Centrella® Smart+ Bed:

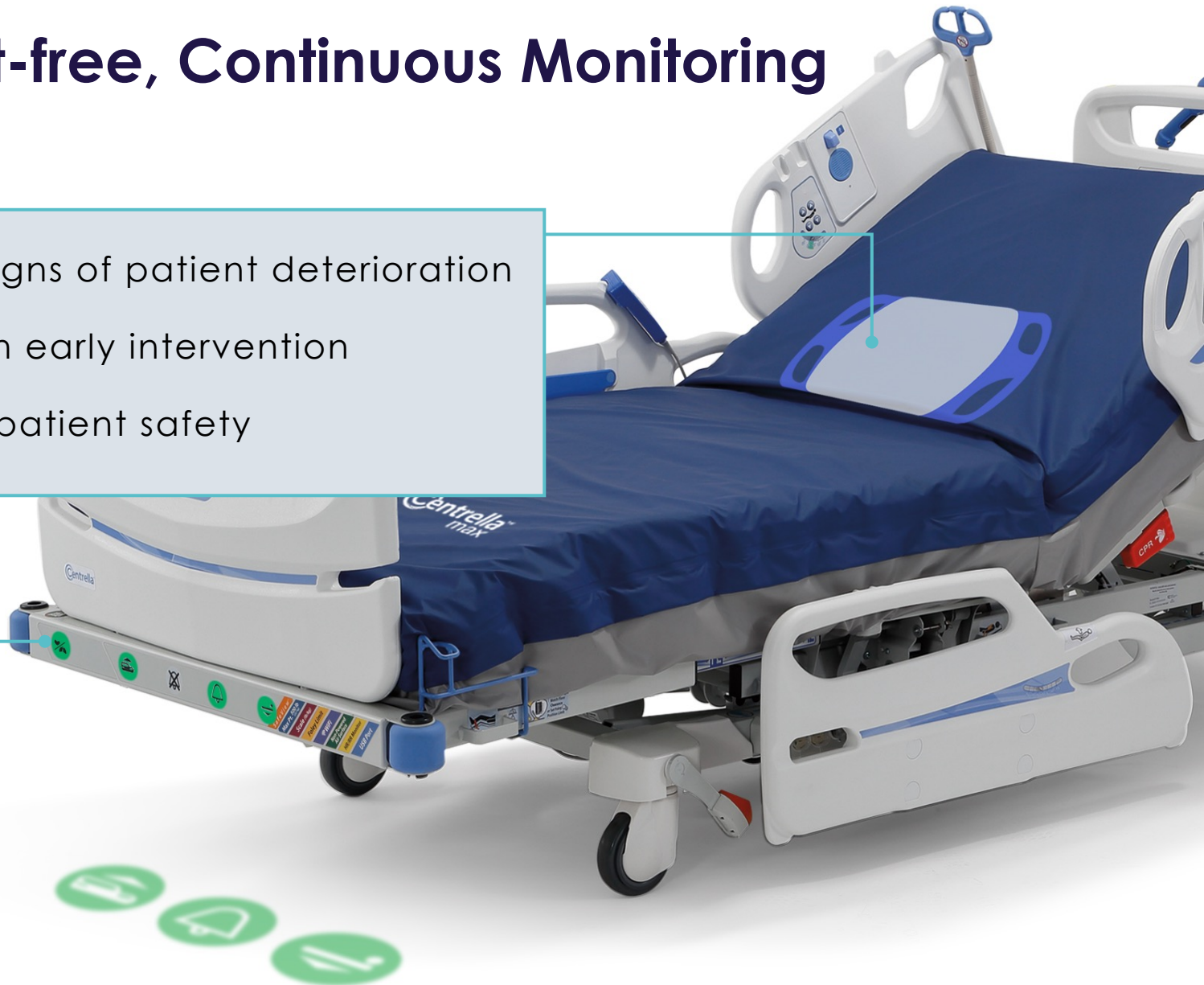# CONTACT-FREE, CONTINUOUS MONITORING

Contact-free, Continuous Monitoring

- ✓ Identify signs of patient deterioration
- ✓ Initiate an early intervention
- ✓ Promote patient safety

Hillrom™

Promoting a Culture of Patient Safety

Institute *for* Healthcare Improvement

Patient Safety MOVEMENT

NPSF

These organizations and others like them have recognized a simple fact:

TOO MANY PATIENTS ARE DYING FROM PREVENTABLE CAUSES.

2019 Top 10 Patient Safety Concerns[1]

ECRI Institute

1. Diagnostic Stewardship and Test Result Management Using EHRs

2. Antimicrobial Stewardship in Physician Practices and Aging Services

3. Burnout and Its Impact on Patient Safety

4. Patient Safety Concerns Involving Mobile Health

5. Reducing Discomfort with Behavioral Health

6. Detecting Changes in a Patient's Condition

7. Developing and Maintaining Skills

8. Early Recognition of Sepsis Across the Continuum

9. Infections from Peripherally Inserted IV Lines

10. Standardizing Safety Efforts Across Large Health Systems

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6. **DETECTING CHANGES IN A PATIENT'S CONDITION**

7. Developing and Maintaining Skills

8. **EARLY RECOGNITION OF SEPSIS ACROSS THE CONTINUUM**

9. Infections from Peripherally Inserted IV Lines

10. Standardizing Safety Efforts Across Large Health Systems

Critical Events Drive Patient Safety Outcomes

UNRECOGNIZED PATIENT DETERIORATION

THAT CAN LEAD TO MORTALITY

17%

MAY AFFECT AS MANY AS 17% OF HOSPITAL ADMISSIONS.[2]

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Patient Deterioration

A patient moves from one clinical state to a worse clinical state.[12]

Increasing their individual risk of

MORBIDITY → **PROTRACTED HOSPITAL STAY** → **DISABILITY** → **DEATH**

FAILURE TO RESCUE[13]

| Heart failure | Electrolyte abnormalities | Sepsis | Ischemia | DVT/PE | Respiratory insufficiency |

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Sepsis

#1 cause of death in U.S. hospitals[8]

35% OF ALL DEATHS IN HOSPITALS[8]

DECREASE IN SURVIVAL

Avg. decrease in survival 7.6% per hour

HOURS

1 2 3 4 5 6
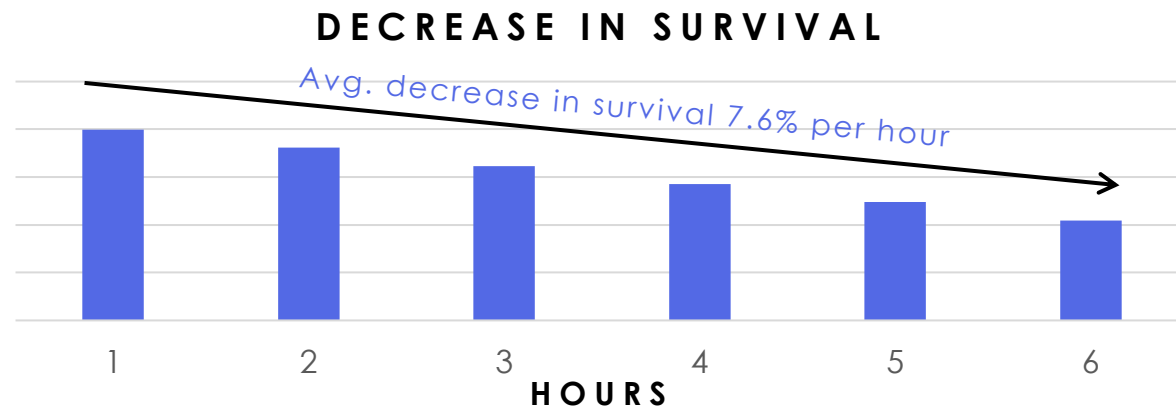
- Risk can be reduced by quickly identifying and managing infections.[8]

- Mortality increases **8%** for every hour that treatment is delayed.[8]

- **$38k**, Median hospital cost to treat Hospital Acquired Severe Sepsis.[10]

Opioid Induced Respiratory Depression

57%

of medical patients were prescribed opioids, sedatives, or both.[3]

1/3

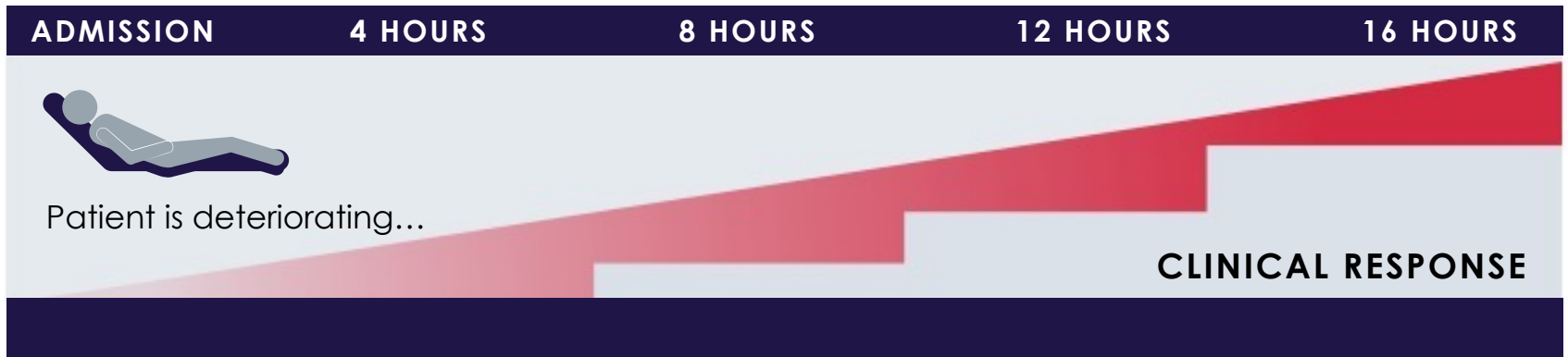of Code Blue arrests are from respiratory depression.[4]

$27k

increased treatment cost for opioid patient that suffers arrest.[5]

7.57 DAYS

increased length of stay of opioid patient suffering arrest.[5]

Patient Deterioration

ADMISSION	4 HOURS	8 HOURS	12 HOURS	16 HOURS

Patient is deteriorating...

CLINICAL RESPONSE

6-8

POTENTIAL HOURS OF WARNING SIGNS PRIOR TO EVENT.[2]

The Med-Surg Environment is Challenging

INCREASING PATIENTS, ACUITY AND COMPLEXITY

STAGNANT TECHNOLOGY & INNOVATIONS

COST CONSTRAINTS
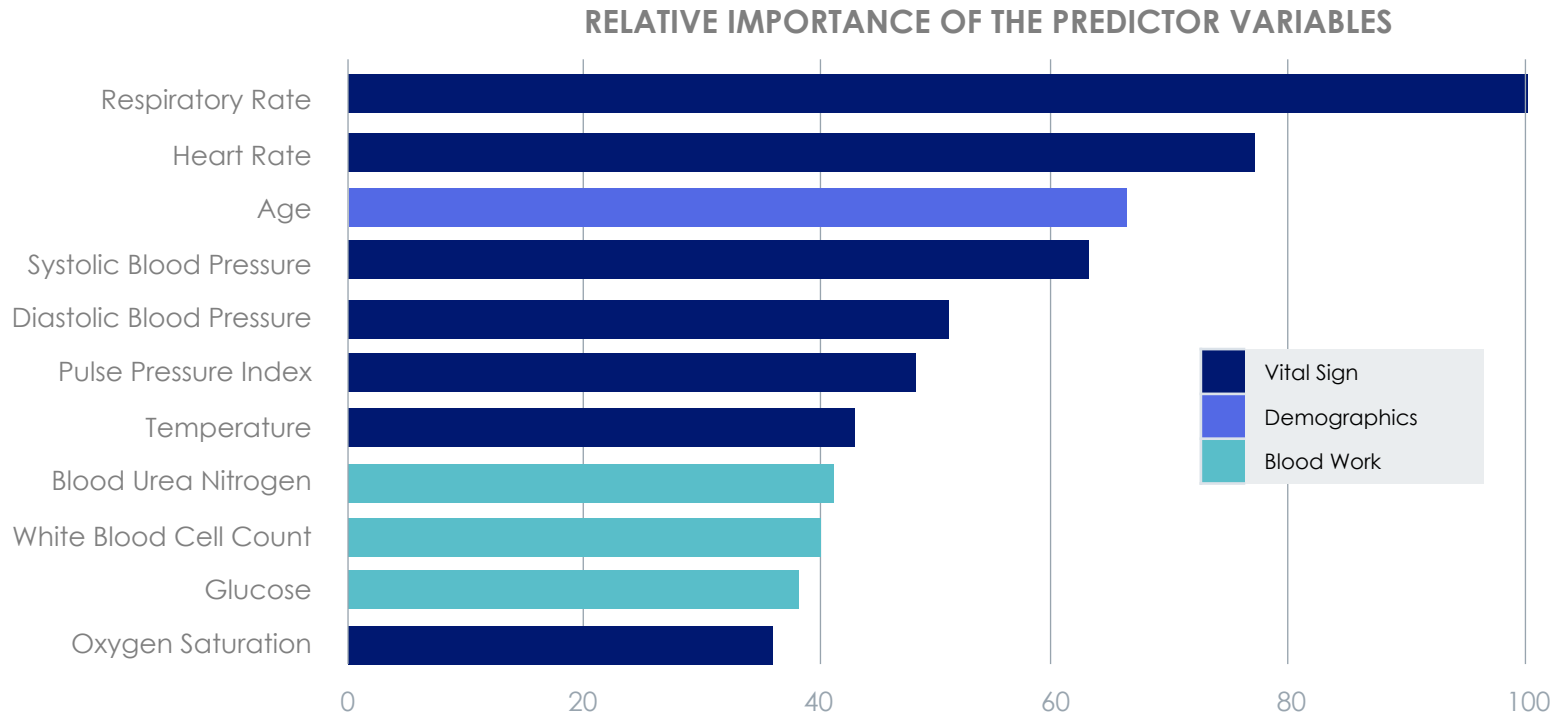
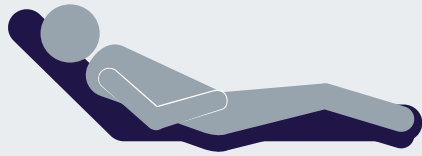**HIGH PATIENT-TO-NURSE RATIOS**

STAFF TURNOVER, RETENTION AND TRAINING

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Leading Indicators of Deterioration

Respiratory rate and heart rate are the most important predictor variables of deterioration.[6]

RELATIVE IMPORTANCE OF THE PREDICTOR VARIABLES

Legend:
- Vital Sign
- Demographics
- Blood Work

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Two Paths of Patient Deterioration

CONTRIBUTING CONDITIONS

PATIENT DETERIORATION

RECOGNIZED

RN Intervention • MD Intervention • Rapid Response

UNRECOGNIZED

Code Blue • ICU Transfer/Readmit • Mortality

A Real-Life Impact:[9]
Opioid Induced Respiratory Failure

John LaChance

- Rotator Cuff surgical patient
- Diagnosed with sleep apnea

Thursday, March 15, 2007

John underwent his second routine rotator cuff repair surgery.

During the afternoon, John began to deteriorate. Symptoms included fever and extreme vomiting.

Within a half hour, John was comatose and never spoke again.

| 10 AM | 12 PM | 2 PM | 5 PM | 5:30 PM | 5:30 AM |

Immediately following surgery, John was doing well. His pain was managed with a shoulder block and Morphine through a PCA pump.

By the early evening, his shoulder block had worn off. John was taken off Morphine and prescribed a high dose of Dilaudid.
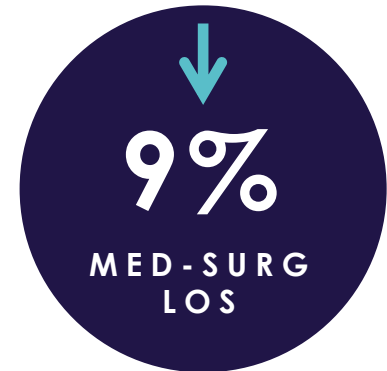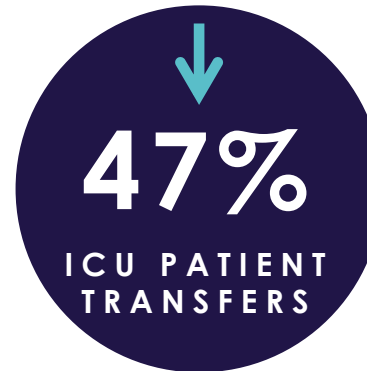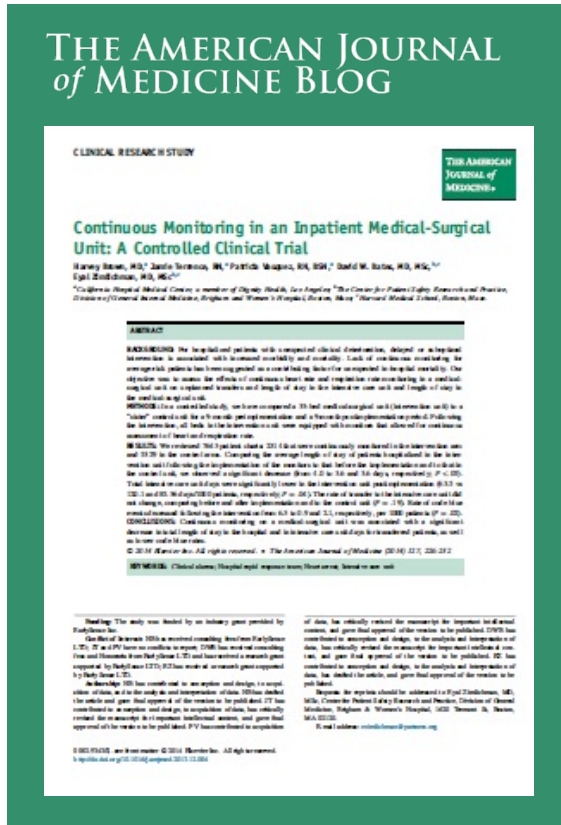
Friday, March 16, 2007

By 5:30am, John was dead.

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Continuous Monitoring in an Inpatient Medical-Surgical Unit: A Controlled Clinical Trial

Harvey Brown, MD[7]

86%
CODE BLUE EVENTS

47%
ICU PATIENT TRANSFERS

9%
MED-SURG LOS

"Results may support the hypothesis that continuous monitoring leads to earlier recognition of patient deterioration."

Identifying Patient Deterioration Early Using Contact-Free, Continuous Monitoring on and Inpatient Medical – Surgical Unit

Arnot Health, accepted to be presented at the Institute for Healthcare Improvement Conference, December 2019

POSTER HIGHLIGHTS

- 26-bed inpatient medical-surgical unit
- 7 cases in which contact-free continuous monitoring was used to **identify patient deterioration** *and* **intervene earlier**

CASE TYPES
– Airway management
– Alcohol withdrawal management
– Opioid Induced Respiratory Depression
– Pain management
– Oxygen management

"Use of the technology helped drive interventions including airway management and medication optimization for appropriate treatment and avoidance of respiratory depression."

Identifying Patient Deterioration Early Using Contact-Free Continuous Monitoring on an Inpatient Medical-Surgical Unit

Authors: Jan Linderberry MSM, RN and Shelley Derr BSN, RN

DESCRIPTION
Up to 17% of inpatient admissions experience clinical deterioration.[1] Warning signs can often be identified 6 to 8 hours before deterioration events occur.[1,2] Early warning scores are used to identify high risk patients, but are not intended to identify deterioration in real time.[3] Respiratory and heart rate are the most accurate vital sign deterioration predictors, and accuracy is improved with trending of those vital signs.[4] Studies have shown contact-free continuous monitoring of respiratory and heart rate on a medical-surgical unit decreases length of stay, ICU length of stay, and code blue rate.[2]

AIM
Implement contact-free continuous monitoring to identify patient deterioration early on a medical-surgical unit.

ACTIONS TAKEN
Contact-free continuous monitoring technology was implemented on a 26-bed inpatient medical-surgical unit at Arnot Ogden Medical Center. In addition to providing alerts at customizable upper and lower limits of both respiratory and heart rate, clinicians were able to view trend data for both vital signs.

SUMMARY OF RESULTS
In this case series, we present seven cases in which contact-free continuous monitoring was used to identify patient deterioration and intervene earlier. Use of the technology helped drive interventions including airway management and medication optimization for appropriate treatment and avoidance of respiratory depression.

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Acknowledgements: This study was supported by Heart Rate & Respiratory Rate Monitoring on Centrella® Smart+ Bed (Hill-Rom, Inc.).

CASE TYPE	DEMOGRAPHICS	ADMITTING DIAGNOSIS	RELEVANT HISTORY	CFCM FINDING/ ALERT	INTERVENTION/OUTCOME
Airway Management	51-year-old female	Cervical disc, herniation, stenosis	• s/p anterior cervical fusion • esophageal swelling	RR 42	• Contact-free continuous monitoring on the bed indicated a high respiratory rate of 42 which triggered the alarm • Brought staff to the bedside and found patient choking but not completely obstructed • Bed showed a onetime burst of elevated respiratory rate due to the patient choking • Ensured patient's airway was patent • Gave patient emotional support – patient expressed relief when staff came in • Prevented patient from hurting herself (she was starting to try to get out of bed) and ensured patent airway
Alcohol Withdrawal Management	22-year-old male	Ethanol withdrawal, Delirium tremens	• Receiving lorazepam for DTs	HR trending up	• Increased lorazepam dose • HR stabilized
Opioid Induced Respiratory Depression	79-year-old male	Total right knee arthroplasty	• Patient recovering from surgery / anesthesia • Asthma • Periods of apnea	RR 7	• Patient evaluated for sleep apnea • Patient evaluated for naloxone treatment
Opioid Induced Respiratory Depression	69-year-old female	Upper abdominal pain s/p colectomy	• Colectomy for ileocecal adenocarcinoma 1.5 months ago • Guillain-Barré syndrome with residual bilateral leg weakness • Chronic back pain	RR 8	• Patient evaluated for naloxone treatment • Given oxygen • Physician notified
End of Life Care – Pain Management	88-year-old female	Acute pancreatitis	Non-responsive on comfort care	• RR 35 alert • HR/RR both trending up	• Based on trends and physical exam, patient determined to be in pain • Patient given IV hydromorphone and sublingual atropine • Vitals stabilized • Based on trends and physical exam, pain level improved

16

Early Detection of Patient Deterioration Using a Novel Monitoring System[11]

Clinically significant reduction of MRT/Code Blue activations, ICU Transfers, and Mortality was noted.
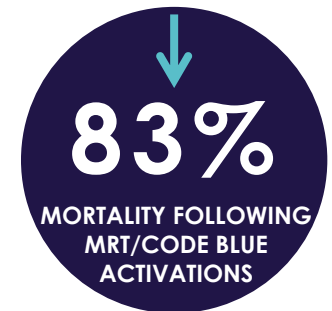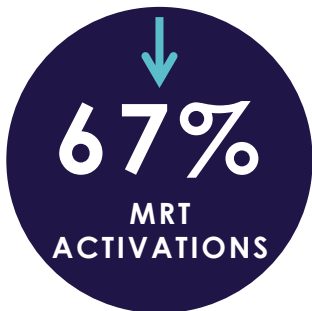
67%
MRT ACTIVATIONS

50%
CODE BLUE ACTIVATIONS

40%
ICU TRANSFERS

83%
MORTALITY FOLLOWING MRT/CODE BLUE ACTIVATIONS
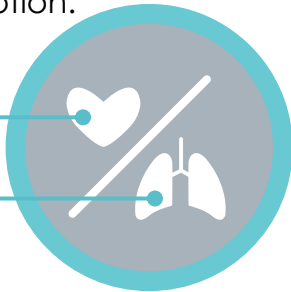
Contact-Free, Continuous Monitoring

- Identify signs of patient deterioration
- Initiate an early intervention
- Promote patient safety

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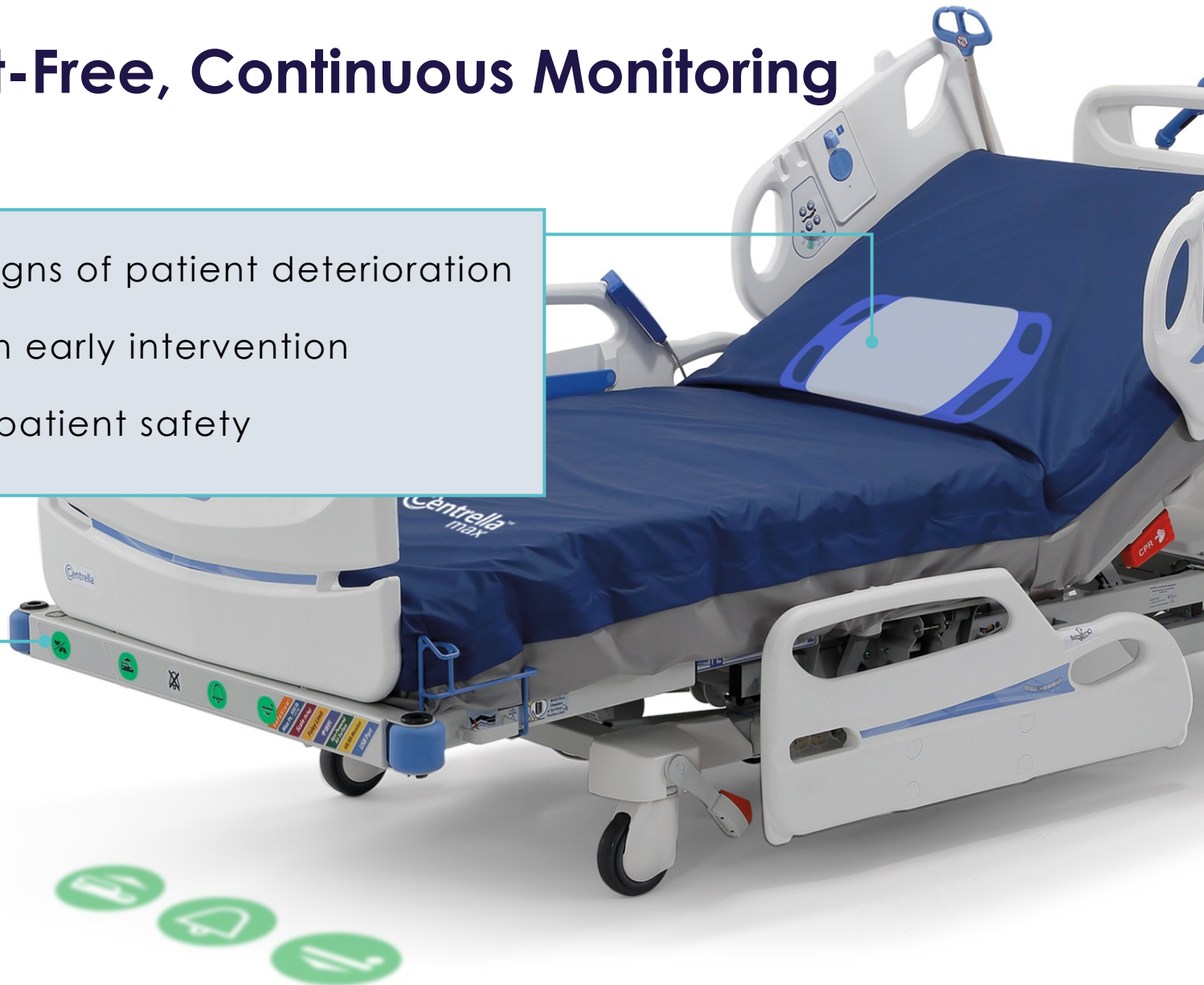
Contact-Free, Continuous Monitoring
HOW DOES IT WORK?

When your heart beats it creates motion.

When you breathe, your lungs expand and contract, creating motion.

The sensor detects cardiac and respiratory motion through the mattress.

Place **Sensor** Here

This side **UP**

The sensor is able to update the HR/RR values twice per second.

All of this information is compiled in an algorithm:

- Creates a running trend of HR/RR
- Filters out other constant motion like an air surface

Hill-Rom

Centrella max

Hillrom™

User Interface Screens

HOME SCREEN

Head Angle
32°

<30° Limit
Stand Assist

♥ 82
◖◗ 18

HR/RR MONITORING

HR ♥
130
82
40

RR ◖◗
32
18
8

Trends   ?   Display   Suspend

SLEEP SCREEN

Bed Exit On

HR ♥   RR ◖◗   Head Angle
120   30   32°

ALERT SCREEN

HR ♥
130
82
50

RR ◖◗
18
5
6

Low RR Alarm   Suspend
Respiratory rate exceeds threshold
Time since alarm: 00:27

7-DAY TREND

Apr 25   Apr 26   Apr 28   Apr 30   May 01

♥ 81   160 120 100 80 60

◖◗ 6   25 20 15 10 5
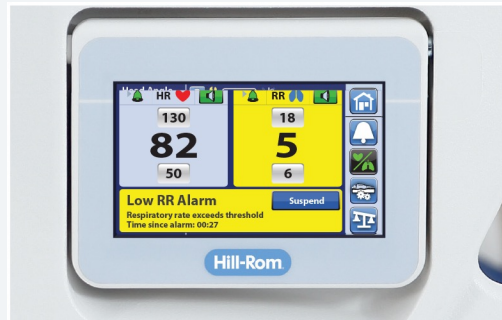
Back   ?   Log   10m   1h   4h   8h   24h   7d

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Heart Rate and Respiratory Rate Alerts

When HR/RR exceeds one of the set thresholds, the bed will alert:

VIA LOCAL ALERTS

SafeView®+ Light
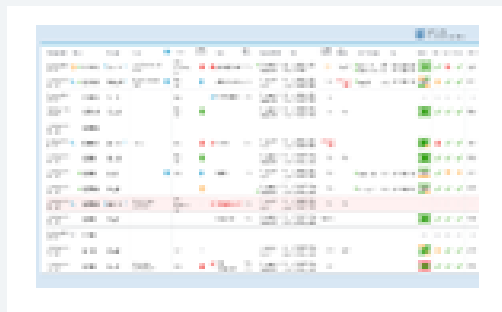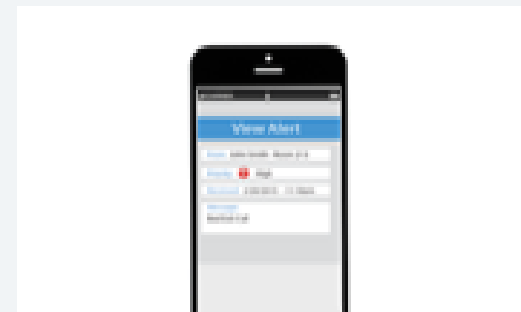

Bed Touchscreen Alerts
(turns yellow)

Audible Alert

AND THROUGH NAVICARE® NURSE CALL*

Dome Lights

Status Board

Mobile Device Alerts

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SafeView®+ Indicators

SafeView®+ indicator is
WHITE

- There is no patient in the bed.
- Patient HR/RR can not be read.

SafeView®+ indicator is
GREEN

- Bed senses patient weight.
- HR/RR is being monitored in safe range.

SafeView®+ indicator is
FLASHING AMBER

- HR/RR threshold is passed.
- Light turns solid Amber once alarm is silenced.

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To learn more about heart rate and respiratory rate monitoring please visit:

https://www.hillrom.com/Centrella-cfcm

CENTRELLA®
 SMART+ BED:
THE BED
  IS JUST THE
    BEGINNING.

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