracic Surgery – Video Visits
Patient Satisfaction

Visit was:

On-time and efficient	100% Strongly Agree
Conducted confidentially	100%
Educational/Informative	98%
Overall Satisfaction	100%
Would choose this appointment type in future	100%

Thank You

Questions?

