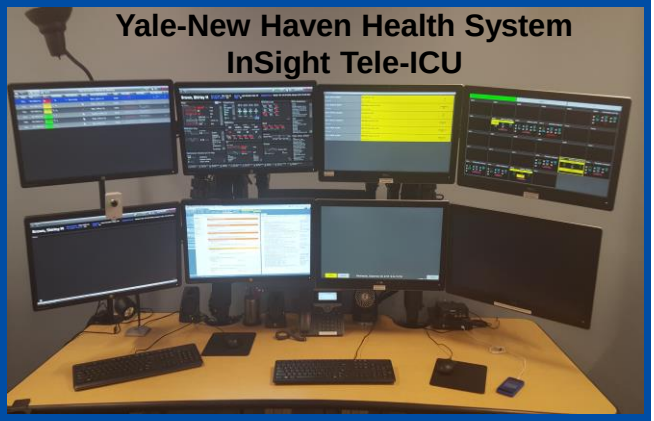
TELE-ICU

"Implementation & Beyond"

Northeast / South Regional AAAP Meeting
October 12th, 2015

Peter S. Marshall, MD MPH
Assistant Professor of Medicine
Co-Director, InSight Tele-ICU
Yale New Haven Healthcare System



Yale SCHOOL OF MEDICINE

DISCLOSURE

~ There is no commercial support for this lecture.

Confirmation is also made that today's lecture and faculty disclosure have been peer reviewed and:

~There are no conflicts of interest.

OUTLINE

- Define the Problem / Define Tele-ICU
- Evidence for Effectiveness of Tele-ICU
- Why / How does it work?
- Yale-New Haven Health System Tele-ICU program: InSight
  - InSight Clinical Center
  - Software and technology
  - Results to date: Pilot
- Financial implications
- Future Directions

History

- **1924:** Radio News suggested that a “radio doctor” may provide direct medical care
- **1977:** Trial of “television” consultation with university based intensivists extended availability of specialist expertise & was better than telephone consultation
- **1997:** Trial of 24 hour remote monitoring, computer based data transmission to communicate with bedside staff
- **2000:** Trial of 19 hour remote monitoring, computer data relay, computer based decision support

Lilly Clinics Chest Medicine 2015; Grundy et al Crit Care Med 1982; Grundy et al JACEP 1977; Rosenfeld et al Crit Care Med 2000; Breslow Crit Care Med v32 2004

The Problem: ICU staffing

- Recommendation for 24 hour staffing of ICUs by Leapfrog group and others in early 2000's
- Many institutions lack patient volume to justify 24/7 hiring
- Staffing ICU 24/7 with intensivists is expensive
- National shortage of intensivists persists
- Locally there is variable night time staffing among ICUs
  - Would need 45 intensivists to staff nights for the entire system
- Telemedicine is one method of addressing these issues
  - Use of audiovisual technology combined with electronic media and data systems to evaluate and treat patients
  - Tele-ICU is the application of Telemedicine to ICU

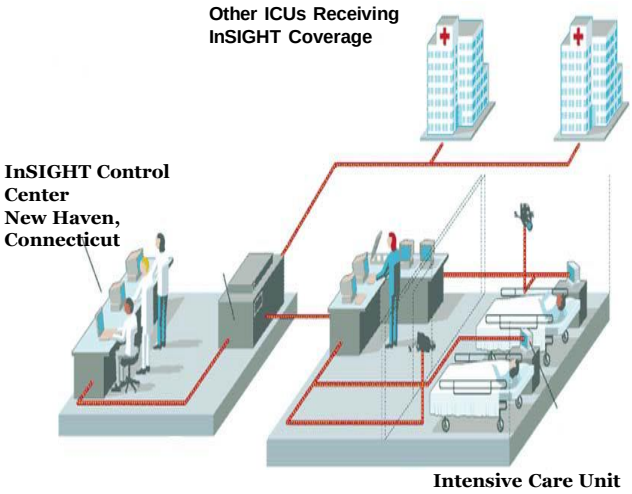
Young et al JAMA 2000; American Telemedicine Association 2014

Tele-ICU is **not** . . .

- A replacement for bedside nurses
- A tool to monitor nursing practice
- A replacement for bedside house staff / LIPs / attendings

Telemedicine in the ICU (Tele-ICU)

- It is meant to **augment** care through the **leveraging** of resources and the standardization of processes.



American Telemedicine Association Guidelines, May 2014

Evidence: Lehigh Valley Health Network

- 730 bed hospital, 36 ICU beds, closed ICU model
- Installment of remote intensivist coverage (RIC) / Tele-ICU & health information technology bundle (HITB):
  - ICU EMR
  - Algorithmic event system
  - Computer assisted physician order entry
- N = 1900
- 16 months, 7 pm – 7 am coverage
- APACHE score – 57 v. 58 (p = 0.17)

Table 2. Observed Mortality, Standardized Mortality Ratio, Ventilator Use, and Length of Stay by Patient Group

Variable	Control Group (n=954)	HITB-RIC Group (n=959)	*P* Value
Observed hospital mortality rate, No. (%)	204 (21.4)	141 (14.7)	<.001[a]
Observed ICU mortality rate, %	15.8	11.5	.006[a]
Standardized mortality ratio[c]	1.075	0.758	. . .[c]
Ventilator use rate, %	36.1	31.5	.04[a]
Hospital LOS, mean No. of days	9.2	9.2	.83[b]
ICU LOS, mean No. of days	4.1	3.8	.88[b]

McCambridge et al Arch Intern Med 2010

Effect of Tele-ICU on ICU Best Practices / Complications

Conclusions:

- Reduced ICU Mortality
- Reduced in-hospital mortality
- Reduced ICU LOS
- Reduced hospital LOS
- Improved adherence with best practice*
- **Reduced ICU complications**

Table 4: Practice Guideline / Complication	OR	P-value
Stress ulcer proph*	4.57	<0.001
DVT proph*	15.4	<0.001
VAP bundle*	2.20	<0.001
CV Protection*	20.7	<0.001
VAP	0.15	<0.001
CLABSI	0.5	0.005
AKI	1.00	ns

N = 6300

Lilly et al JAMA 2011

How can Telemedicine Improve Matters?

- Example: Sepsis – Clinical syndrome not amenable to automated diagnosis. Cost of missing the diagnosis is high.
  - Use IT to apply screening tools (high sensitivity, low / moderate specificity) at defined intervals, "cast a wide net several times per day"
  - Clinicians make the final diagnosis from among positive "screens"
  - Rincon et al performed approximately 194 screens / day to find 5 new cases of severe sepsis:

→ Staff avoid sifting through gigabytes of data; info presented in a useful format to facilitate diagnosis

→ Diagnosis of the disease earlier; avoid multi-organ failure or death

→ Using only 1 intensivist and 2 – 3 RNs – while covering 100 to 120 ICU patients

Rincon et al Telemed J E Health 2011

Effect of Tele-ICU on influencing processes

Pre	Tele-ICU
Bedside alarms	Trend alerts Lab alerts Off-site rounds
Day / goal sheet	Electronic surveillance Real time audits
Case presentation via telephone	Review in parallel with house staff Interaction with RN, RT, pharmacy etc. . . .

N = 6300

→ Significant improvement in compliance with ICU processes

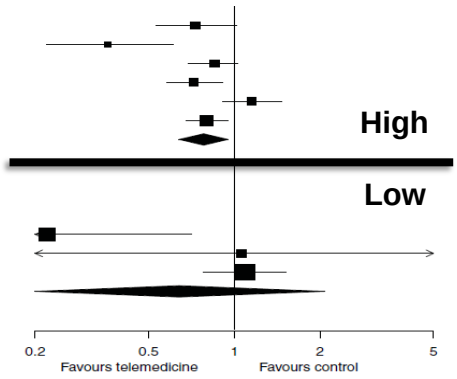
→ In addition, significantly reduced ICU and hospital mortality (& LOS)

Lilly et al Chest 2012

Meta-analysis: "More Tele-ICU is better"

- Analyzed studies with full Tele-ICU control (high intensity) separately from low intensity units
- Noted greater benefit of Tele-ICU in high intensity group
- Also demonstrated reduction in overall and ICU mortality with combined analysis (not depicted)

ICU mortality by **intensity** of TeleICU coverage



Wilcox & Adhikary, Crit Care 2012

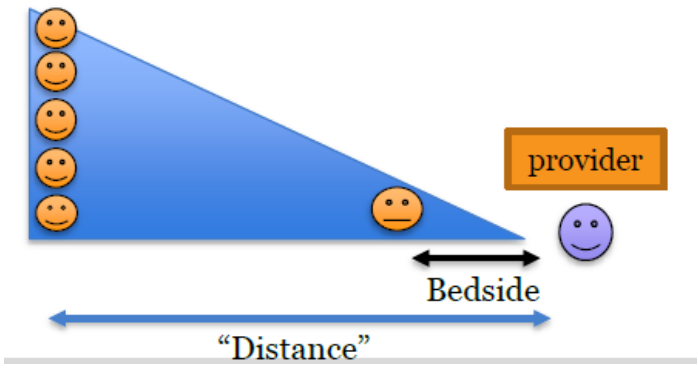
Lessons

Tele-ICU can:

- Reduce ICU and In-hospital mortality
- Promote standardization of process (e.g. adherence to sepsis bundles)
- Create a “24 hour” ICU and unburden night staff
- Allow expert management of rare or complex cases across distance
- Assess performance at unit level
  - Data collection and care occur simultaneously
- Create perspective via “Distance”
  - Facilitates multi-tasking
  - Allows situational awareness
  - Responding to trajectories and composites

Lilly et al JAMA 2011; Mercy, Crit Care Res & Pract 2013; Willmitch et al, Crit Care Med 2012; McCambridge et al Arch of Intern Med 2010

Perspective



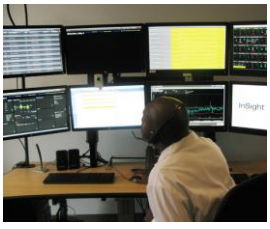
Pediatrics and Tele-ICU

- Lack of data for continuous Tele-ICU coverage in Pediatrics
- Some data for Telemedicine consultation
- Studies underway

Marcin, Pediatric Clinics of NA 2013

InSight Overview

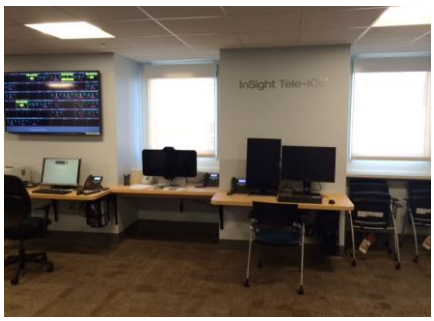
- A second set of eyes for ICU patients
- Virtual clinical center staffed with intensivists, APPs, and RNs
  - 7pm – 7am, 365 nights/year
- Combines telemedicine with software applications to monitor ICU patients remotely via two-way audio/visual feed
  - HIPAA secure
  - No recording



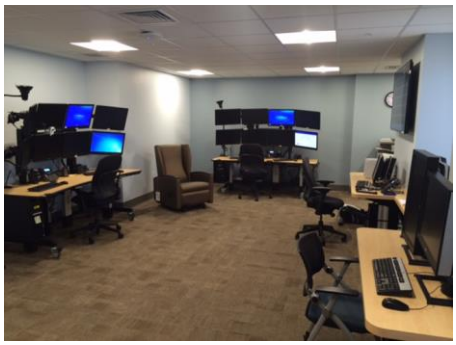
YNHHS InSight Tele-ICU

- Integration of Epic EMR and audiovisuals
  - First Epic system to use Epic for Tele-ICU
- Epic EMR with upgrades to create Epic Monitor & Dashboard
- Best Practice Alerts used to alert clinicians to changes in status
  - Integrated with Yale Early Warning Score (YEWS)
  - YEWS = algorithmic event system
- Live data from bedside monitors via Cardiopulmonary Corp (CPC)
  - Spontaneous, un-validated data

InSight Clinical Center

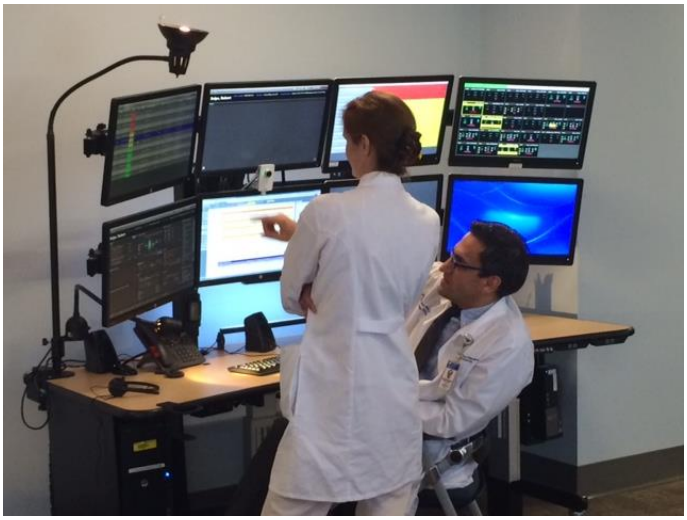


- Clinic Building
  - Access controlled
- 3 workstations
  - MD, APRN/PA, back-up
- Downtime PC and printer



- PACS
- Videoconference Station
- Dedicated phone, fax, email, pagers, and Mobile Heartbeat numbers

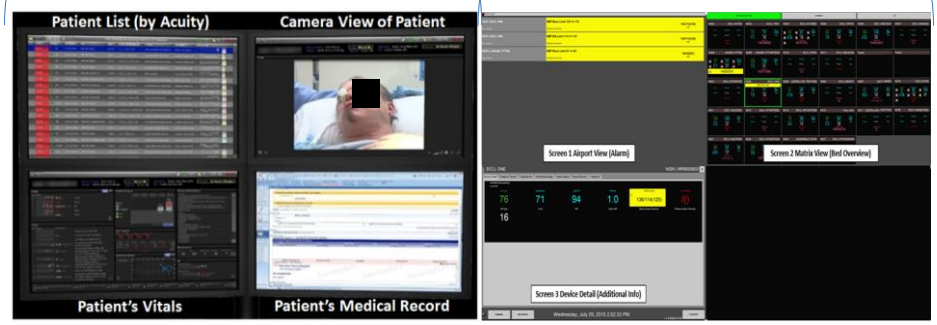
Clinician Workstations



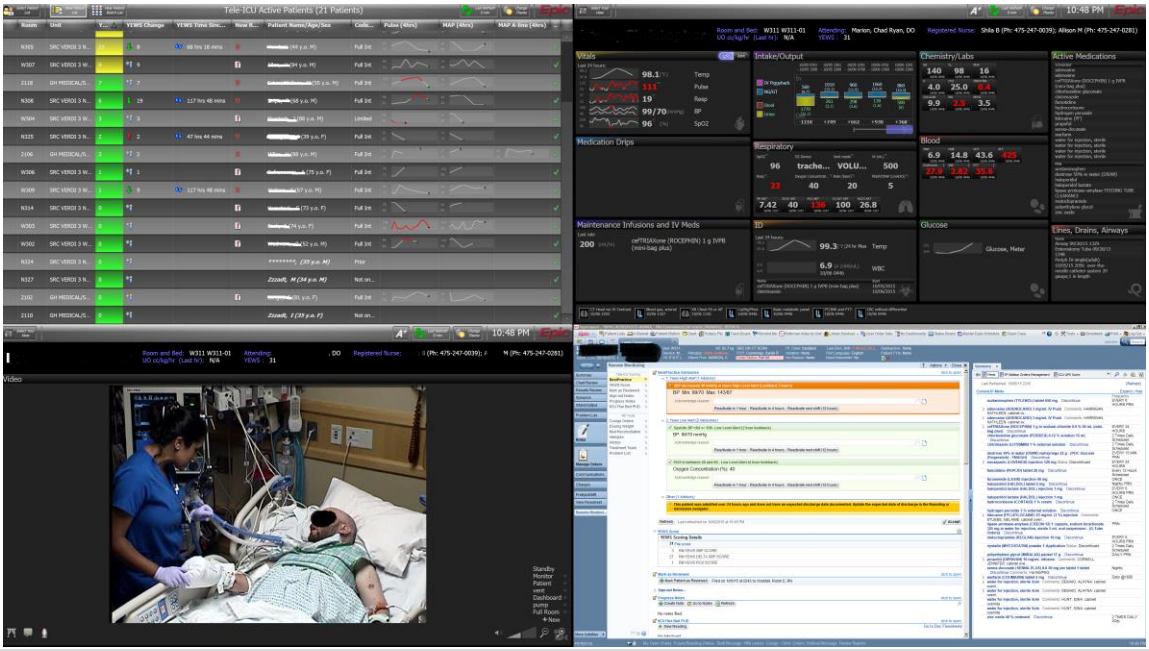
Clinician Workstations: Monitors

4 monitors display **Epic** patient data or camera view

4 monitors display direct **patient monitoring** feeds / vitals



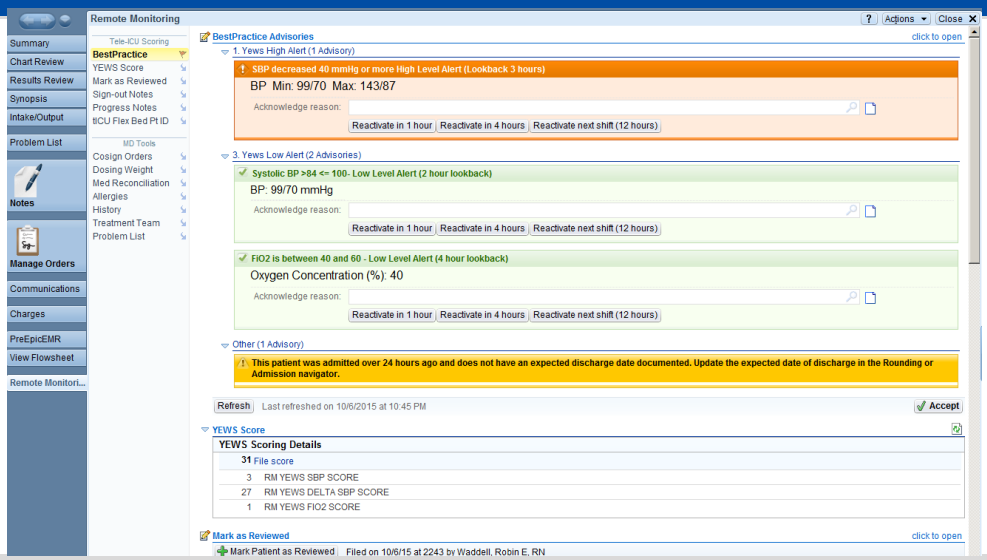
Epic **Bernoulli / CPC**


Tele-ICU Active Patients (21 Patients)
10:48 PM
Vitals
Intake/Output
Chemistry/Labs
Active Medications
Medication Drips
Respiratory
Blood
Maintenance Infusions and IV Meds
ID
Glucose
Lines, Drains, Airways
Video

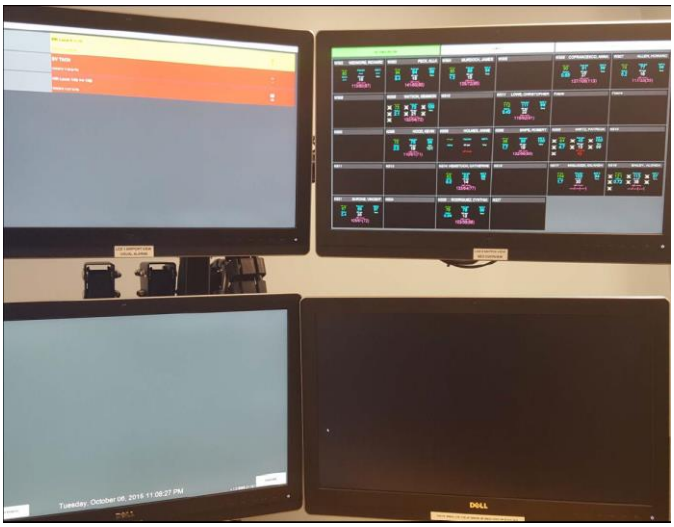

Tele-ICU Active Patients (12 Patients)
Room
Unit
Y...
YEWS Change
YEWS Time Sinc...
New R...
Patient Name/Age/Sex
Code...
Pulse (4hrs)
MAP (4hrs)
MAP A-line (4hrs)
W306 SRC VERDI 3 W... 89 89
W311 SRC VERDI 3 W... 63 57 107 hrs 1 mins
W304 SRC VERDI 3 W... 29 23 106 hrs 59 mins
N310 SRC VERDI 3 N... 20 20
W309 SRC VERDI 3 W... 19 19
N309 SRC VERDI 3 N... 12 12
N306 SRC VERDI 3 N... 11 11
N313 SRC VERDI 3 N... 9 9
W308 SRC VERDI 3 W... 7 7
N303 SRC VERDI 3 N... 4 10 107 hrs 0 mins
N305 SRC VERDI 3 N... 2 2
W307 SRC VERDI 3 W... 1 1
Limited
Full Int
Not on...

Epic Dashboard

Yale Early Warning Score (YEWS)

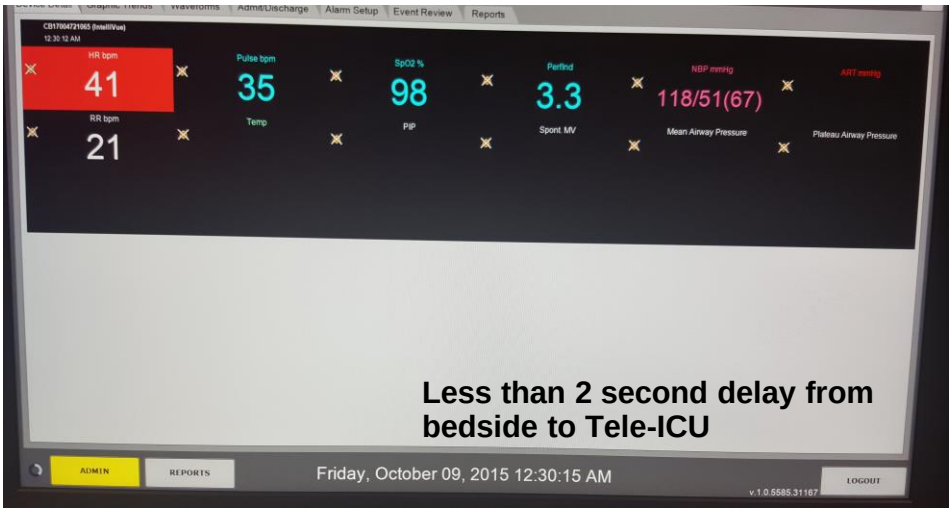


CPC 4 screen display: Live data



CPC Alarm List

CPC Detail View



CPC Waveforms

Mobile Heart Beat

HIPAA compliant, secure smart phones that connect bedside staff with Clinical Center and one another

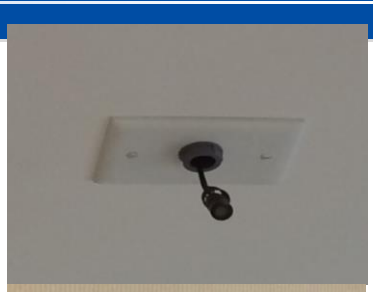
Ability to text, call and teleconference

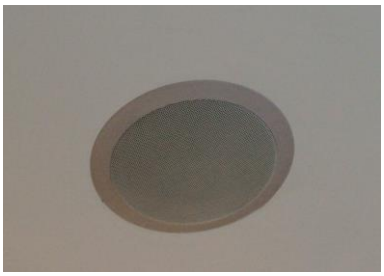
Soon . . . patient results sent directly to phone

InSight Equipped Room: SRC

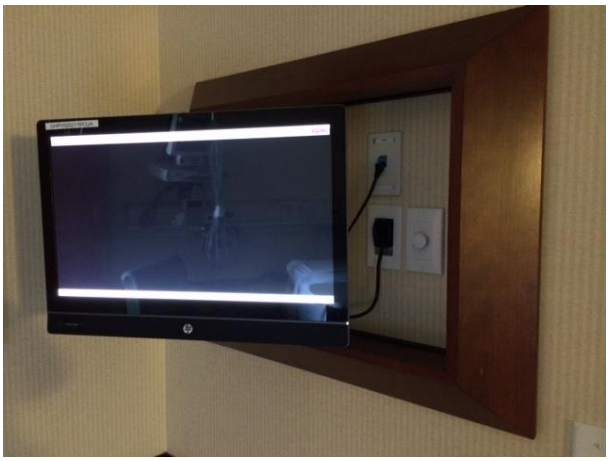
YALE NEW HAVEN HEALTH

InSight Room Technology: GH

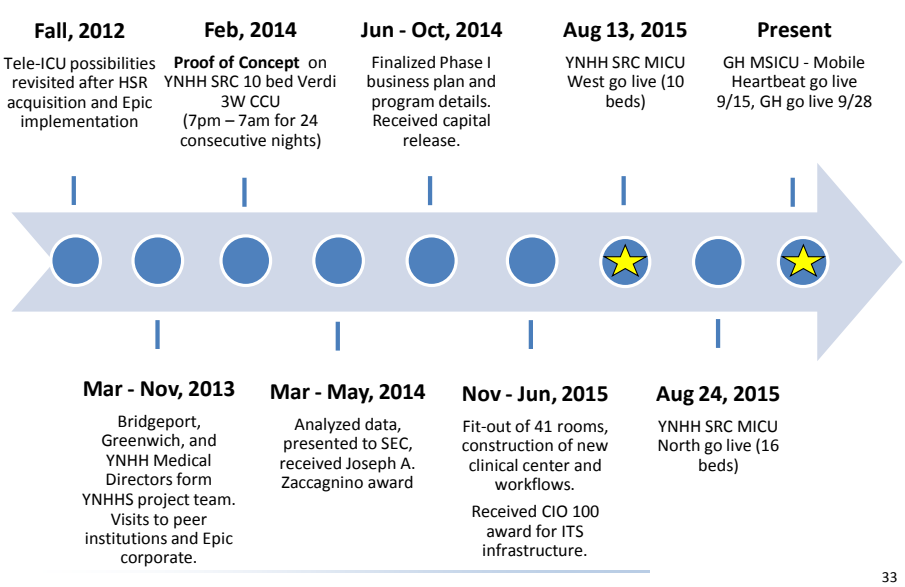




InSight Patient Monitor: GH / SRC



Work to Date



33

YALE NEW HAVEN HEALTH CARE SYSTEM ADULT ICU BEDS

DATE / UNIT	06/15/2013	01/02/2014	09/01/2015	FUTURE?
SRC – MICU*	(18)	18	22	22?
SRC – SICU	-	(15)	15	15?
YNHH – NICU	-	-	14	14
YNHH - CTICU	-	-	(18)	18
SRC - CTICU			--	--
YNHH – SICU	-	-	(21)	21
GH – MICU / SICU**	-	(10)	(10)	10
BH – MICU / SICU**			-	32
Totals	(18)	18, (43)	51	**(100)** **132**

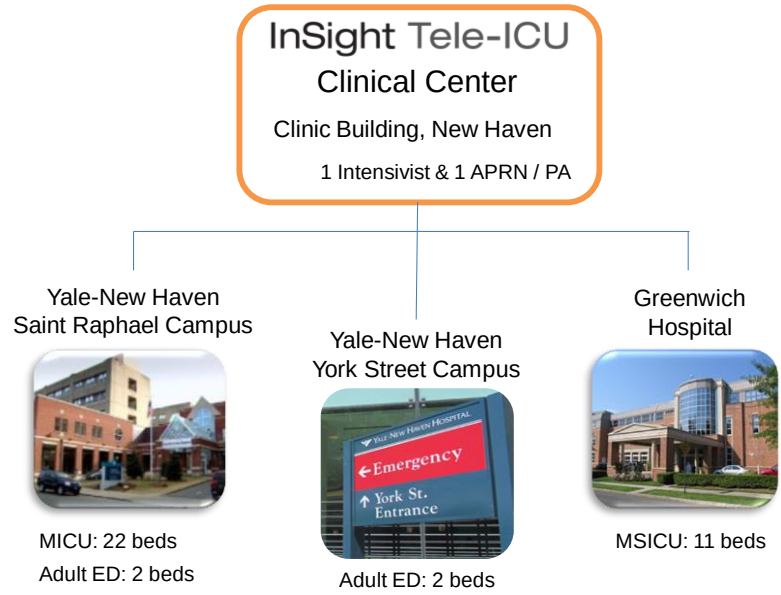
YNHHS - PILOT RESULTS

	Sepsis Bundle	Spontaneous Breathing Trial Protocol	Glucose Management (#controlled/ patient days)	Oxygen	Urinary Catheter Order
tICU Pilot (2/6/14 – 3/1/14) 164 patient days	75%	76%	82%	93%	90%
Control (1/31/14 – 3/1/14) 272 patient days	0%	30%	73%	61%	73%
Relative Change	↑ 75%	↑ 153%	↑ 12%	↑ 52%	↑ 23%

YNHHS - PILOT RESULTS - 2

	ICU LOS	Overall LOS	Mortality	Direct Cost/ Case	Complication Rate (% patients w/ CVI)
tICU Pilot (2/5/14 – 2/28/14) n = 38	3.97	4.92	11%	$14,860	16%
Control (2/5/14 – 2/28/14) n = 30	4.60	3.80	17%	$15,533	20%
Relative Change	↓ 14%	↑ 29%	↓ 35%	↓ 4%	↓ 20%

Phase I: 41 Beds



BILLING FOR SERVICES

- Potential Cost savings
  - Traditional staffing costs $100,000 per monitored bed per year.
  - The Tele-ICU model costs $30,000 per monitored bed per year.
- Telemedicine reimbursement limited to rural areas
- Prospects for reimbursement dependent upon state laws
  - CT: proposal for reimbursement of Telemedicine services
  - Will Tele-ICU meet standard?
- Financial support from regional payers for "start-up"
  - Recognize potential long-term cost savings
  - Support improvements in ICU care

Tele-ICUs: Remote Management in Intensive Care Units 2007; Rogove & Stetina, Crit Care Clin 2015

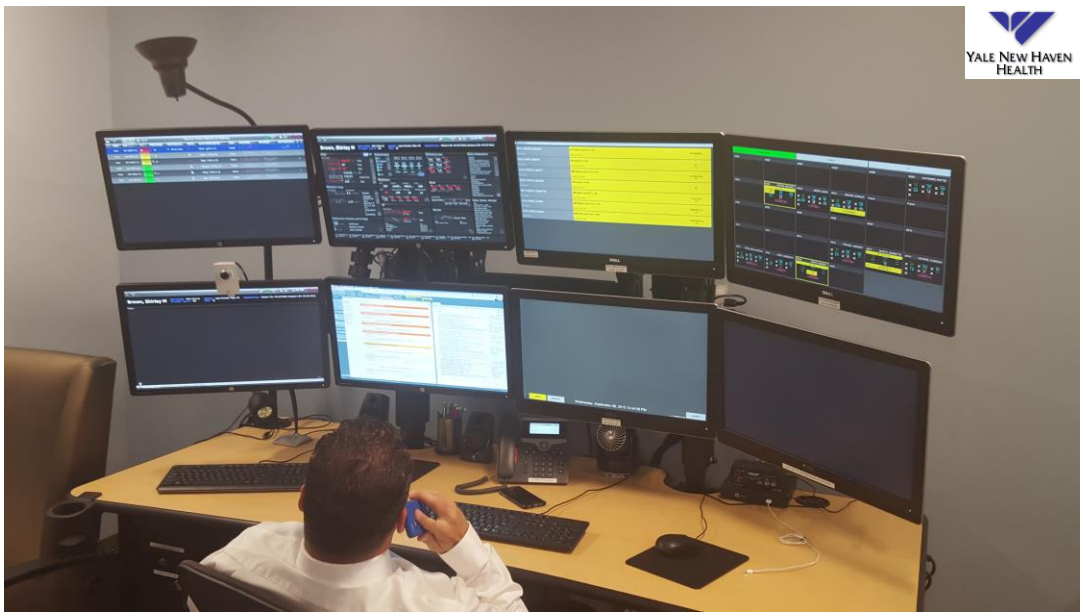
Future "InSight"

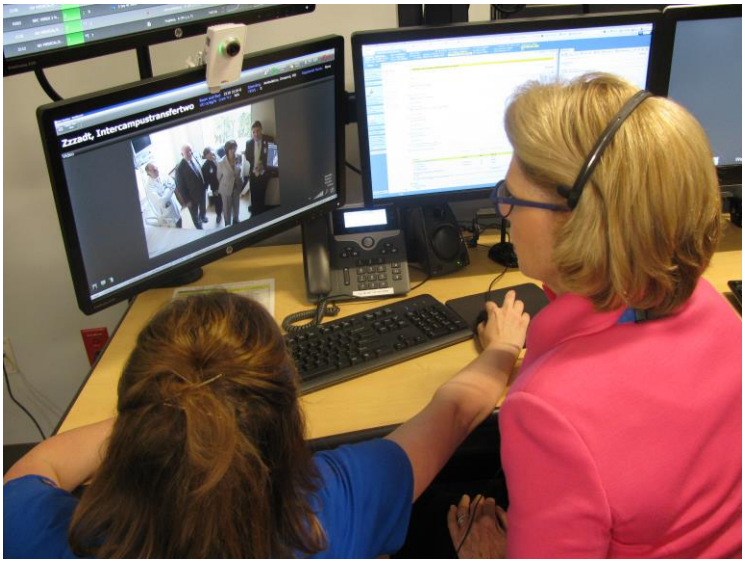
- Expansion to other units
  - SICU SRC (15 beds) → December 2015
  - Total: 132 ICU beds in current Yale New Haven Health Network
  - Lawrence & Memorial Hospital / Westerly Hospital 2016?

- Further Examination of Tele-ICU as tool to address patient safety and medical errors

- Further define its role in multi-disciplinary patient care / **other patient populations**
  - Role of other providers (RTs, Pharmacists)
  - Identify populations where most benefit can be derived (Neuro, Pedi, LTACH . . .)

- Education Research
  - Exposing trainees to Tele-ICU (13 % US adult ICU beds have Tele-ICU coverage)
  - Tool for education of Faculty, Residents and Fellows





YALE NEW HAVEN HEALTH