

Using Predictive Analytics for Clinical Surveillance & Protocol Tracking

A.G. Breitenstein, JD, MPH
VP & GM, Provider Markets

Humedica

August 17, 2010

Problem

- Potentially High-Risk, High-Cost patients are difficult to detect before adverse events have occurred
 - Risk factors not well documented or scored on a systematic basis
 - Diagnoses may be ambiguous during critical time period in which an intervention can still be effective
 - EMR's not well suited to detect
 - Predictors are often subtle and don't lend themselves to hard coded rules engines

Cost of Preventable Complications

Preventable Complications for an Average 250 Bed Hospital

Injury	Excess LOS (days)	Excess Charges	Incidence/ 1000 Discharges	Average Annual Excess LOS (days)	Annual Charges for Average Hospital	% of Cost Covered by Medicare
Decubitus Ulcer*	3.98	\$10,845	33.95	1621.5	\$4,383,624	6.7%
Post-op Physiologic and Metabolic Derangement	8.89	\$54,818	1.73	184.6	\$1,138,021	
Post-op VTE*	5.36	\$21,709	11.88	764.1	\$2,290,083	11.6
Post-op Respiratory Failure	9.08	\$53,502	3.80	414	\$2,439,691	
Post-op Sepsis	10.89	\$57,727	13.56	1772	\$6,199,469	15.3%
Post-op Wound Dehiscence	9.42	\$40,323	5.31	600.2	\$2,569,381	
Catheter & IV Infections*	9.58	\$38,656	2.42	278.2	\$1,122,570	
MRSA	9.1	\$21,000	3.95	431.3	\$995,400	
Vent Acquired Pneumonia	11	\$40,000	5.12	675.8	\$2,457,600	

Total/Year

6,741.7 Days \$23,595,839

*Complications no longer paid for by Medicare and most major private payers October 2008

Goals & Objectives

- Goal: Prospectively prevent Iatrogenic Complications and missed care for measured populations (JCAHO)
- Objectives:
 1. Screen all patients in near real-time (every 5 mins)
 2. Find patients of interest without making demands on work flow (e.g. no requirement for admitting Dx or concurrent coding)
 - 95% sensitivity
 - 75% specificity
 3. Track protocol compliance and flag patients in need of care while opportunity to intervene still exists

Challenges

- Data required often siloed in different applications/systems (e.g. lab, pharmacy, rad, admitting)
- Data often in free text (e.g. Ejection Fraction, Chief Complaint)
- Different data available at different times (or not at all)
- Alert fatigue significant
- Diagnostic ambiguity

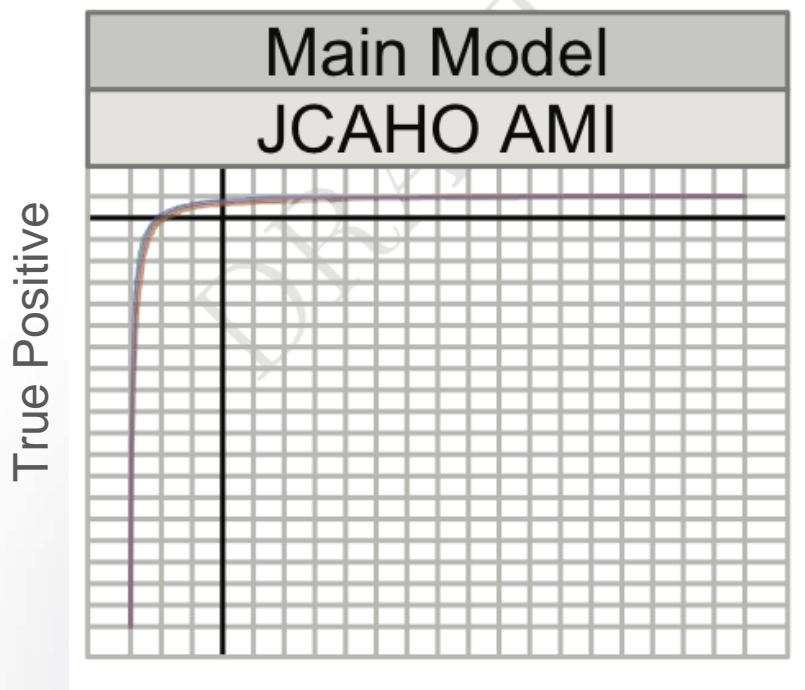
- Clinical Surveillance v. Clinical Decision Support
 - Targeted at QA staff
 - Focused on identifying patients who are:
 - High-Cost, High-Risk
 - Hard to find or track
 - Falling through cracks
 - Where opportunity exists to intervene effectively

Pilot Focus

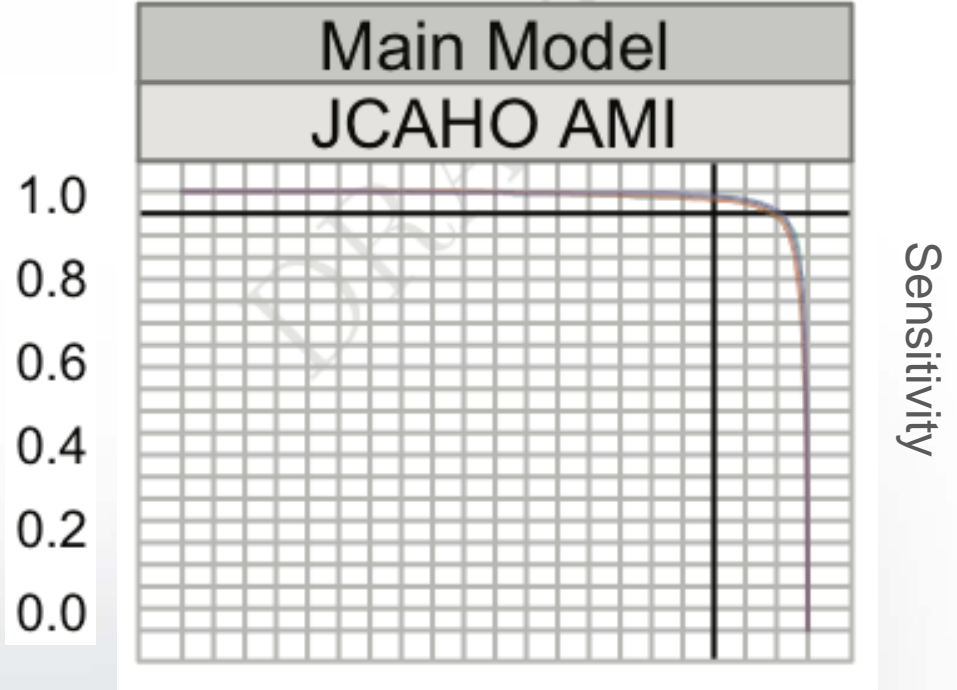
- AMI - JCAHO Core Measure
- Patients on anti-coagulant medications
 - National Patient Safety Goal

AMI Detection Algorithm:

Parameter	Goal	Actual
Sensitivity	95%	97%
Specificity	75%	96%



False Positive



Specificity

AMI Tracking

- Web-Base Interface
- Tracks Each Core Element
 - Aspirin, PCI, ACE/ARBs, etc.
 - Flags patients who need therapy but haven't gotten it yet
 - Automatically alerts when critical time threshold approaches
 - Aspirin w/in 24 hours
 - Includes logic for inclusion/exclusion criteria
 - EF < 40% for ACE/ARB
 - Print tracking lists for floor rounds
 - Generate electronic and paper documentation for Core Measure reporting

Screen Shot

HUMEDICA MinedStream Home **Tracking** Issues Reports Karen Waters Log Out

Last updated at Oct 28 13:51 (About 3 minutes ago)

Displaying **All** patients in **AMI** risk group(s), located in **Any Location** + Include

Patient	Location	Arrived	Aspirin at Arrival	Fibrinolytic Therapy	Primary PCI	Aspirin at D/C	ACEI or ARB at D/C	B-blocker at D/C	Smoking Cessation	LDL Cholesterol	Lipid Rx at D/C	Priority	Attending	Exclude
DOE, JANE FD10392 - F 42	Unit 1	Oct 04 08:09	✓	Overdue	Today 2:23pm	✓	✓	✓	At D/C	At D/C	At D/C	Low	MILLER, THOMAS MD	⊖
DOE, JANE FD11009 - F 73	Unit 1	Oct 25 14:08	Overdue	✓	Overdue	Friday 10:30 am	✓	Friday 10:30 am	Friday 10:30 am	Friday 10:30 am	Friday 10:30 am	Low	EDWARDS, GEORGE MD	⊖
DOE, JOHN FD15733 - M 55	Unit 1	Oct 13 23:41	✓	Overdue	Today 2:12 pm	Today 2:12 pm	At D/C	Today 2:12 pm	At D/C	At D/C	At D/C	High	MCDONALD, MICHAEL MD	⊖
DOE, JANE FD36123 - F 43	Unit 1	Oct 08 06:21	✓	Overdue	Overdue	✓	✓	✓	At D/C	At D/C	✓	High	SMITH, JOHN MD	⊖
DOE, JOHN FD57465 - M 58	Unit 1	Oct 06 12:10	✓	Today 4:07 pm	Today 4:07 pm	✓	At D/C	✓	At D/C	At D/C	At D/C	Low	BLAKE, JENNIFER MD	⊖
DOE, JANE FD34565 - F 33	Unit 1	Oct 11 04:23	✓	Overdue	Overdue	✓	✓	At D/C	At D/C	At D/C	✓	Medium	BLAKE, JENNIFER MD	⊖
DOE, JANE FD18432 - F 83	Unit 1	Oct 13 05:23	✓	Today 3:45 pm	Today 3:45 pm	✓	✓	At D/C	At D/C	At D/C	✓	Low	TANAKA, KEN MD	⊖
DOE, JOHN FD21432 - M 70	Unit 1	Oct 06 09:46	✓	Overdue	Overdue	✓	✓	✓	At D/C	At D/C	✓	High	SILVIA, DONALD MD	⊖
DOE, JOHN FD31337 - M 30	Unit 1	Oct 08 00:52	✓	Overdue	Overdue	✓	✓	✓	At D/C	✓	✓	Low	JACKSON, WILLIAM MD	⊖

Legend: ■ OK ■ Alert/Urgent ■ Critical ■ Overdue ■ Non-urgent ■ N/A ✓ Completed ✓ Completed Late ✓ Ignored * Followed

Build: 3467 revision: 11072

Anti-Coagulation Therapy

- Find patients on target therapy (easy)
- Predict and flag intrinsic clinical risk
 - Age, Cancer, MI, etc.
- Parameterize and track appropriate care:
 - Baseline, test frequency, levels
 - PTT
 - INRs
 - Platelet Counts
 - Rescue meds

Last updated at Jun 14, 04:08 America/New_York (About 2 minutes ago)

Displaying Coag patients with Active status, located in Any Location Include

Patient	Location	Arrived	Bleed risk	PTT bf hepm	PTT result	PTT freq	Plt count	Rescue protam	INR bf warfm	INR result	INR freq	Rescue vit K	Priority	Attending	Exclude	Print
BRIGHT, THADDEUS W9929217 - M 67	A.BL5	Feb 14 14:45	Alert/Urgent	Critical	Critical	OK	OK	OK	OK	OK	OK	OK	High	GENTRY,PABLO	Exclude	Print
SANDERS, HESTER T9902369 - M 69 active in 2 risk groups	A.BL5	Feb 09 08:21	Critical	Critical	Critical	OK	Alert/Urgent	OK	OK	OK	OK	OK	High	SANDOVAL,LE O	Exclude	Print
CALLAHAN, ADELINE G4638018 - M 41	A.BL5	Apr 16 15:03	Alert/Urgent	Non-urgent	Non-urgent	Non-urgent	Non-urgent	Non-urgent	OK	Critical	OK	OK	High	SANDOVAL,LE O	Exclude	Print
JENKINS, LAURA Z8621906 - F 68	B.MM7	Jun 11 13:36	Alert/Urgent	OK	Critical	OK	OK	OK	OK	OK	OK	OK	High	MERCERED	Exclude	Print
RODGERS, ADELINE A5319739 - F 84 active in 2 risk groups	B.BL1	Feb 15 14:14	Critical	OK	Critical	OK	OK	OK	Non-urgent	Non-urgent	Non-urgent	Non-urgent	High	RAMIREZ,SON NY	Exclude	Print
SWANSON, JOSHUA E9195276 - F 55	B.MM7	Mar 15 10:32	Alert/Urgent	OK	Critical	Alert/Urgent	OK	OK	Non-urgent	Non-urgent	Non-urgent	Non-urgent	High	ROJAS,ROSALI ND	Exclude	Print
GRIMES, GARRETT N2150708 - M 55	A.BL3	Jun 15 17:28	OK	Non-urgent	Non-urgent	Non-urgent	Non-urgent	Non-urgent	OK	Alert/Urgent	Alert/Urgent	OK	High	FOREMAN,GER TRUDE	Exclude	Print

Legend: OK Alert/Urgent Critical Overdue Non-urgent N/A Completed Completed Late Dismissed/ignored * Reviewed

Last updated at Jun 14, 04:08 America/New_York - About 5 minutes ago!

Displaying Coag patients with Active status, located in Any Location

Patient	Location	Arrived	Bleed risk	PTT of heparin	PTT result	PTT freq	PE count	Rescue protain	INR of warfin	INR result	INR freq	Rescue vit K	Priority	Attending	Exclude	Print
BRIGHT, THADDEUS W9929217 - M 67	A.BLS	Feb 14 14:45	Yellow	Red with star									High	GENTRY,PABLO		
SANDERS, HESTER T9902369 - M 69 active in 2 risk groups	A.BLS	Feb 09 08:21	Red	Red									High	SANDOVALLE, O		
CALLAHAN, ADELINE G4638018 - M 41	A.BLS	Apr 16 15:03	Yellow	Green									High	SANDOVALLE, O		
JENKINS, LAURA Z8621906 - F 68	B.MM7	Jun 11 13:36	Yellow	Green									High	MERCER,ED		
RODGERS, ADELINE A5319729 - F 84 active in 2 risk groups	B.BL1	Feb 15 14:14	Red	Green									High	RAMIREZ,SON NY		
SWANSON, JOSHUA E9195276 - F 55	B.MM7	Mar 15 10:32	Yellow	Green									High	ROJAS,ROSALI ND		
GRIMES, GARRETT N2150708 - M 55	A.BL3	Jun 15 17:28	Green										High	FOREMAN,GER TRUDE		

Patient Info
 Patient Name: JENKINS,LAURA
 Patient Number: J6069055
 Account Number: Z8621906
 Attending: MERCER,ED
 Medications: [Show all anticoagulant dosings](#)

Measure Status
 Measure: Is the patient's PTT test result within therapeutic range?
 Status: Updated on Jun 13, 21:38 by MinedStream
The last two PTT results are out of therapeutic range

Most Recent Result [Show all 6](#)
 Result: 80.0 sec
 Result Time: Jun 13, 21:38
 Collection Time: Jun 13, 21:00
 Normal: 23.0-36.0 sec
 Baseline: 86.0 sec (last test result prior to administration of heparin)
 Target: 129.0-215.0 sec (1.5 - 2.5x of baseline)

Mark Reviewed Ignore...

Case Study – Cost Savings

\$1M/annual savings opportunity for first pilot disease states implemented

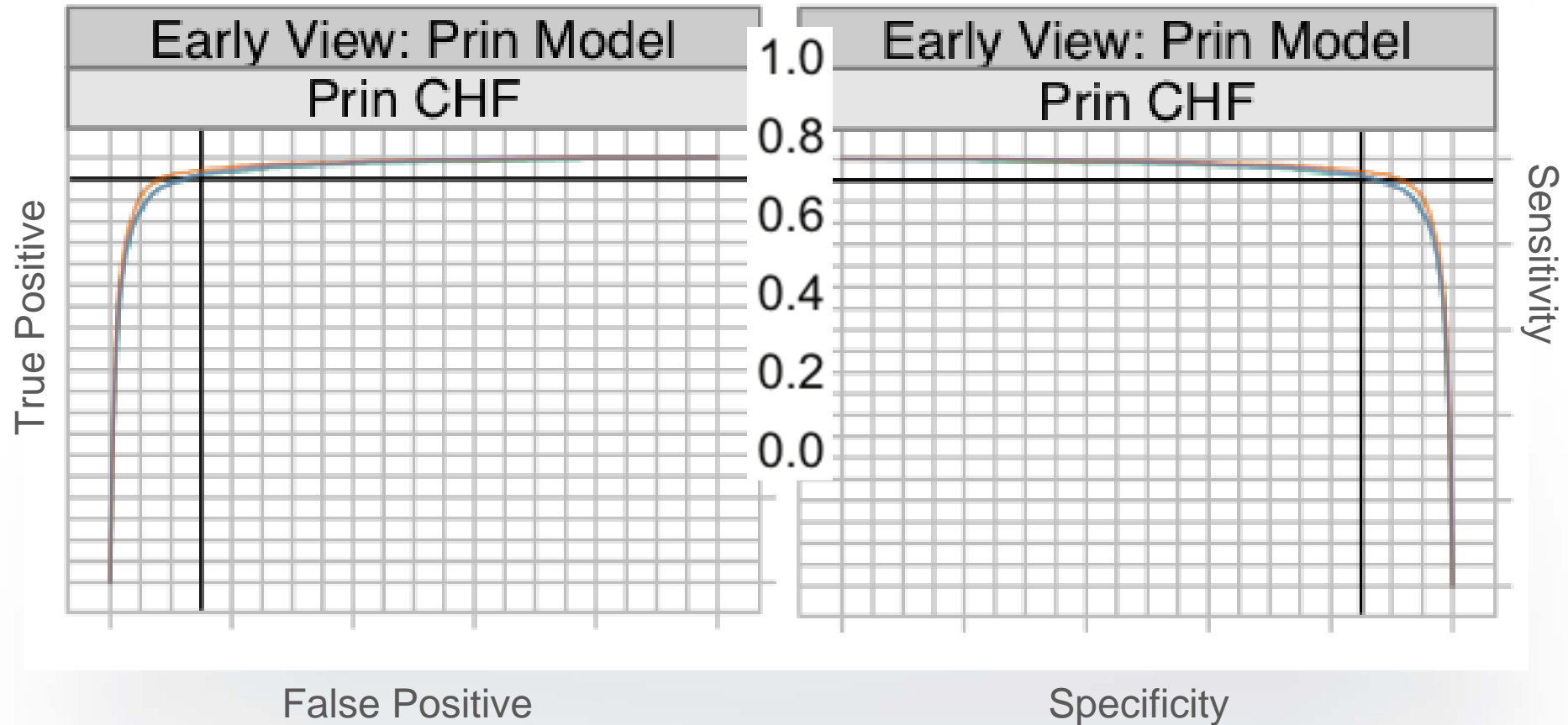
Risk group	Staff cost reduction	Complication cost reduction	Mortality reduction	Productivity gain
AMI	\$16k	\$240k	14	21%
Anticoagulant Therapies	\$20k	\$690k	151	18%

Expansion

- Q3: CHF and CAP
- Q4: Sepsis and DVT

More, More, More....

CHF Detection Algorithm

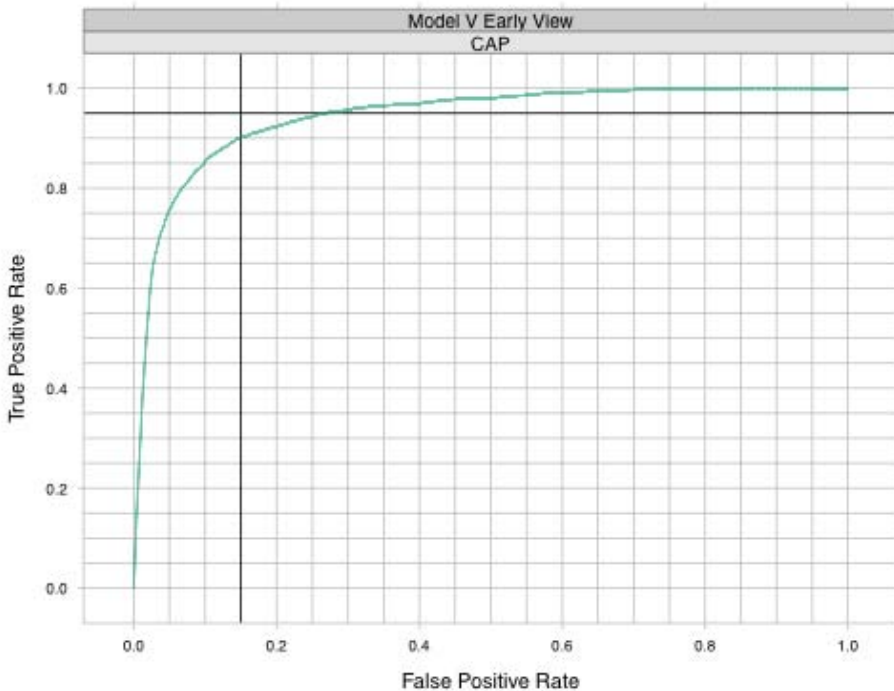


CAP Detection Algorithm

Train: ROC Curve Model V Early View

Training Sample ●

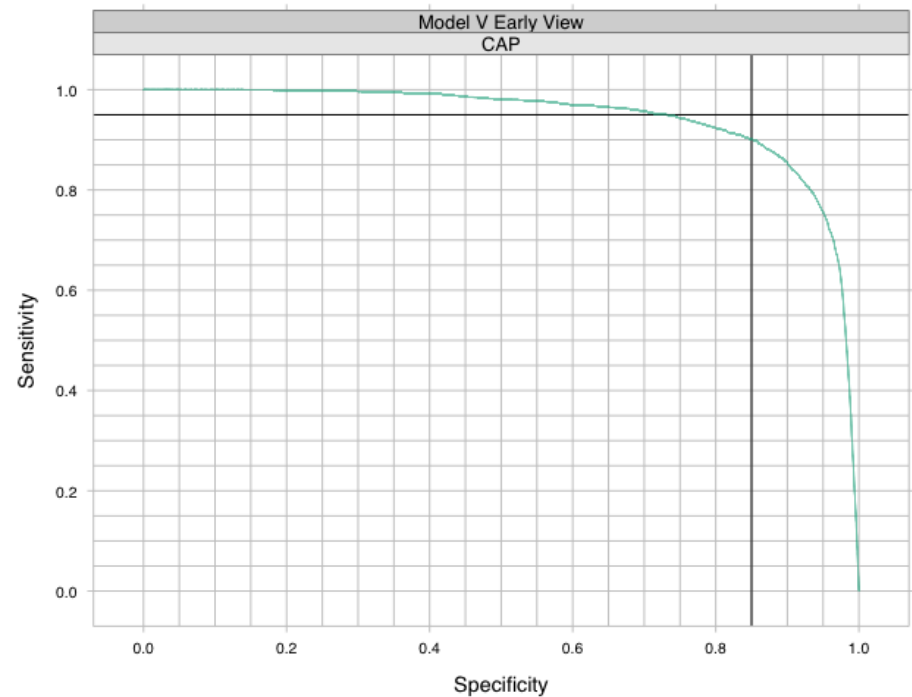
Model V Early View
CAP



Train: Sensitivity–Specificity Curve Model V Early View

Training Sample ●

Model V Early View
CAP



Conclusions

- Predictive analytics can be successfully developed and deployed
- Critical Success Factors
 - High threshold for sensitivity and specificity to prevent alert fatigue
 - Lots of data for modeling
 - World-class statistical capability
 - Targeted NLP
 - Flexible algorithms that can adjust to variance in care and documentation
 - Focus on “high-value patients”
 - High-cost, high-risk
 - Falling through the cracks
 - Interventional opportunity known & still available
 - Must be matched to an interventional workflow that makes sense

Thanks!

A.G. Breitenstein

ag@humedica.com

www.humedica.com

617-475-3800