

Artificial Intelligence & Applications in Healthcare

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Houston Methodist Hospitals

Houston Methodist Hospital



Opened in 1919

Houston Methodist Baytown



Added in 1983

Houston Methodist Sugar Land



Opened in 1998

Houston Methodist Willowbrook



Opened in 2000

Houston Methodist West



Opened in 2010

Houston Methodist Clear Lake



Added in 2014

Houston Methodist Continuing Care



Opened in 2014

Houston Methodist The Woodlands



Opened in 2017

Leading Medicine: Values & Culture



Our Core Values

I CARE

*Integrity
Compassion
Accountability
Respect
Excellence*

FACILITIES AND CAPACITY

Houston Methodist is a faith-based, academic medical center comprised of 8 hospitals,

1 academic
medical center

6 community
hospitals

1 long-term acute
care hospital

2,711 operating
beds

PHYSICIANS AND STAFF



32,000+
Employees



1,215+
Employed Physicians
+ **5,069** Affiliated Physicians



PATIENT ENCOUNTERS


In 2023, Houston Methodist had

138,000+ HOSPITAL ADMISSIONS
2,091,200+ OUTPATIENT VISITS
2,046,600+ CLINIC VISITS

RECOGNITION AND ACCOLADES



RESEARCH, EDUCATION AND GIVING


\$299 MILLION
research and
education funding


71
ACGME residency
training programs


WEILL CORNELL
Medical School
affiliation


ENMED PROGRAM
partnership with
Texas A&M

More than **\$1 BILLION** in charity care and community benefits



THE VISION FOR THE SECOND CENTURY

Houston Methodist will set a new standard for leading academic medical centers through unparalleled safety, quality, service AND innovation.



Center for Innovation is Part of a Larger Innovation Network

Digital
Innovation
Obsessed
People



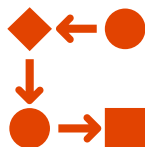
What is Houston Methodist's approach to innovation?

Center for Innovation Principles



EVERYONE'S RESPONSIBILITY

Innovation is everyone's job and responsibility.



TRANSFORMATIVE

Focus on initiatives that will transform the way you do business.



RESEARCH & DEVELOPMENT

Embrace new technologies and new ideas.



AGILE

Succeed fast or fail fast.

Center for Innovation Steering Committee Responsibilities

Governance Structure



CFI Steering Committee (DIOP) Responsibilities:

- Approvals
- Funding source
- Accelerator + speed (resources)
- Strategic vision
- Finding products and building partnerships

Center for Innovation Approach

What does success look like?
How long will the pilot take place?
ROI? How much would it take to
implement at scale?



One Page Business Plan




DIO Pitch
How are we measuring the success of the pilot?




Family Review

Do we have the right partner / solution?



Business Case Template



DIO Graduation
Is the business case ready for scale?

Success



Graduate

Who will manage?
How will we improve?



Value Report Card



Long Term Value
Did the product achieve previously set outcomes?

Fail



Rest in Peace

What did we learn?
How can we make sure not to repeat the same mistakes?

Goals to Achieve

Hard savings

Actual FTEs that we can eliminate from the organization without compromising any functionality of the organization.

Sustainability as the **true** target

Soft savings

Improvements that can be made to the workforce or the functions but may come in addition or instead of actual changes in FTE.

Changing Ratios
LOS savings

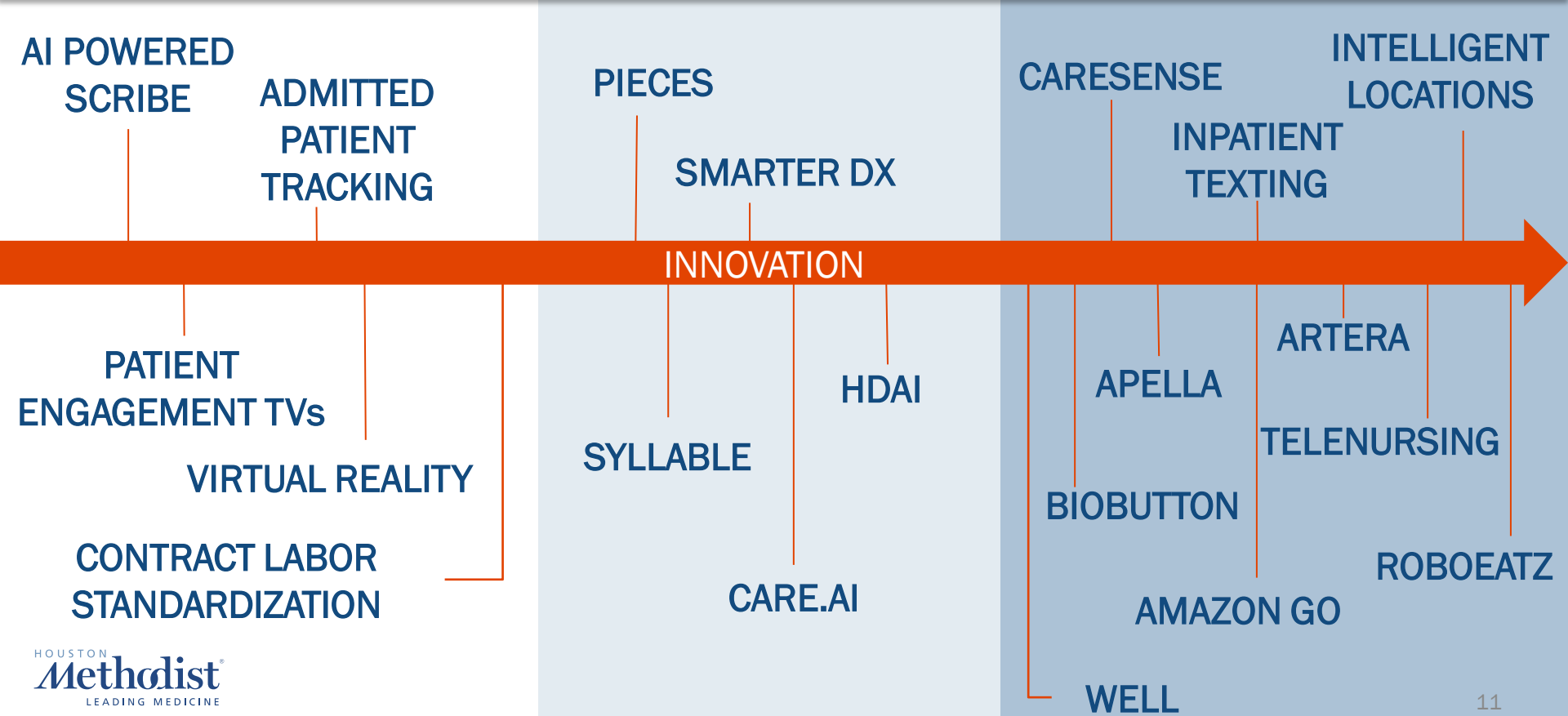
Language of cost savings

Value savings

PIPELINE

SMALL ROLLOUT

AVAILABLE NOW



Smart Hospital DNA

Innovation Vision



Technology Bets



Innovation Centric Design



Partner Ecosystem



Innovation Infrastructure



Technology Selection Process



Smart Hospital of Future Bets



**Self Control
Scheduling**



**Self Control
Check-in**



**Clinical &
Financial
Knowledge**



**No Call
Center
Agents**



Phygital



**Smart
Room**



**Voice over
Type**



**Predictive
and
Proactive AI**



**Ambient
Intelligence**



**Service
Robotics**



**Remote
Monitoring
of Patients**



**Multi-modal
Education**

Pieces Predict reads notes in Epic

How We Are Different: Pieces surfaces social determinants directly from doctor's and nurse's notes for SDOH longitudinal care and interventions.

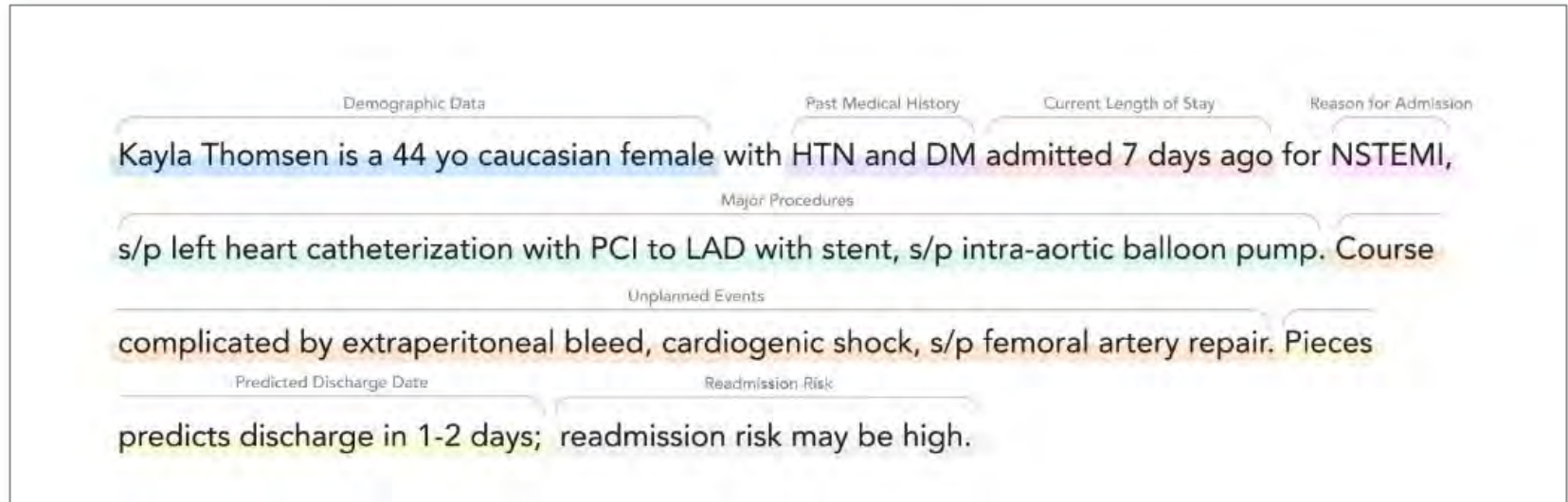
medication issue consultation feedback social vulnerability pending placement

Dispo: needs IV AB, final plan for AB therapy pending ID recs, unlikely to self administer & no family support, might need SNF, OPAT team following

pieces

Pieces: Patient Summary/Overview

The pieces summary takes structured and unstructured data from the patient chart and consolidates pages of information into one actionable sentence, which allows physicians and care providers to quickly get up to speed on a patient.



reLOS AI Patient List

The screenshot shows the reLOS AI Patient List interface. At the top, there is a navigation bar with the 'pieces' logo and several menu items: User Manager, Insights, Metrics, reLOS, Patient List, Archives, COVID-19 Patient Registry, Sepsis Patient Registry, and LOS. A search bar is located below the navigation bar, with the text 'Search by Patient Last Name or MRN' and a 'Clear' button. To the right of the search bar, there are radio buttons for 'View As: Case Manager/Social Worker', 'Universal', and 'My List'. Below the search bar, there is a table of patients with columns for MRN, Name, LOS, Location, Estimated Discharge Date, Pieces For You, and Admission Date. The table lists five patients: Brett Aguas, Lisa Athearn, Karen Beckman, Teresa Bennett, and Troy Benninger. A callout box on the left points to the 'Discharge Barriers' section for the first patient, Brett Aguas. This section contains three items: 'Consultation Feedback' by Ricky Freeland, 'Consultation Feedback' by Chad Holden, and 'Pending Test And Procedure' by Chad Holden. A callout box on the right points to a 'Pieces Note Interpretation' for the first patient, which states: 'Patient presents with necrosis of the left talus; Clinically stable; Low likelihood of discharge; Disposition pending surgery on Friday.'

Filters [Clear all](#)

Search by Patient Last Name or MRN

View As: Case Manager/Social Worker Universal My List

MRN	Name	LOS	Location	Estimated Discharge Date	Pieces For You	Admission Date
2b158c0332	Aguas, Brett	8	HOSP1, UNIT1	10-03-2020	Low	09-30-2020
ffd1d2da3f	Athearn, Lisa	7	HOSP1, UNIT1	10-04-2020	Low	10-02-2020
bclb6e74dd4	Beckman, Karen	14	HOSP2, UNIT3	09-27-2020	Low	09-27-2020
dcdf1db935	Bennett, Teresa	9	HOSP2, UNIT2	10-03-2020	Low	10-03-2020
d39e49a3a9	Benninger, Troy	7	HOSP2, UNIT2	10-03-2020	Low	10-01-2020

Discharge Barriers

Consultation Feedback | Author: Freeland, Ricky, Registered Nurse
Note Excerpt: "Yes, will consult case management" [Select Action](#)

Consultation Feedback | Author: Holden, Chad, Registered Nurse
Note Excerpt: "Pt awaiting ortho consult tomorrow from Dr." [Select Action](#)

Pending Test And Procedure | Author: Holden, Chad, Registered Nurse
Note Excerpt: "Possibly surgery on Friday." [Select Action](#)

Pieces Note Interpretation: Patient presents with necrosis of the left talus; Clinically stable; Low likelihood of discharge; Disposition pending surgery on Friday.

Quickly view a patient's top three barriers for immediate action.

Natural Language Generation is used to present patient clinical and potential barrier synopsis.

Leveraging Big Data



Access to **22 years of Medicare FFS** and **4 years of MA data** from **100 million Medicare beneficiaries**



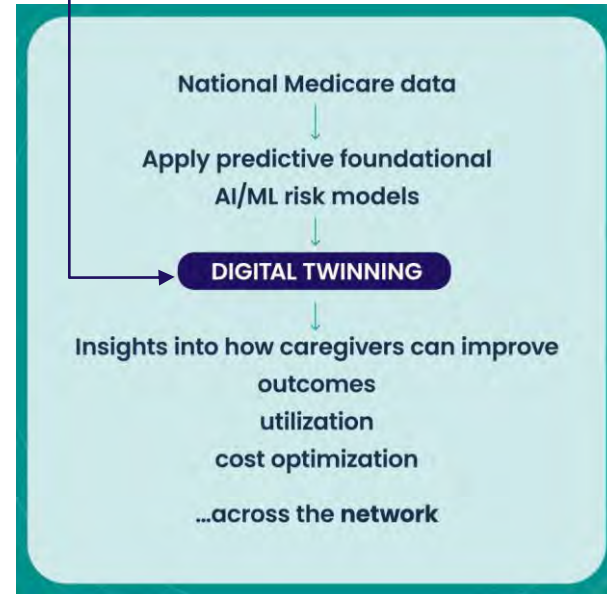
Compares Houston Methodist to **other similar Academic Medical Centers**



Predictive analytics capabilities guide actions to improve patient care



Focus on **post-discharge care** is enhanced; extends view **outside of the walls of the hospital**



HDAI: What is it?

Health Data Analytics Institute



Access to **22 years of Medicare FFS** and **4 years of MA data**
Data from **100 million Medicare beneficiaries**



Compares Houston Methodist to **other similar Academic Medical Centers**



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Focus on **post-discharge care** is enhanced; extends view **outside of the walls of the hospital**

Leveraging the Power of Data and Analytics with Physicians

Cardiology/Cardiovascular Surgery

Improve performance on 30-day post-admission mortality

Orthopedics

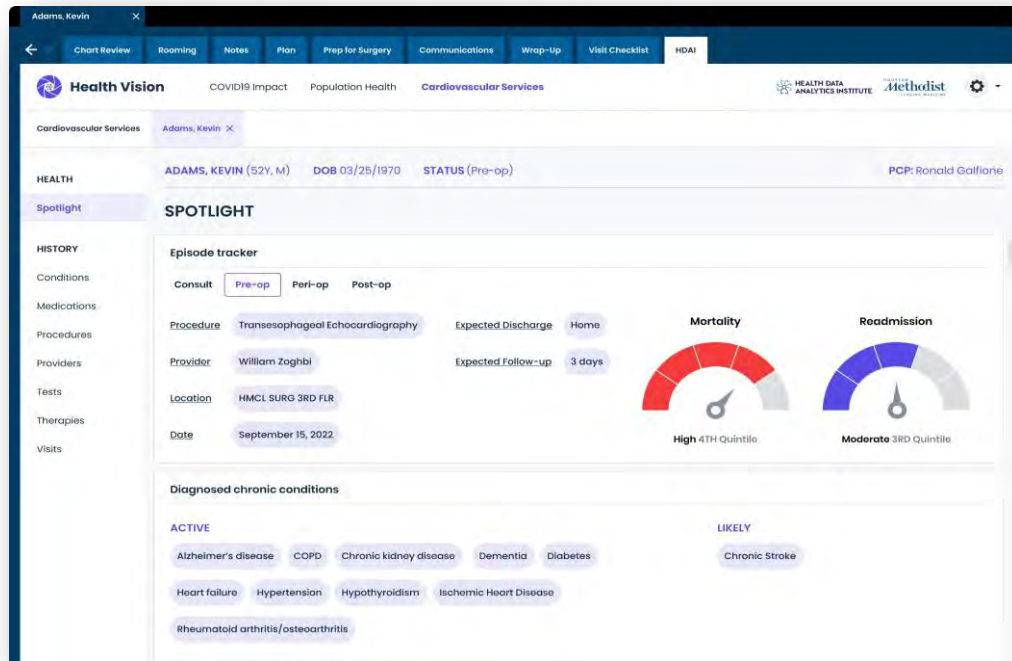
Shared decision-making conversations with patients at high risk of mortality about appropriateness of elective procedure vs. other options

Pre-Op Optimization

Data-driven care planning assistance for multispecialty pre-op teams to identify and act upon potential ICU/hospital-related adverse events

HMCC ACO


Improve the efficiency of the discharge planning process for inpatient and outpatient care managers















Success: Volume



Success: Operational Metrics

-  Better
-  Flat/Neutral
-  Worse

*Directly tied to use case

	Metric	Outcome
Patient Experience	HCAHPS Scores - Overall Rating of Hospital*	
	HCAHPS Score - Discharge*	
Throughput/LOS	Discharge before 2PM*	
	Average LOS*	
	Discharge Order to Actual Discharge Time (Hours)*	
Other Clinical	Malnutrition Screening*	
	Completion of EPIC admission profile*	
	CAUTIs/CLABSIs	
	Falls (w/injury)	
Staffing	Overtime	
	Turnover	
	Nursing Ratios*	





BioButton for Vital Signs




Current state bedside vitals



BioButton Data



	Resting HR
	Resting RR
	Skin Temperature
	Activity

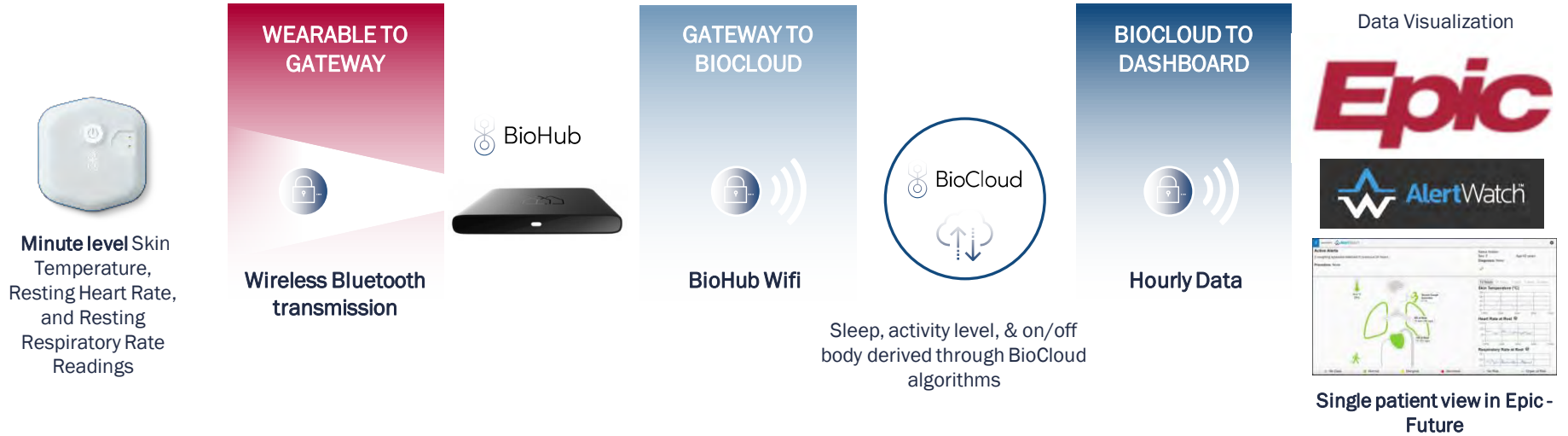
	Sleep/hr
	Sleep/day
	Device On/Off Body



Wearable BioButton

BioButton: Acute Care

Data Measurement and Transmission Frequency



**Central Monitoring – Future
(Virtual Operations Center)**



vICU Program

Physician Support (vMD)

- Experienced intensivist physician team available for immediate consultation
- Can assist with management- codes, admits, calls
- Works collaboratively with bedside team
- Plan of care support

Nursing Support (vRN)

- Experienced critical care nurses
- Facilitate video connections and conversations
- Support shift transitions & staff interaction and communication



Monitoring

- Software: consolidates data from bedside & EMR
- Extra set of eyes- vRNs review monitoring info and communicate alerts/trends to bedside team/vMDs
- Algorithms and predictive analytics
- Data collection tool

BioDashboard

HMH Walter 17 | Filter: Active, Data Within 24 hours | Sort by: Alerts | View: Expanded Grid | Search:

Not Set [14]	HMH WT17 1712	HMH WT17 1729	HMH WT17 1737	HMH WT17 1716	HMH WT17 1705	HMH WT17 1706	HMH WT17 1724	HMH WT17 1727
	Duration: 17 hr Name Hidden Age: 73 Last Data: 1.6 hours 34.1°C HR: 48 RR: 15	Duration: 1 hr Name Hidden Age: 33 Last Data: 2.6 hours 34.6°C HR: 107 RR: 21	Duration: 8 hr Name Hidden Age: 54 Last Data: 1.6 hours 35.3°C HR: 100 RR: 18	Duration: 7 hr Name Hidden Age: 40 Last Data: 1.6 hours 33°C HR: 74 RR: 17	Duration: 5 hr Name Hidden Age: 64 Last Data: 2.6 hours 31°C HR: 82 RR: 11	Duration: 4 hr Name Hidden Age: 65 Last Data: 1.6 hours 34.1°C HR: 71 RR: 20	Duration: 3 hr Name Hidden Age: 90 Last Data: 1.6 hours 33.7°C HR: 64 RR: 18	Duration: 2 hr Name Hidden Age: 61 Last Data: 1.6 hours 35°C HR: 64 RR: 13
	HMH WT17 1731	HMH WT17 1723	HMH WT17 1703	HMH WT17 1702	HMH WT17 1708	HMH WT17 1735		
	Duration: 2 hr Name Hidden Age: 65 Last Data: 2.6 hours 34.1°C HR: 103 RR: 16	Duration: 1 hr Name Hidden Age: 70 Last Data: 22.6 hours 35.1°C HR: 72 RR: 22	Duration: 9 hr Name Hidden Age: 46 Last Data: 2.6 hours 33.7°C HR: 102 RR: 19	Duration: 8 hr Name Hidden Age: 75 Last Data: 2.6 hours 34.1°C HR: 77 RR: 17	Duration: 5 hr Name Hidden Age: 78 Last Data: 2.6 hours 31.1°C HR: 70 RR: 17	Duration: 4 hr Name Hidden Age: 72 Last Data: 2.6 hours 32.9°C HR: 64 RR: 18		
	Floor is empty	Monitor is empty	Telemetry is empty	SNF is empty	Home is empty			
Discharged [14]	HMH WT17 1734	HMH WT17 1733	HMH WT17 1704		HMH WT17 1730	HMH WT17 1728	HMH WT17 1710	
	Duration: 23 hr Name Hidden Age: 70 Last Data: 1.6 hours 36.1°C HR: 88 RR: 26	Duration: 15 hr Name Hidden Age: 71 Last Data: 1.6 hours 34.5°C HR: 81 RR: 14	Duration: 23 hr Name Hidden Age: 43 Last Data: 1.6 hours 39°C HR: 64 RR: 18	Duration: 1172 hr Name Hidden Age: 76 Last Data: 8.6 hours 33.2°C HR: 63 RR: 13	Duration: 14 hr Name Hidden Age: 78 Last Data: 2.6 hours 35.4°C HR: 89 RR: 20	Duration: 8 hr Name Hidden Age: 69 Last Data: 3.6 hours 35.6°C HR: 87 RR: 13	Duration: 6 hr Name Hidden Age: 74 Last Data: 3.6 hours 33°C HR: 73 RR: 13	
	HMH WT17 1709	HMH WT17 1732	HMH WT17 1701	HMH WT17 1720	HMH WT17 1726	HMH WT17 1725		
	Duration: 2 hr Name Hidden Age: 49 Last Data: 7.6 hours 33.6°C HR: 93 RR: 17	Duration: 2 hr Name Hidden Age: 64 Last Data: 3.6 hours 31.4°C HR: 54 RR: 20	Duration: 2 hr Name Hidden Age: 70 Last Data: 6.6 hours 31.5°C HR: 60 RR: 20	Duration: 2 hr Name Hidden Age: 74 Last Data: 4.6 hours 34.9°C HR: 60 RR: 22	Duration: 2 hr Name Hidden Age: 75 Last Data: 23.6 hours 34.2°C HR: 66 RR: 14	Duration: 1 hr Name Hidden Age: 25 Last Data: 7.6 hours 34.3°C HR: 90 RR: 16		

Computing by Location | Not Set | Floor | Monitor | Telemetry | SNF | Home | Discharged | (Click for icon legend descriptions)

BioDashboard – Single Patient View

Active Alerts

2 coughing episodes detected in previous 24 hours.

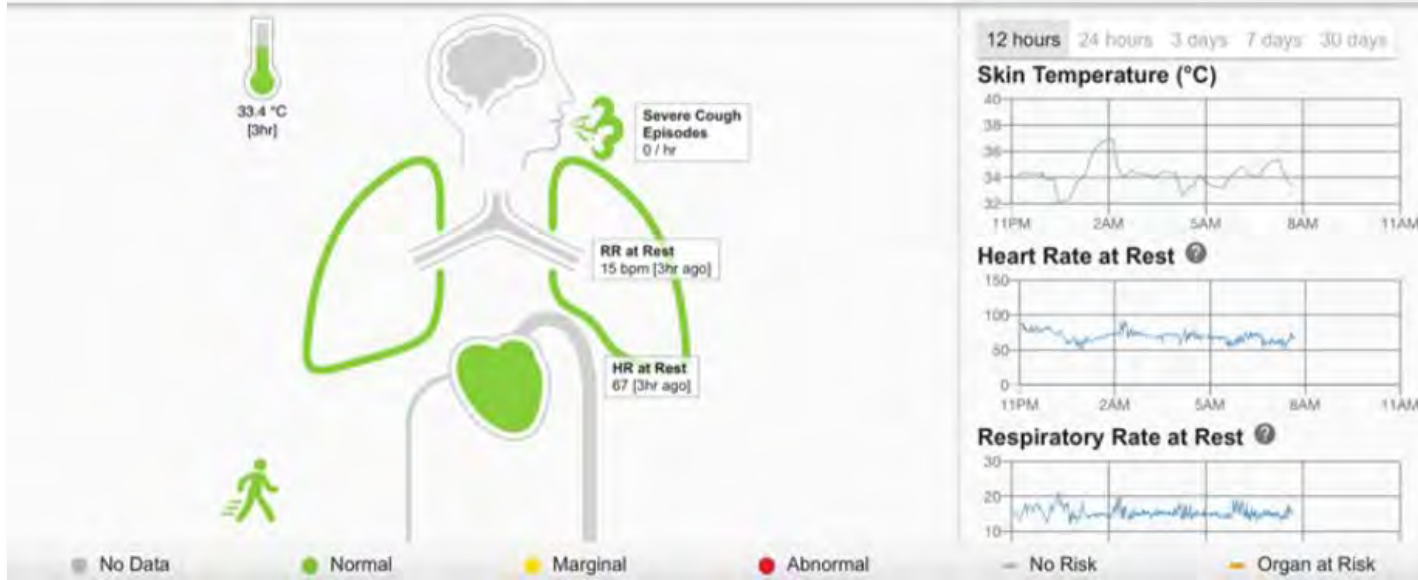
Procedure: None

Name Hidden

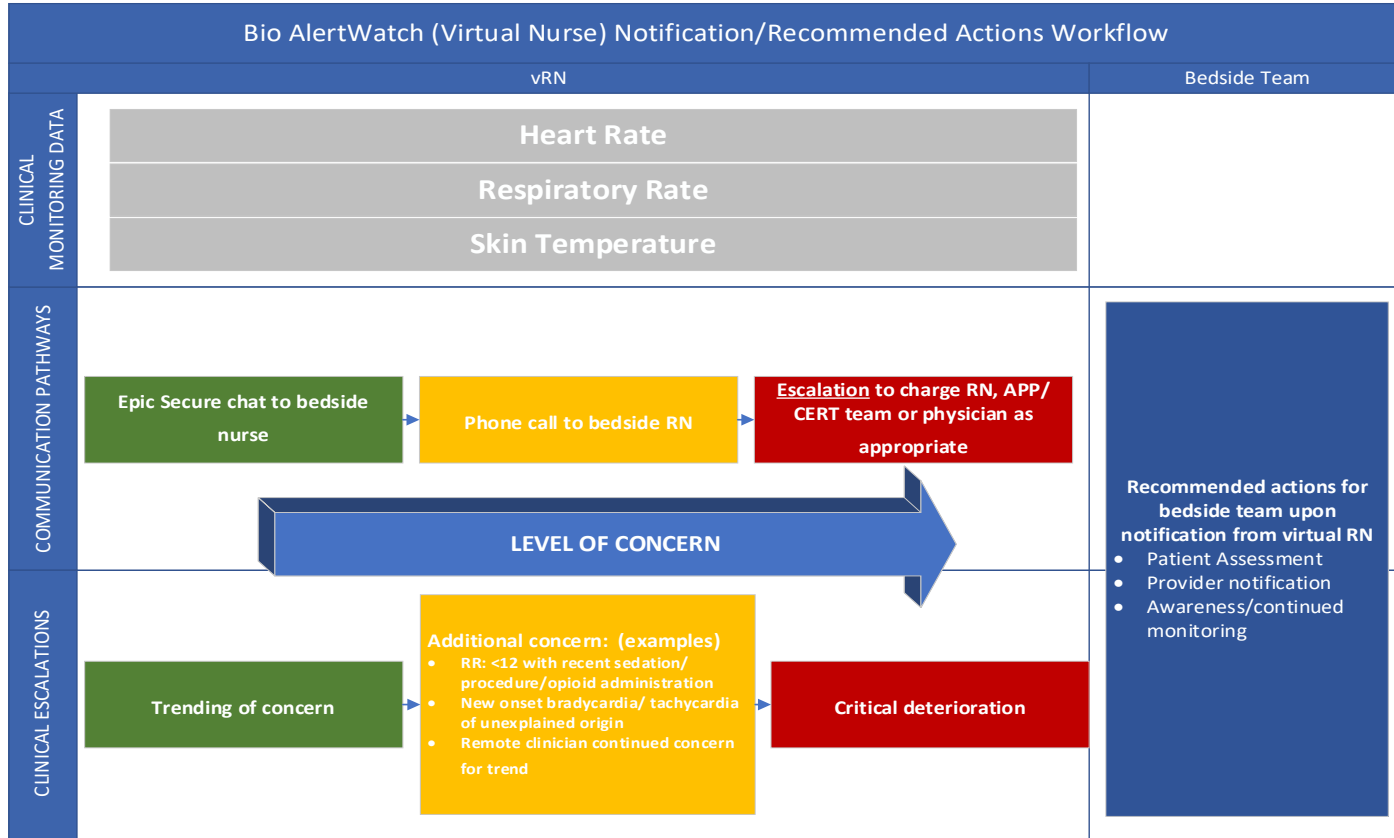
Sex: F

Age: 42 years

Diagnosis: None



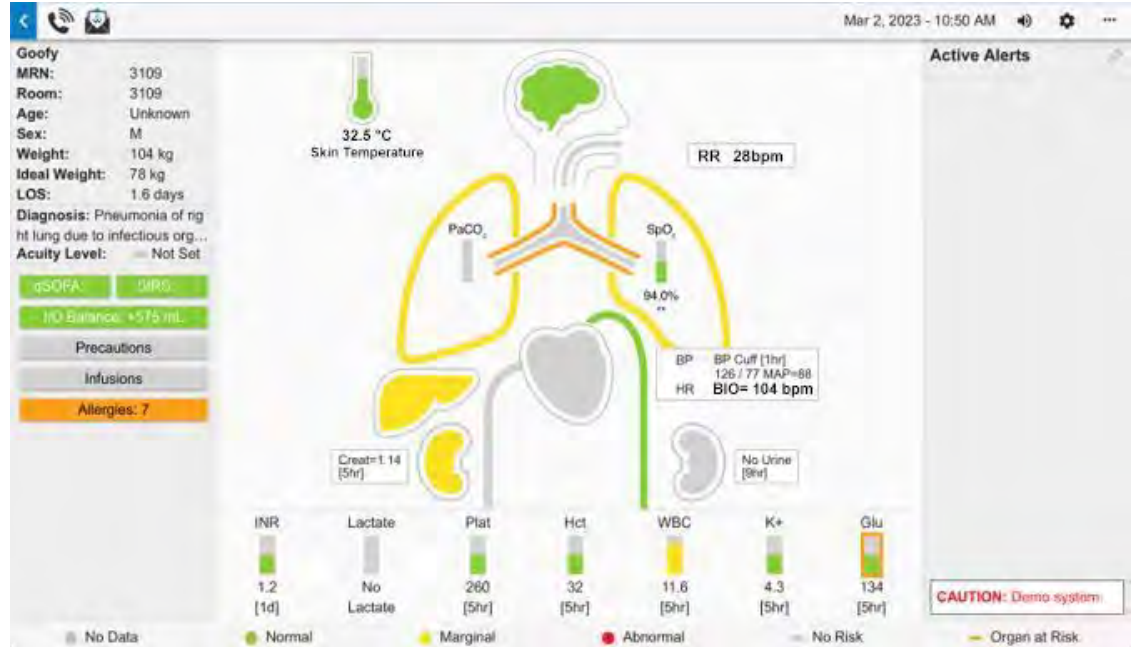
Alert Escalation Protocol



BioDashboard – Expanded Alerts

Additional Context for Accelerated Patient Review

- Patient demographics
- Inpatient vitals
- Lab results
- ICD-10 codes
- Infusions & medications
- LDAs
- Nursing documentation
- Staffing schedules
- Comorbidities



BioDashboard – Expanded Alerts

Expanded analytics

- qSOFA
 - Systolic BP \leq 100
 - Respiratory rate \geq 22 bpm
 - Glasgow coma scale $<$ 15
- SIRS
 - Temperature $>$ 38 or $<$ 36, measured in the last day.
 - Heart rate $>$ 90, median over one hour.
 - Respiratory rate $>$ 20, median over one hour.
 - WBC $>$ 12 or $<$ 4, measured in the last day.

Default expanded alerts

- Potential sepsis
 - qSOFA is \geq 2
 - SOFA is \geq 2
 - Lactate is \geq 2
- Sepsis treatment (next page)
- Low / high BP
- Low SpO₂
- Low urine output
- Quality of care / lab alerts

BioButton: Selected Great Catches



WT18

2/27/24 – Night Shift

- BioButton alerts remote monitoring team of high HR.
- Patient was sleeping, looked ok.
- Virtual RN requests double check, escalates to CERT NP.
- Floor RN and CERT NP find large volume of bloody fluid in suction cannister.
- Patient transferred to WT11 NICU and put on continued transfusions, fluids & pressors.

A8

01/04/24 – Day Shift

- Admission from the ED for hypotension and tachycardia
- Admitted to A8 on 1/2
- BioButton alerts of abnormal HR on 1/4
- Remote monitoring team escalates to RN and CERT NP.
- CERT NP evaluates patient and finds tachycardia and tachypnea present with decreased breath sounds.
- Patient transferred to CICU.

A8

12/16/23 – Night Shift

- BioButton alerts remote monitoring team of patient deterioration.
- Remote monitoring escalates to bedside RN and CERT NP.
- Patient visibly changed from baseline - is lethargic.
- CERT NP visits patient and finds patient hyperglycemic.
- CERT initiated and patient transferred to ICU.

care.ai Cameras in Patient Rooms

403 beds at HMH with wall-mounted cameras

Virtual Nursing & Virtual Monitoring

- Virtual Monitoring - Moving to fixed camera solutions installed in the patient room and deployment of care.ai R2 carts
- Virtual Nursing - admissions and discharges across the HM system via iPad and care.ai-installed patient rooms ()

Workstreams in Development

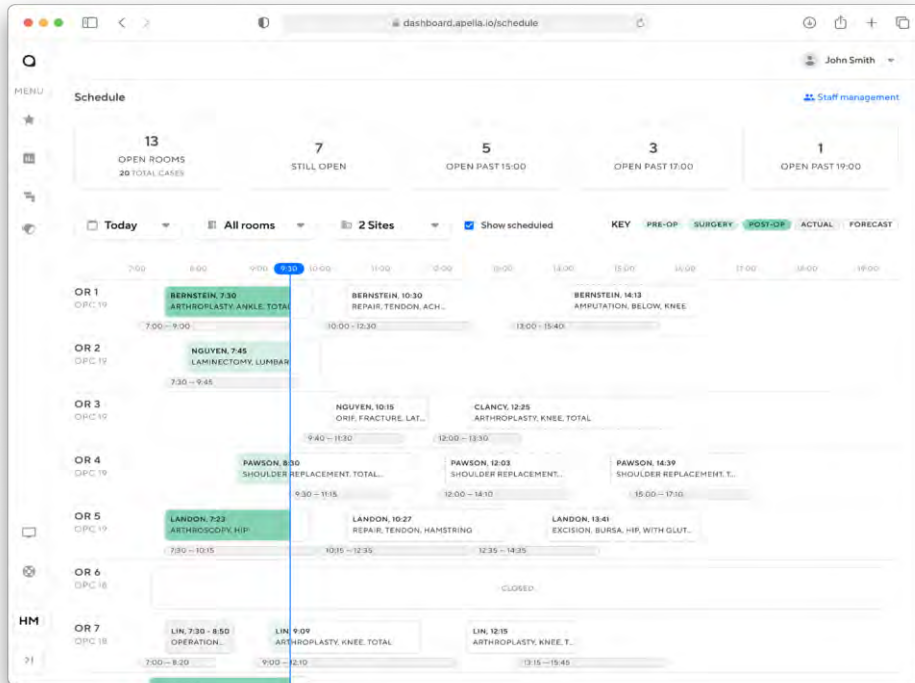
- Telepsych & Telestroke transitioning to care.ai
- Telepharmacy pilot on WT17 & WT18
- Epic Context Linking (drop-in video calls from patient chart)
- TeleRounding
- Dedicated ED Mobile cart for multi-use (e.g. Pharmacy, Hospitalists, Specialists, & Case Management)



care.ai™

R2 – 2-way video & audio camera that turns the TV into an environment where we can intervene with tele-sitter, tele-nurse, and tele-visits.






Predictive Capabilities

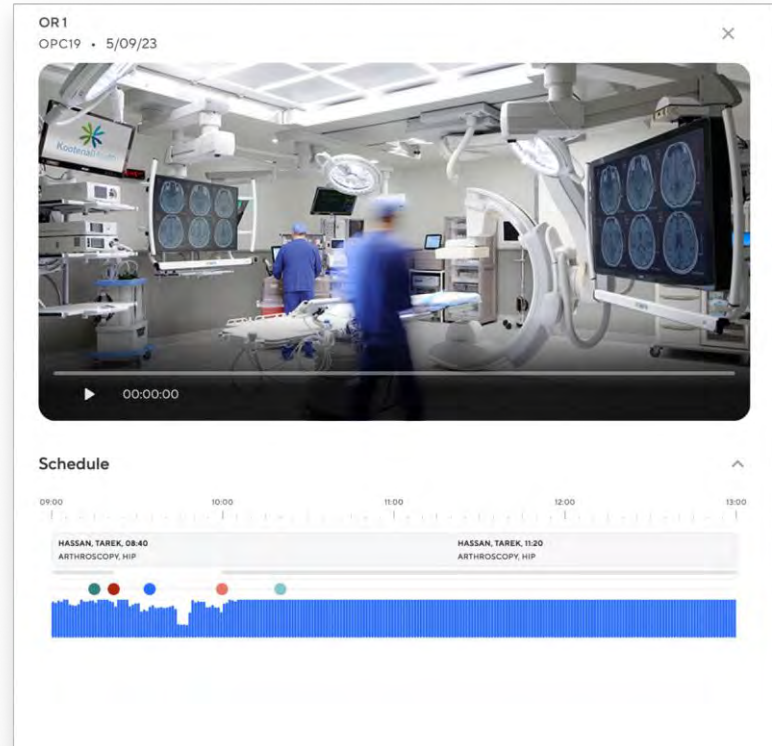


Apella is **24% better** than **EHR** at predicting case durations and the schedule **updates every minute, autonomously.**

Event Accuracy

Computer vision accurately identifies case events in real time.

	Accuracy*
 Patient undraped	99.1%
 Patient wheels out	99.7%
 Back table open	99.5%
 Patient wheels in	99.6%
 Patient draped	98.9%



Human vs. Apella: Latency

Delayed data makes it harder to run an OR.
Apella collects the data we need, automatically.

A patient-first mindset is essential to great care, but it can lead to delayed data.

- 59% of **wheels-in** events are recorded **>10 mins late**
- 10% of **wheels-out** events are recorded **>10 mins late**

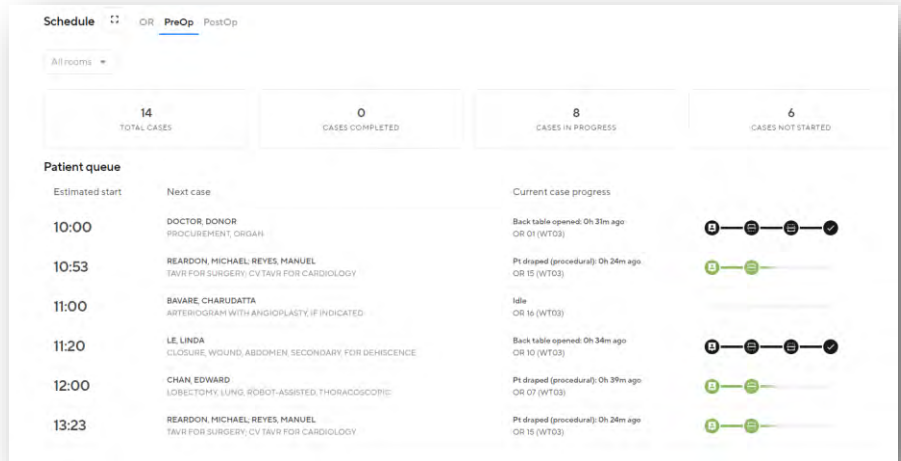
Apella is within 2 mins,
>99% of the time



Live Gallery and Coordination Dashboard

The Live Gallery helps the Board Runner/Charge RN identify where to intervene proactively.

Pre-op & PACU have access to the same event information as the OR.



Apella Outcomes



Made business critical data **accessible and usable** for stakeholders



Validated staffing allocation with measuring room utilization and case distribution



Allocated a **new 10-hour block** to a high utilization surgeon in OPC-19



Reduced turnover time in WTOR by 10%+



Access to curated video snips for **timely cleaning audits and procedure review**



Developed **predictive staffing tools** for the OR

Real Time Location Services (RTLS)

Asset management

Through tracking, identify underutilization of assets to optimize inventory/ capital spend in all departments

Admitted patient tracking

Keep patients from eloping or being left in a hallway unattended (epic)

Track transport times

Improve operating room workflow by tracking transport and wait times (epic)

Monitor call response time

Optimize staffing levels by improving productivity and patient flow (epic)



Gateway
Wall mounted,
listener device



Digital wayfinding

Improve patient satisfaction and decrease visit no shows by enabling turn by turn navigation (convenient)

Hand hygiene compliance

Improve handwashing compliance and reduce HAC

Environmental monitoring

Utilize environmental monitoring built into every tag to meet DNV & joint commission standards

Staff duress

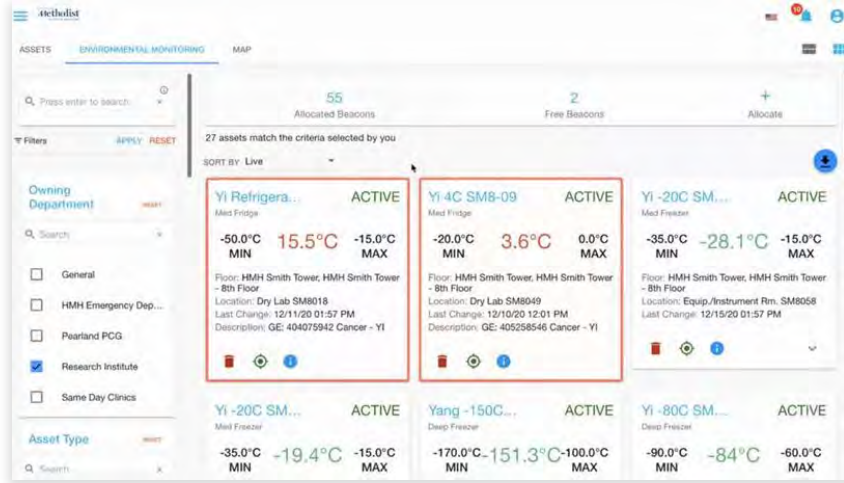
Allow staff to trigger alarms if they are caught in an unsafe situation (workplace violence)



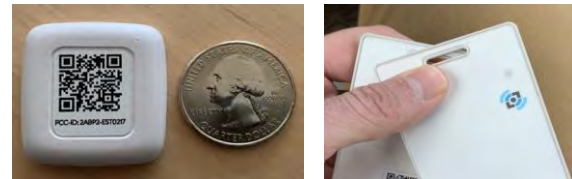
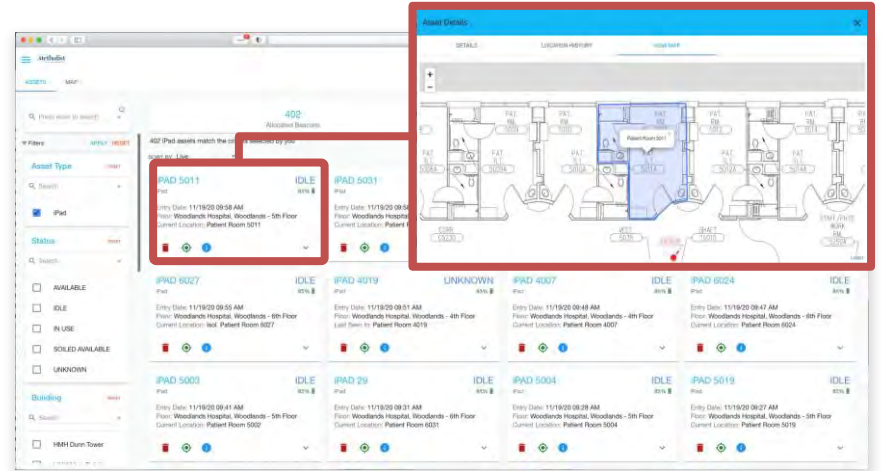
Beacons
Tracking device, multiple styles; this is what is 'tracked'.

Dashboards

Temperature Monitoring



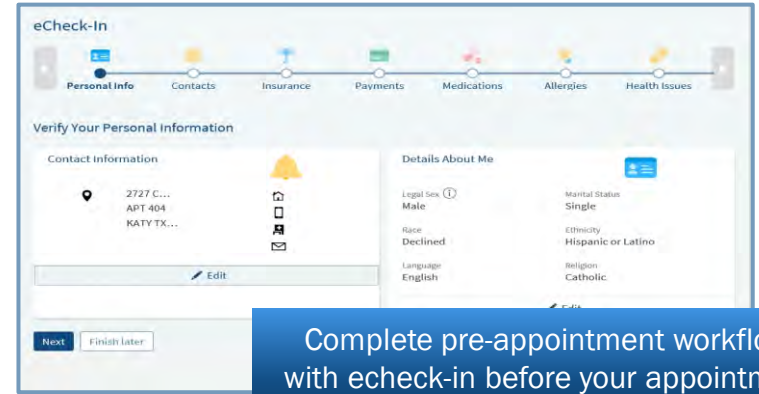
Asset Tracking



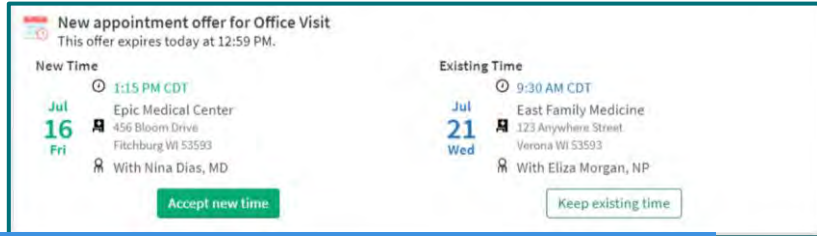
Leveraging Technology to Improve Experience



Enhanced call center platform to help manage call volume (over 6 million in 2023)



Complete pre-appointment workflows with echeck-in before your appointment. 5,500 completed each day



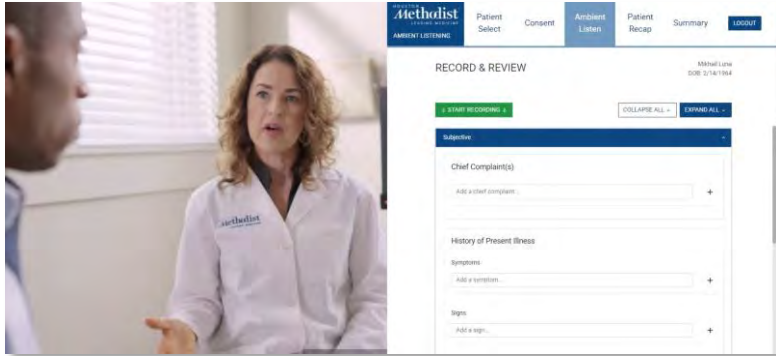
Fast Pass is a wait list feature that automatically sends patients text or email messages to notify them of a wait list appointment offering. 18K Appointments filled in 2023



Engage with our patients with bi-directional texting for appointment reminders and referrals

Voice Over Text

Ambient Listening



Ambient Listening uses Natural Language Processing to document patient interactions and reduce clicks.

Using Voice in Patient Rooms



Each room is equipped with a smart speaker.



Clinicians carry mobile devices for documentation in the room.



Removed computers from patient rooms.

Outcomes Across Specialties

OPERATIONAL EFFICIENCIES

71%

saw decrease in time in notes per scheduled day

50%

saw decrease in pajama time

100%

Saw decrease in **time notes per appointment**

64%

saw decrease in time on unscheduled days

63%

PCG utilization rate through month 2 of pilot

17.6 MINUTES

average time savings in notes per day

PATIENT SATISFACTION

85%

of MDs feel like this allows them to focus more on their patient

71%

of MDs feel like this has improved the quality of the patient experience



ROI

estimated # of incremental visits per week per MD

3 to 5

82%

Saw an increase in **Est Level 4 encounters**

93%

of physicians agree this technology...

saves them time in charting

71%

improved the quality of clinical documentation and their work-life balance

86%

agree this has improved their work-life balance

93%

would recommend this to their colleagues

PHYSICIAN SATISFACTION

Mashgin Self Checkout

Self-Checkout System Advantages

- 24/7 coverage – ideal for weekends and after hours
- Integrates with payroll and credit card machines seamlessly
- Little to no oversight is needed
- One self-checkout register could cover two FTEs (*considering two shifts, including weekends*)

Two-year lookback

- HMH started the pilot with 3 devices:
 - 2 at Marketplace
 - 1 at Texas Sky Café
- System is expanding
 - HMH total of six stations
 - HMTW has one self-checkout system



Annual Direct Cost Savings: \$500K

Artificial Intelligence Applications in Healthcare

Diagnostics
Medical Imaging
& Pathology

Predictive
Analytics

Personalized
Medicine

Virtual Health
Assistants

Natural
Language
Processing
(NLP)

Robotic Surgery

Remote
Monitoring &
Telehealth

Drug Discovery &
Development

Clinical Trials

Fraud Detection

Population
Health
Management

Purpose-Driven AI

- Deployment of AI technology must be purposeful.
- To be adopted with ROI in mind, not for its own sake.
- Must be:
 - Based on solid business cases
 - Guided by internal governance structures



Governance & Ownership

- Deployment requires strong governance and clear ownership.
- Involves strategic approach to:
 - Analyzing alternatives
 - Selecting the right partners
 - Implementing use cases with precision



Insights into Action

- While AI is instrumental in generating insights, its true value is realized only when:
 - Coupled with meaningful process changes
 - Inform and drive transformation for improved outcomes

