

Above all else, we are
committed to the **care** and
improvement of human life

INTEGRATING DATA SCIENCE INTO CLINICAL PRACTICE: A CASE STUDY IN SEPSIS

Dr Jonathan Perlin

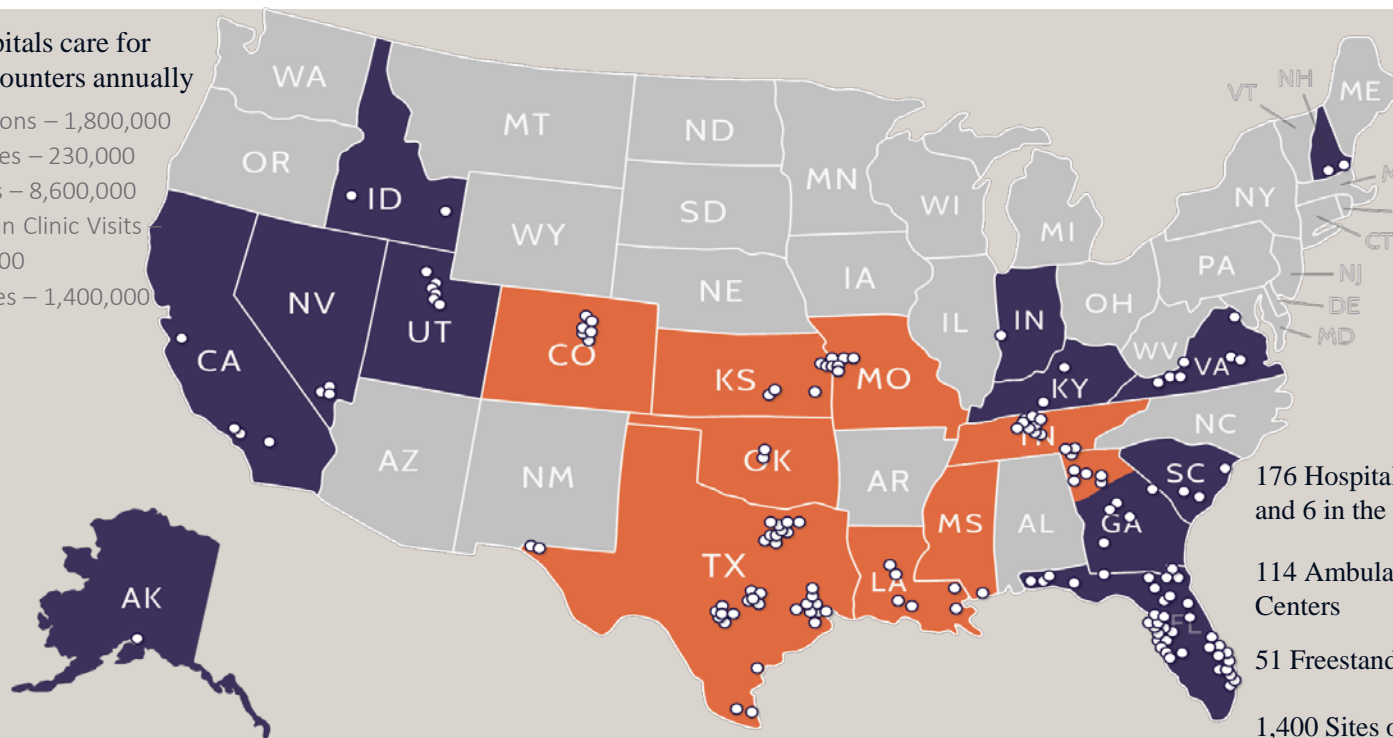
Dr Edmund Jackson

HCA[®]

HCA HEALTHCARE

HCA hospitals care for 28M+ encounters annually

- Admissions – 1,800,000
- Deliveries – 230,000
- ER visits – 8,600,000
- Physician Clinic Visits 9,500,000
- Surgeries – 1,400,000



233,000 employees

- 79,000 nurses
- 47,000 allied health professionals
- 37,000 affiliated physicians
- 3,100 employed physicians & 1,000 practitioners



176 Hospitals in the U.S. and 6 in the U.K.

114 Ambulatory Surgery Centers

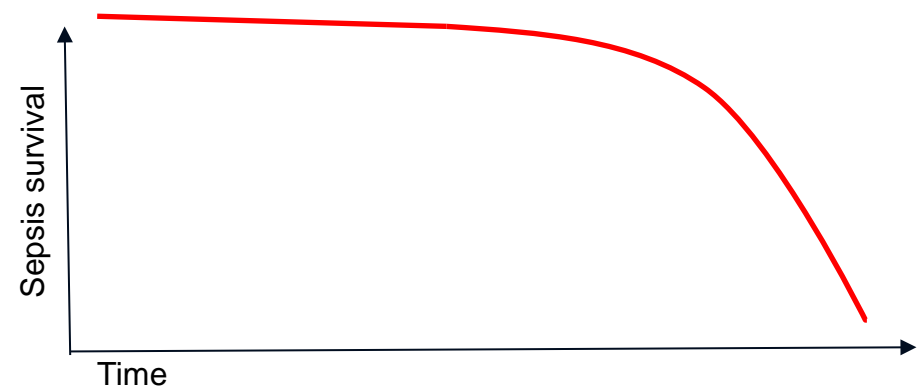
51 Freestanding Ers

1,400 Sites of care



NEXT GENERATION PERFORMANCE: SEPSIS IMPROVEMENT

Sepsis Mortality:
 #11 in U. S.
 #9 in Hospitals
 #3 in ICU
 #1 in non-cardiac ICU

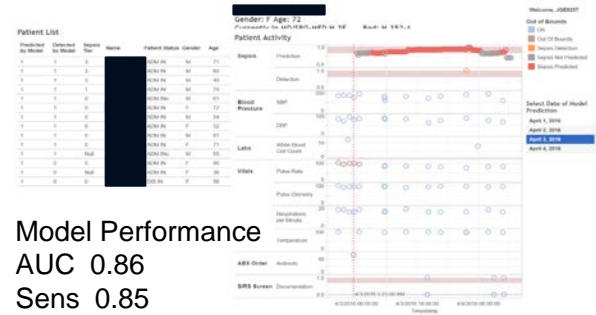


Detecting & Predicting Sepsis Early []

Descriptive
 What is Happening?



Predictive
 What is going to happen



Model Performance
 AUC 0.86
 Sens 0.85
 Spec 0.85

Imagine: the ideal clinician...



Imagine: the ideal clinician...

Single Hospital
January Sepsis Volume
(Positive Sepsis Screen)
= 666 Patients

Current: Screens performed at shift change	Screens by Hour of Day																								
	Day of ts	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23 Total
Mon 01/30/17	2	1	3	6	1	1	5	47	18	7	1	3	3	8	8	10	9	8	7	58	166	16	15	9	574
Sun 01/29/17	8	3	2	6	4		5	56	166	21	19	2	1	5	4	10	6	7	1	50	176	10	8	6	576
Sat 01/28/17	5	5	4	6	8	1	3	62	178	9	3	4	2	2	6	5	6	6	16	36	202	6	6	5	586
Fri 01/27/17	9	4	3		1	5	9	74	212	6	3	1	9	7	3	6		6	9	56	196	10	13	8	650
Thu 01/26/17	5	4	5	4	5		4	64	210	15	10	13	2	7	8	13	11	8	3	46	231	22	17	14	720
Wed 01/25/17		7	10	2	5	2	3	55	232	10	5	5	9	4	13	4	3	8	9	34	219	19	25	9	692
Tue 01/24/17	7	2	5	2	3	3	1	60	253	7	5	2	1	5	7	4	6	6	7	62	210	17	12	11	698
Mon 01/23/17	11	1	5		2	2	2	48	222	15	4	5	6	5	7	6	11	6	8	45	204	15	18	11	659
Sun 01/22/17	9	3	9	4	2	1	3	76	207	8	5	1	2	2	5	7	6	6	7	41	201	16	11	17	649
Sat 01/21/17	6	4	1	6	2	11	2	55	191	14	6	8	1	8	4	6	9	3	9	38	211	4	16	9	624
Fri 01/20/17	6	6		3	12	1		61	225	6	3	9	13	9	11	8	9	12	13	54	191	23	13	14	702
Thu 01/19/17	6	5	3	5	3	1	4	52	242	21	13	12	4	4	9	10	4	9	9	68	212	24	10	9	739
Wed 01/18/17	5	9	7			1	1	56	260	20	8	7	3	7	8	10	5	8	13	52	253	12	3	27	775
Tue 01/17/17	4	2	6	6		3	2	60	238	20	9	8	5	1	7	9	4	4	8	62	241	19	12	5	735

666 Positive
Screens
20,419 Screens
Performed
= 3.3% Hit Rate



Imagine: the ideal clinician...

Single Hospital
January Sepsis Volume
(Positive Sepsis Screen)
= 666 Patients

Screens by Hour of Day

Current:
Screens
performed at
shift change

Day of ts	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Mon 01/30/17	2	1	3	6	1	1	5	47	18	7	1	3	3	8	8	10	9	8	7	58	166	16	15	9	574
Sun 01/29/17	8	3	2	6	4		5	56	166	21	19	2	1	5	4	10	6	7	1	50	176	10	8	6	576
Sat 01/28/17	5	5	4	6	8	1	3	62	178	9	3	4	2	2	6	5	6	6	16	36	202	6	6	5	586
Fri 01/27/17	9	4	3		1	5	9	74	212	6	3	1	9	7	3	6		6	9	56	196	10	13	8	650
Thu 01/26/17	5	4	5	4	5		4	64	210	15	10	13	2	7	8	13	11	8	3	46	231	22	17	14	720
Wed 01/25/17		7	10	2	5	2	3	55	232	10	5	5	9	4	13	4	3	8	9	34	219	19	25	9	692
Tue 01/24/17	7	2	5	2	3	3	1	60	253	7	5	2	1	5	7	4	6	6	7	62	210	17	12	11	698
Mon 01/23/17	11	1	5		2	2	2	48	222	15	4	5	6	5	7	6	11	6	8	45	204	15	18	11	659
Sun 01/22/17	9	3	9	4	2	1	3	76	207	8	5	1	2	2	5	7	6	6	7	41	201	16	11	17	649
Sat 01/21/17	6	4	1	6	2	11	2	55	191	14	6	8	1	8	4	6	9	3	9	38	211	4	16	9	624
Fri 01/20/17	6	6		3	12	1		61	225	6	3	9	13	9	11	8	9	12	13	54	191	23	13	14	702
Thu 01/19/17	6	5	3	5	3	1	4	52	242	21	13	12	4	4	9	10	4	9	9	68	212	24	10	9	739
Wed 01/18/17	5	9	7			1	1	56	260	20	8	7	3	7	8	10	5	8	13	52	253	12	3	27	775
Tue 01/17/17	4	2	6	6		3	2	60	238	20	9	8	5	1	7	9	4	4	8	62	241	19	12	5	735

666 Positive
Screens
20,419 Screens
Performed
= 3.3% Hit Rate

SPOT Detections by Hour of Day

SPOT Enabled:
Screens
performed when
SPOT detects

Day of ts	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Mon 01/30/17												8	2			1		2		1	1	1	1	2	19
Sun 01/29/17	1			1	2			1	1		1	1	1		1					1	1	1	1	2	10
Sat 01/28/17		1		1	1		1	2	6	1		3		2	4	2	1		1	1	3	2		2	34
Fri 01/27/17		1		1				2	1					1		3	1			1		2	2		15
Thu 01/26/17								3	1	3			3	1	1	1	1	1	2	1	1	2			21
Wed 01/25/17	2		1		3	2		1	2	2		1	1			1		1	2	5					27
Tue 01/24/17	1	1						1	1	1			2		2	1	1	1						2	15
Mon 01/23/17	1			1	1		3	4	2	1	1	1	1	1	2	3	2	2	1	3		2			31
Sun 01/22/17	3			1	1	2	2	1			1	1	1	1	1	2	3	2	1	1	1	1		1	27
Sat 01/21/17			1	1	2	2	1	2	2	2		2				2		2	1	1			1		22
Fri 01/20/17	1	1		1	1			4			2	1	1	1	1	1				1	1	1	1	3	23
Thu 01/19/17	1	1			2		1	4		1	2		2	2	2	1	1	2	1	1		2	6		31
Wed 01/18/17	1	3		3		1	2	1		1	2	2	1	3	1	2				2	1	1	2		29
Tue 01/17/17	1			2	2	1		4			2	2		1		3	3	1		2	1	1	2	1	29

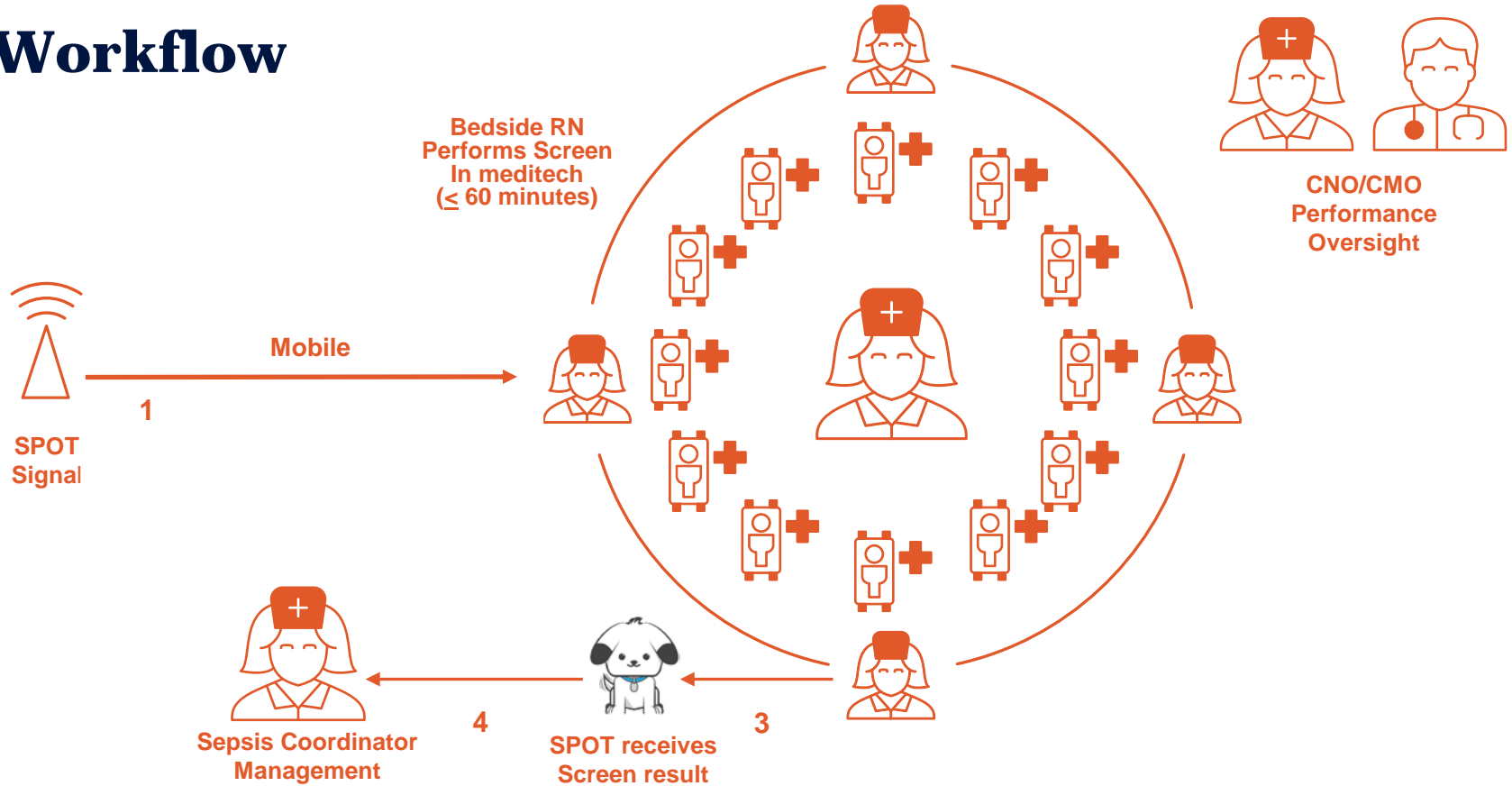
666 Positive
Screens
722 SPOT
Detections
= 92.2% Hit
Rate



SPOTLIGHTS



Workflow



SPOT INTERFACE ELEMENTS

Tier: 0
2017-11-12 - 19:00

ACCID
ROOM

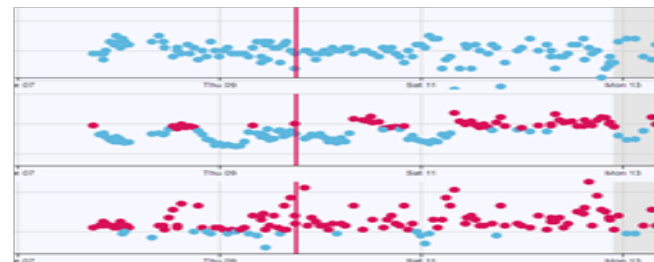
Wbc Count Temperature Antibiotic Order

65
Reason for Visit
GI BLEED

UNIT
H.B3PCU
GENDER
M

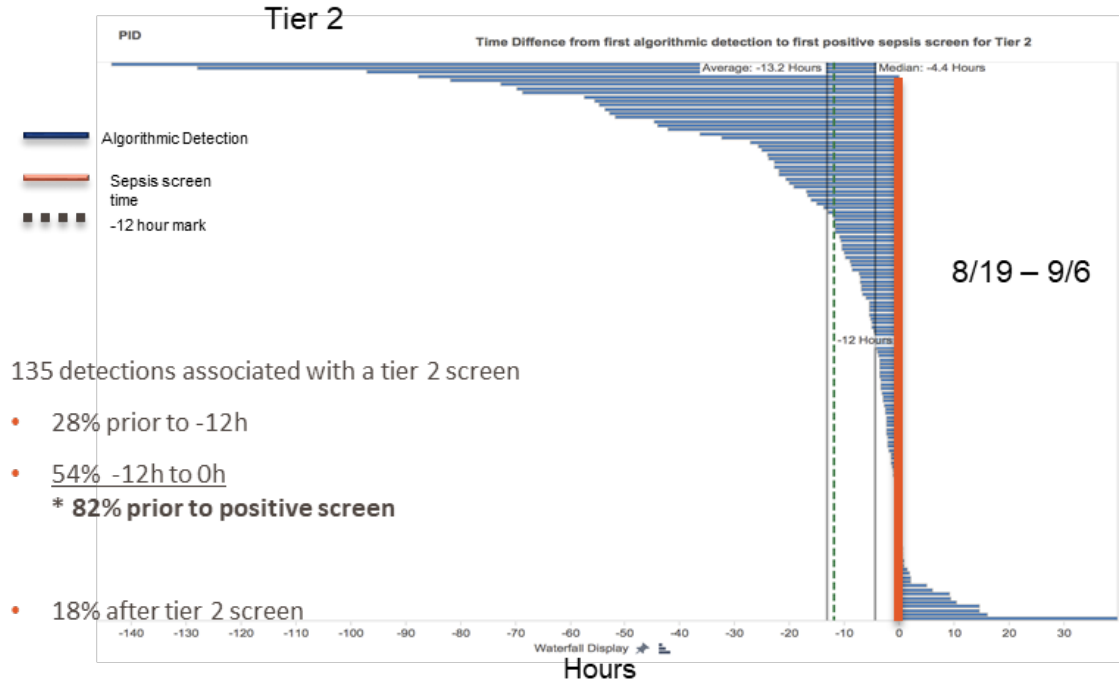
detection 2017-11-13 - 07:02

Add to List Acknowledge Snooze Vitals

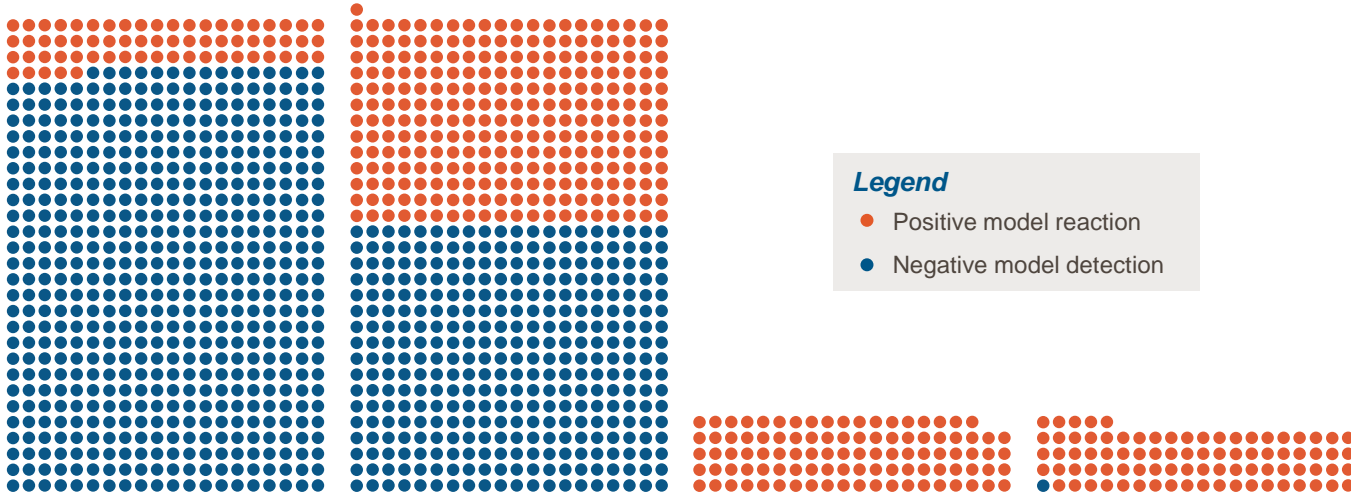


VALUE AND RELIABILITY

- On average, algorithmic detection occurs 12 hours prior to current nursing tier 2 and tier 3 screens



Concordance with Sepsis Screens



No Sepsis Screen

580 patients did not receive a sepsis screen, of which 71 had sepsis detected by the model.

SIRS

601 patients screened had a maximum sepsis screen level of SIRS positive, of which 261 had sepsis detected by the model.

Sepsis

88 patients had a maximum sepsis screen level of sepsis, all of which had sepsis detected by the model.

Severe Sepsis

45 patients had a maximum sepsis screen level of severe sepsis, 44 of which had sepsis detected by the model.

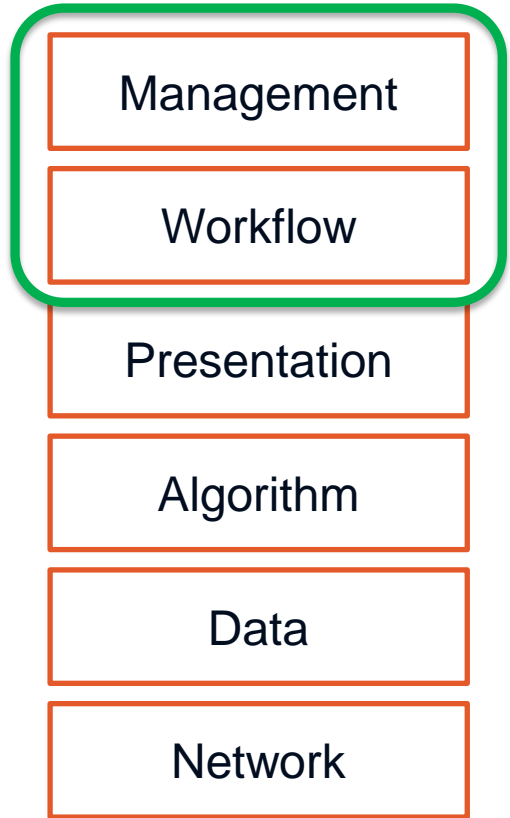
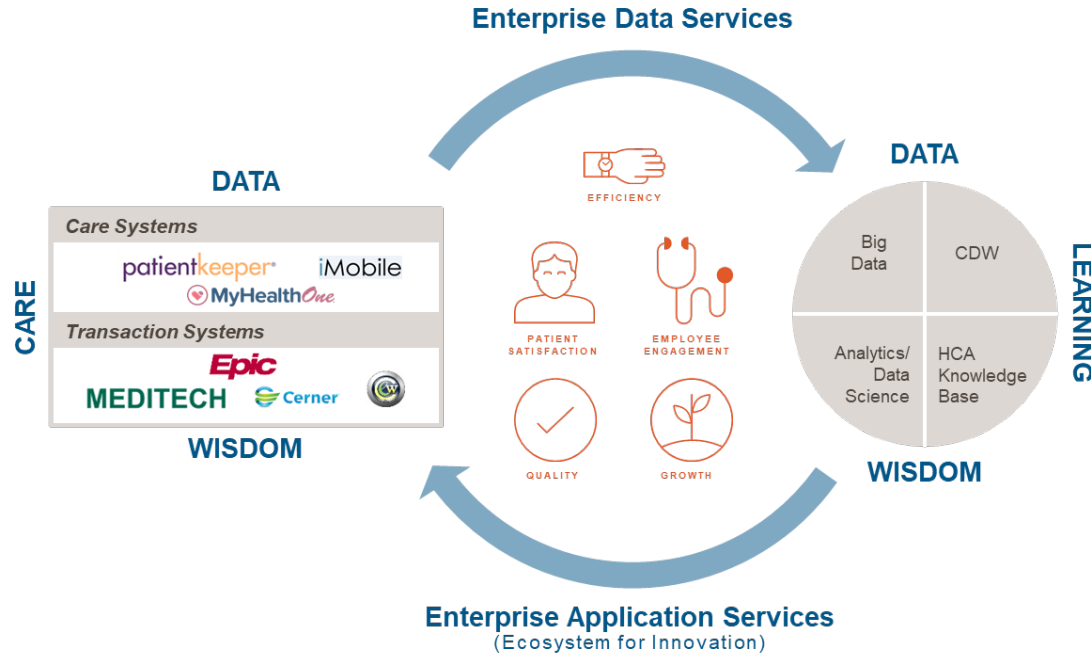
Legend

- Positive model reaction
- Negative model detection

- Machine detects 132 of 133 patients with at least Tier 2 (Sepsis).
 - Misses 1 Tier 3 (Severe Sepsis) patient
- Machine detects 464 patients vs 734 total patients with at least SIRS screen.



INTEGRATION LAYERS



MEASUREMENT 2.0: PREDICTIVE & PRESCRIPTIVE



Digital Dividend: The Ultimate Value – Lives Saved