



PCCI

Pioneering New Ways to Health

Implementing high dimensional decision support

October 29, 2018

Holt Oliver Md, PhD

Disclosures



No consulting or equity disclosures

Patents:

Co-inventor on patent on implementation of clinical predictive model system,
royalties assigned to Parkland Hospital



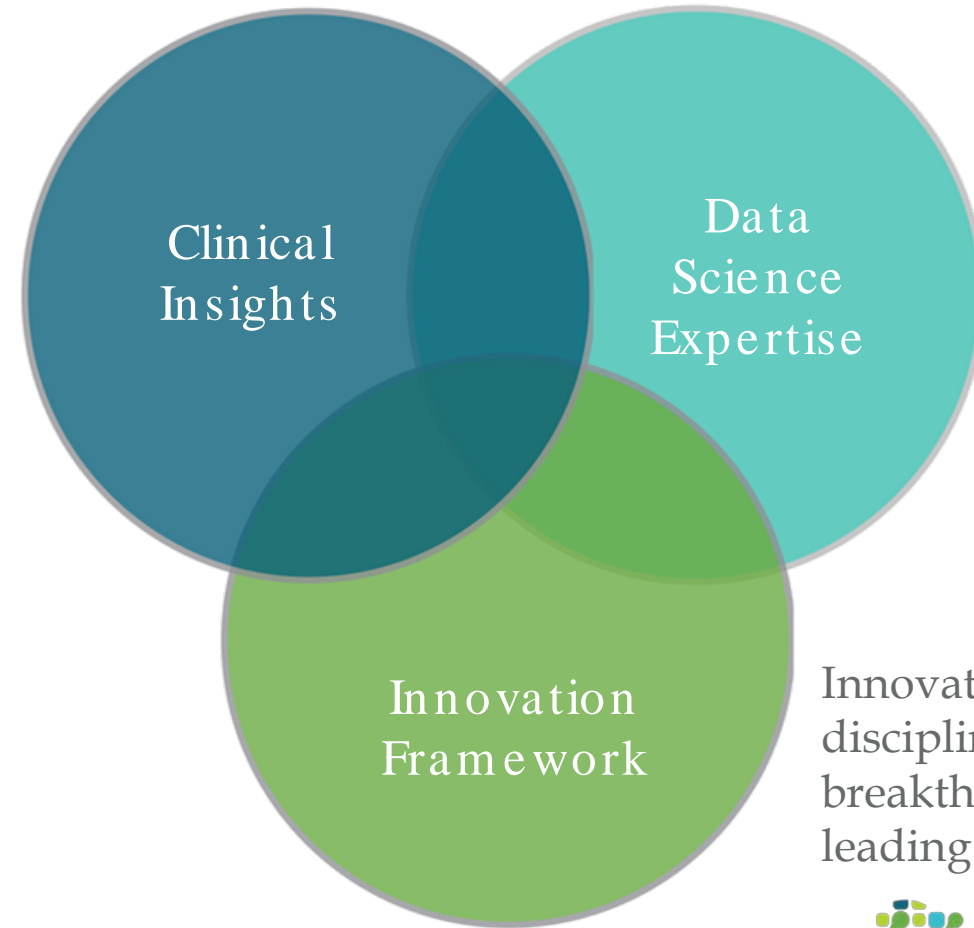
CREATING A WORLD OF CONNECTED COMMUNITIES WHERE EVERY HEALTH OUTCOME IS POSITIVE

MISSION: Reimagine and expand the knowledge base of healthcare through prescriptive analytics and artificial intelligence to deliver precision medicine.



Leading clinical expertise
applying practical insights
across the continuum of care

Prescriptive analytics and
artificial intelligence driving
personalized and precision
medicine

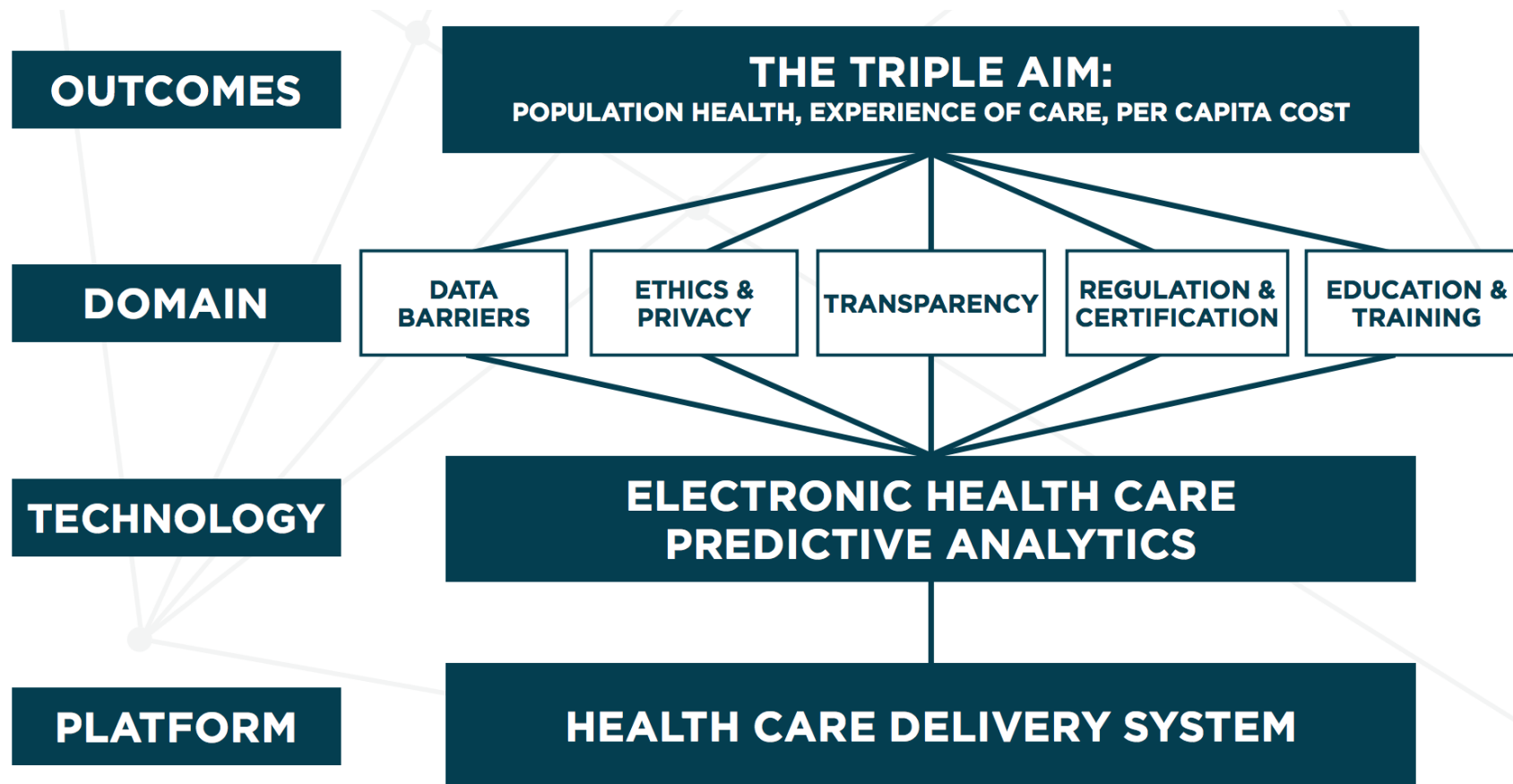


Innovation process and
discipline, building
breakthroughs and
leading change



Consensus Statement on Electronic Health Predictive Analytics: A Guiding Framework to Address Challenges

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Predictive Models to Focus on Clinical Quality & Performance Metrics



Hours

Days

Years

Minutes to hours

- Cardio-Pulmonary Arrest
- Sepsis
- Patient Safety Event
- Surgical Complication

30 Days

- Readmissions
 - All-Cause
 - CHF
 - AMI
 - PNA
 - HIV
 - Cirrhosis

90 Days

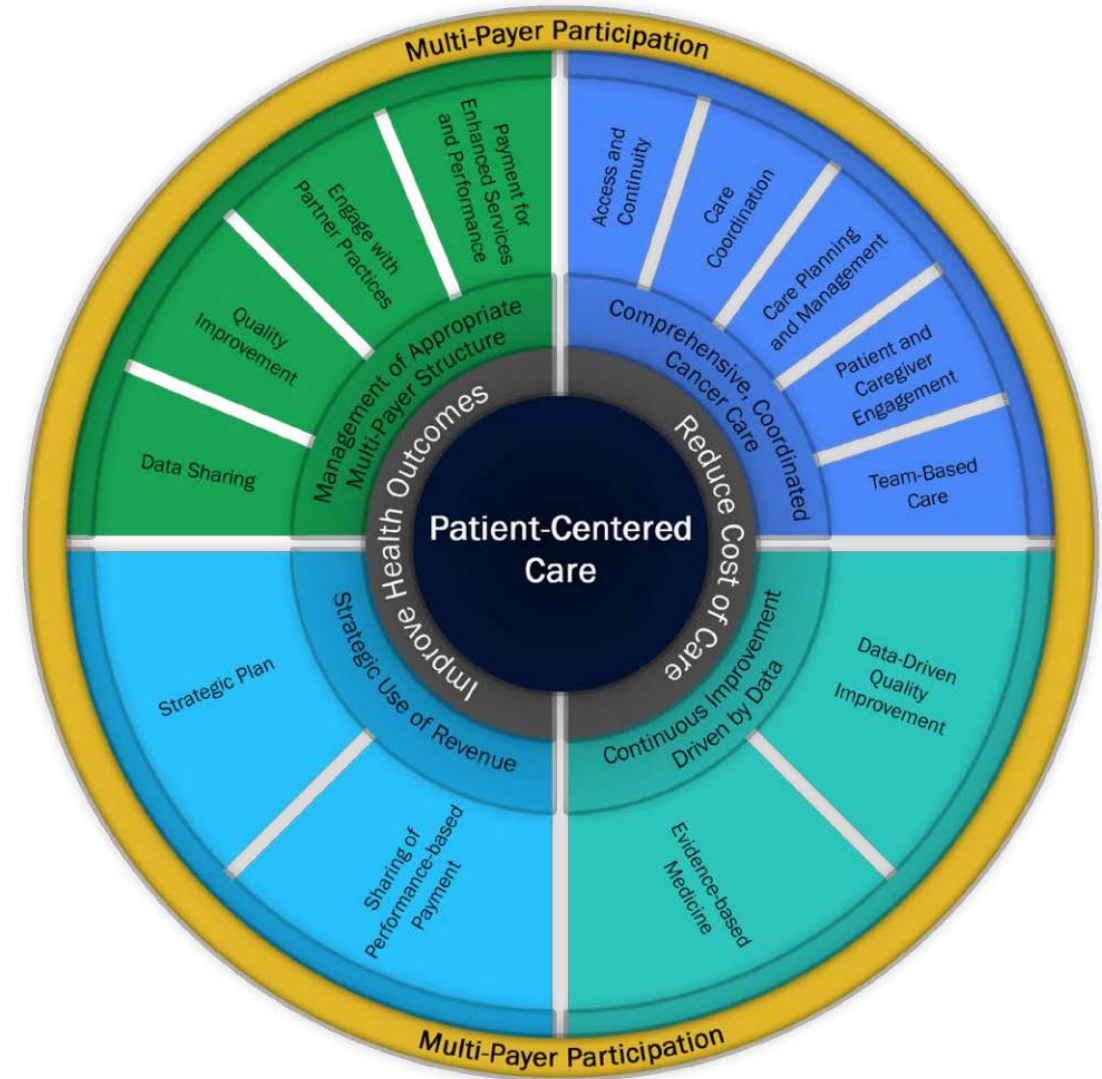
- Short-Term Diabetic Complications
- Pediatric Asthma Utilization

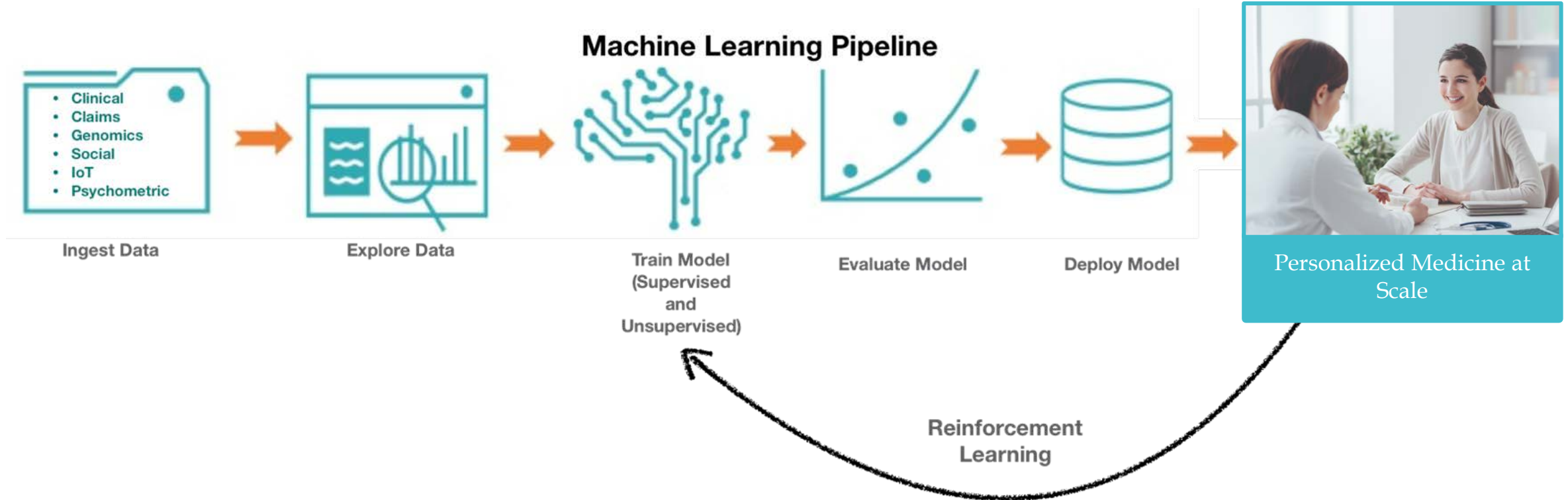
5 Years

- Chronic Kidney Disease
- Preventable Admissions
- Cancer Screening Followup



- Care transformation
- Improving care coordination, symptom management, palliative care, and end of life care
- Recognizing depression and distress in cancer patients
- Addressing financial toxicity
- Improving communication with patients and other providers

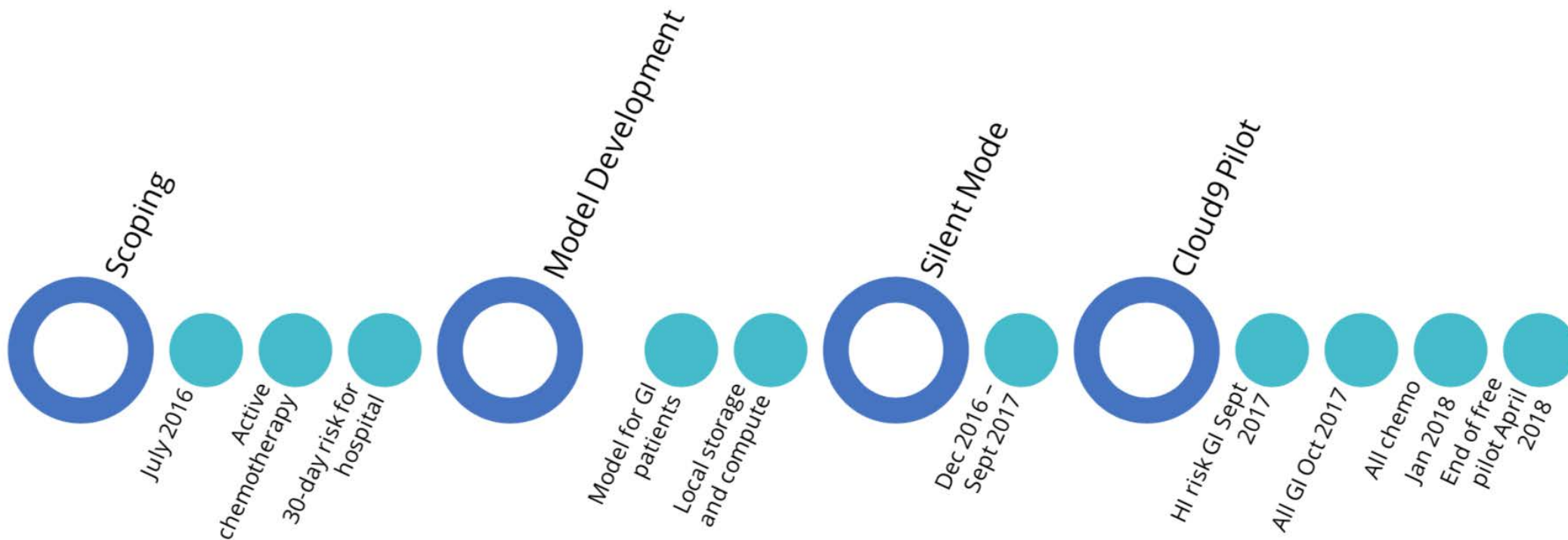




Modeling Framework

| Description | | Status |
|--------------------------------|---|---|
| Step 1: | Define the scientific problem and outcome variable | INP/Obs/ED 30d after a visit for IV chemotherapy |
| Step 2: | Literature Review and Acquire subject matter knowledge | |
| Step 3: | Define and acquire the dataset | GI chemo active therapy from Composite |
| Step 4: | Data cleaning and processing | |
| Step 5: | Modeling and evaluation strategy | Random Forest Model, evaluated on test population of unique patients |
| Review and Approval | Expert panel reviews and approves the modeling and evaluation strategy | PCCI and GI team (Dr. Cox and Dr. Karri) |
| Step 6: | Model development | Patient with upcoming week GI chemo : deliver (HIGH/MED risk) Composite Data Pull + local R process → xls report |
| Code Review | Code review for data source, data processing and model implementation | Initiated |
| Governance Review and Approval | Expert panel reviews and approves the model for deployment | |
| Step 7: | Model deployment | |
| Step 8: | Model performance, outcome, and cost effectiveness evaluation; manuscript preparation | |

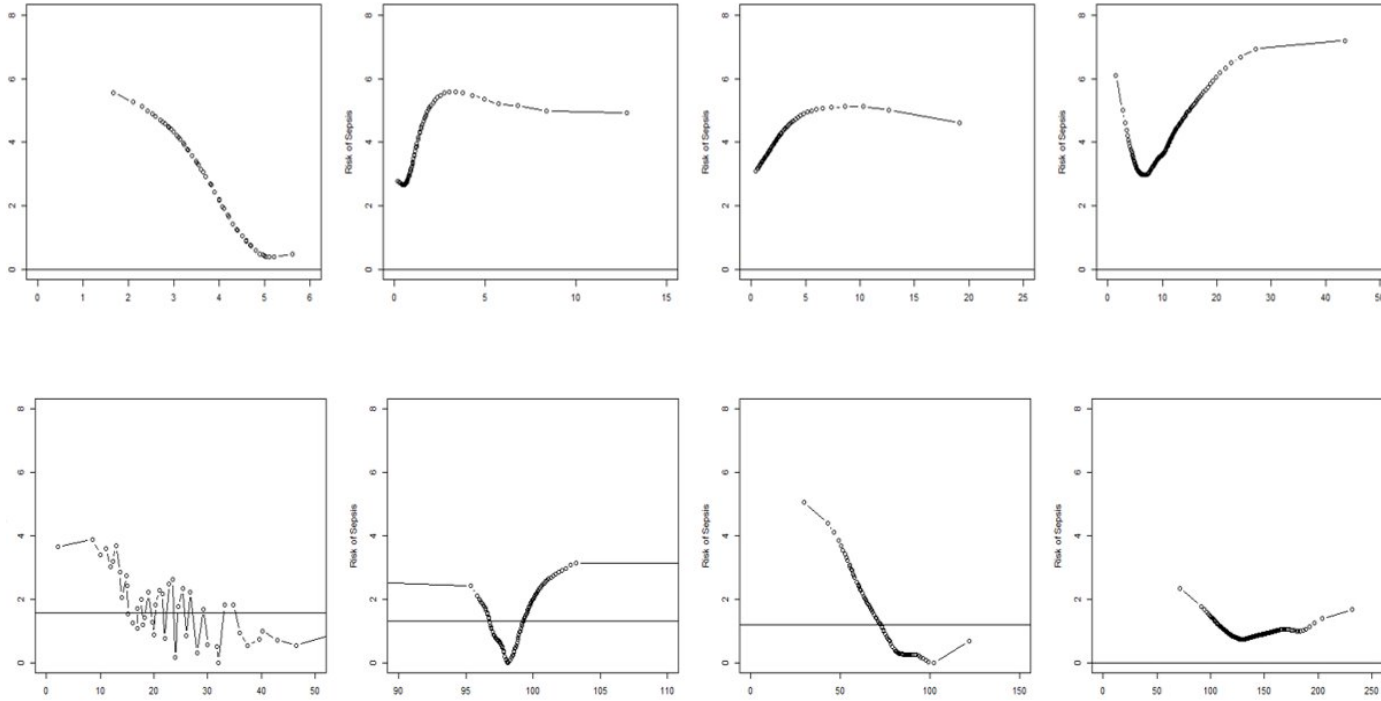
TEXT SLIDES



Predictor set



- Windowed transformation on administrative data
- Time windowed , Min/Max functions on LOINC defined laboratory
- Time Window and trend functions on Vital signs
- Socioeconomic/Demographic data
- Oncology treatment related variables





The data is split on the patient level (algorithm based on patient identifier).
Train data is ~ 50% of patients,
test is ~ 30% of patients
holdout is ~20% of patients.

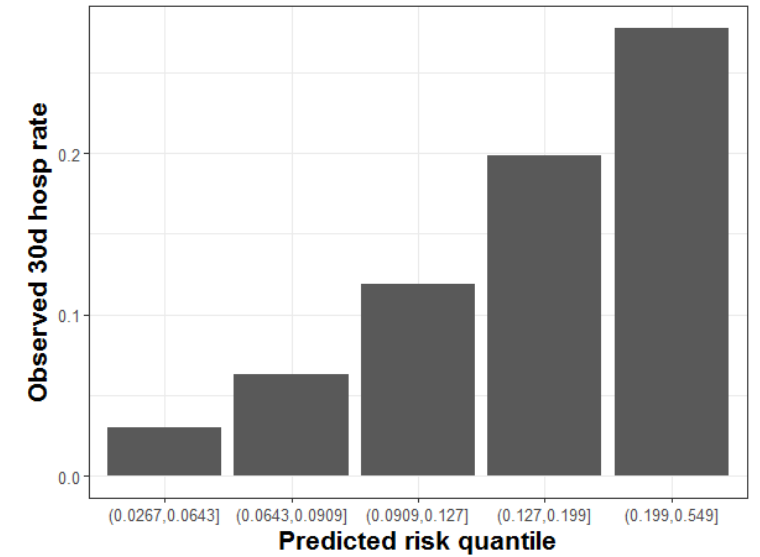
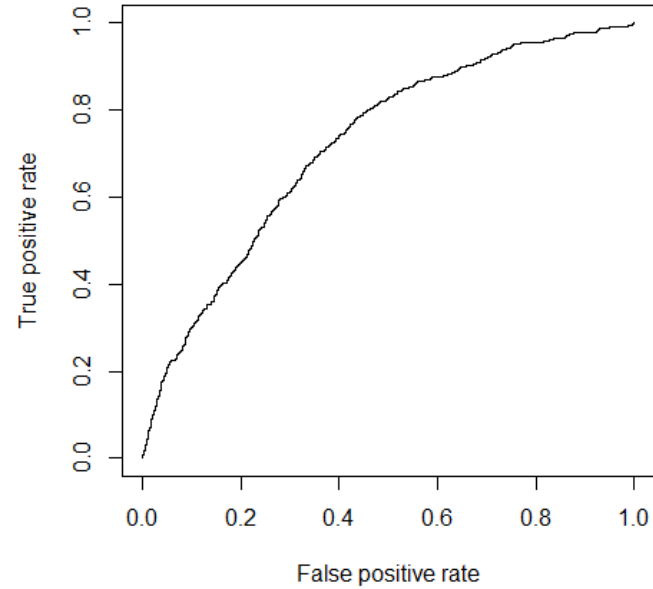
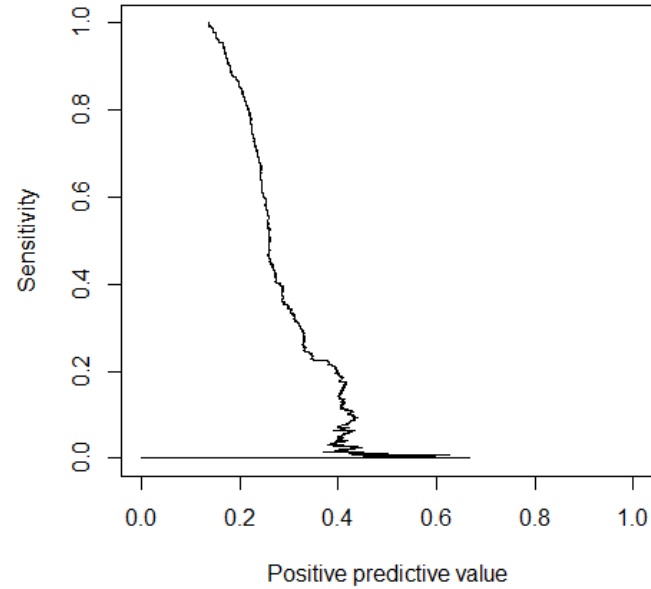
A random forest regression model was built on binary output of hospital(emergency, observation or inpatient) with 30 days of scheduled chemotherapy administration. Forest tuning was performed to maximize c-statistic on test data set. Variable selection was performed by automated forest variable importance selection and clinical judgement.

R libraries - randomForestSRC 2.2.0.

Performance



**C
stat
0.72**



Report

| Patients with top 20% risk | | | | Report Ran on 2017-01-11 | | | | | | | |
|----------------------------|-------|------|-------------|--------------------------|----------------|---|--|----------------|--|--|--|
| Demographics | | | | Scheduled Treatment | | | | Stage Clipping | | | |
| MRN | Patid | Name | Rounded Age | Sex F=1 | Treatment Date | Treatment Plan Name | Stage | | | | |
| 1 | | | 85 | 1 | | GI OCTREOTIDE EVERY 28 DAYS SP1 | : pT3N2a And excised r;pT3N2a B. Rectum | | | | |
| 2 | | | 60 | 2 | | GI FOLFIRI (IRINOTECAN/FLUOROURACIL/LEUCOVORIN) EVERY 14 DA | : pT3N2a And excised r;pT3N2a B. Rectum;pT3N2aMo | | | | |
| 3 | | | 55 | 1 | | GI FOLFIRI (IRINOTECAN/FLUOROURACIL/LEUCOVORIN) EVERY 14 DA | : (T4N0M1) Appendiceal | | | | |
| 4 | | | 55 | 1 | | GI FOLFIRI (IRINOTECAN/FLUOROURACIL/LEUCOVORIN) EVERY 14 DA | : (T4N0M1) Appendiceal | | | | |
| 5 | | | 75 | 1 | | GI FOLFOX WITH BEVACIZUMAB EVERY 14 DAYS | : pT4aN1cM1b (multiple | | | | |

| Treatment History | | | | Hospital History | | | | Diagnosis | | | | | | | | | | | | Labs past 2 | |
|-------------------|-----------------------|---------------------------|-----------|------------------------|-------------------------|-----------------|---------------|----------------------|-------------|--------------------|--------------|------------|------------------|-------------------|---------------------|----------------|-------------|-----------------------------|-----------------------|-------------|--|
| First chemo date | Days from first chemo | N days chemo administered | N Regimen | N Hosp in last 90 days | N Hosp in last 365 days | C15 - esophagus | C16 - stomach | C17 -small intestine | C18 - colon | C19 - rectosigmoid | C20 - rectum | C21 - anus | C22 - liver bile | C23 - gallbladder | C24 - biliary tract | C25 - pancreas | C77 - lymph | C78 - secondary resp digest | C79 - secondary other | | |
| | 0 | 1 | 1 | 0 | 4 | | | | | | | | | | | 1 | | | | | |
| B ?stage | 280 | 16 | 2 | 2 | 18 | | | | 1 | | 1 | | 1 | | | | 1 | 1 | | | |
| | 942 | 28 | 2 | 2 | 5 | | | | 1 | | | | | | | | | 1 | | 1 | |
| | 945 | 29 | 2 | 2 | 5 | | | | 1 | | | | | | | | | 1 | | 1 | |
| | 47 | 5 | 2 | 2 | 3 | | | | 1 | 1 | | | | | | | | 1 | | | |

9 days, 9999 = missing

| Pain_min_29 | | Pain_max_29 | ALB_max_29 | CALCIUM_min_29 | CALCIUM_max_29 | HGB_max_29 | CREATINI_NE_min_29 | HCT_max_29 | HGB_max_29 | K_max_29 | MONOSA_BS_min_29 | NEUTROA_BS_min_29 | NEUTROA_BS_max_29 | RBC_max_29 |
|-------------|------|-------------|------------|----------------|----------------|------------|--------------------|------------|------------|----------|------------------|-------------------|-------------------|------------|
| 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 |
| 5 | 5 | 2.7 | 8 | 8.4 | 10.3 | 1.25 | 34.2 | 10.3 | 3.8 | 0.1 | 0.92 | 3.93 | 4.27 | |
| 9999 | 9999 | 3.2 | 8.4 | 8.5 | 8.4 | 2.96 | 27.6 | 8.4 | 4 | 9999 | 9999 | 9999 | 2.87 | |
| 9999 | 9999 | 3.2 | 8.4 | 8.5 | 8.4 | 2.96 | 27.6 | 8.4 | 4 | 9999 | 9999 | 9999 | 2.87 | |
| 9999 | 9999 | 4.1 | 9.5 | 9.7 | 11 | 1.21 | 33.9 | 11 | 3.4 | 0.44 | 1.5 | 2.11 | 4.02 | |

Advance directives

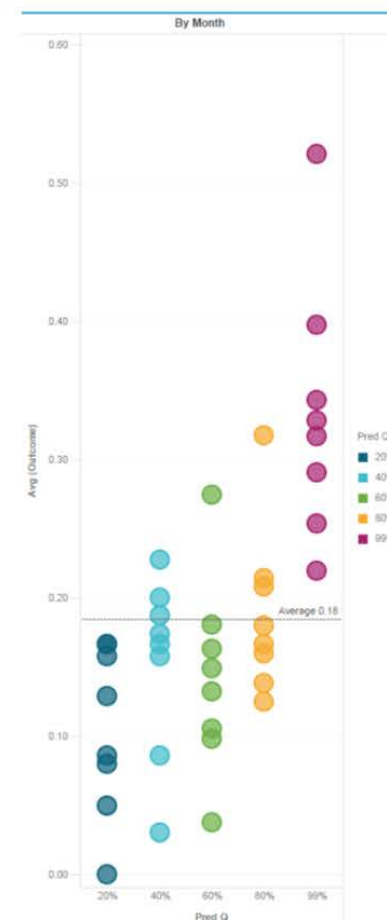
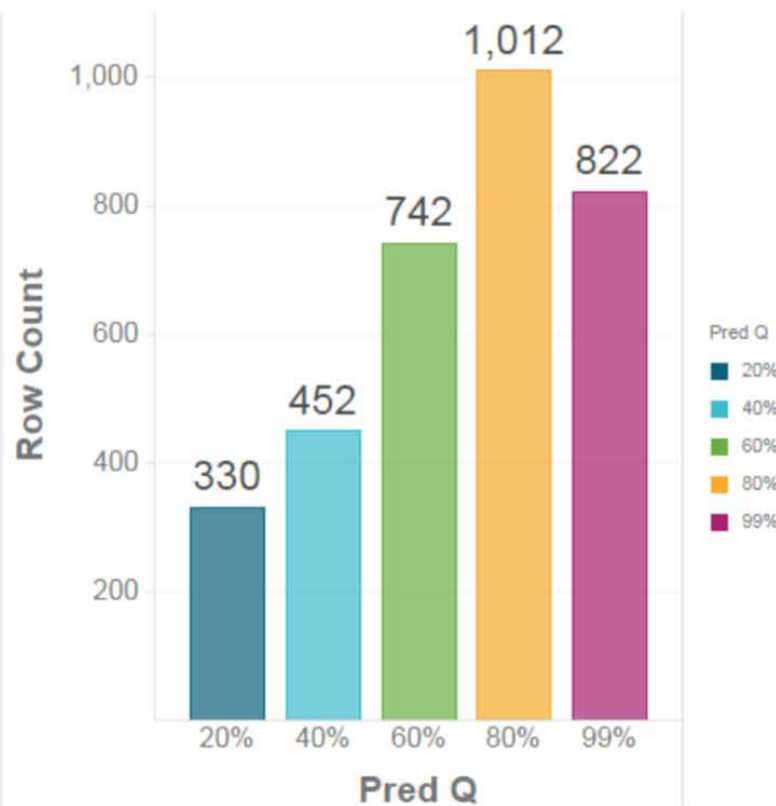
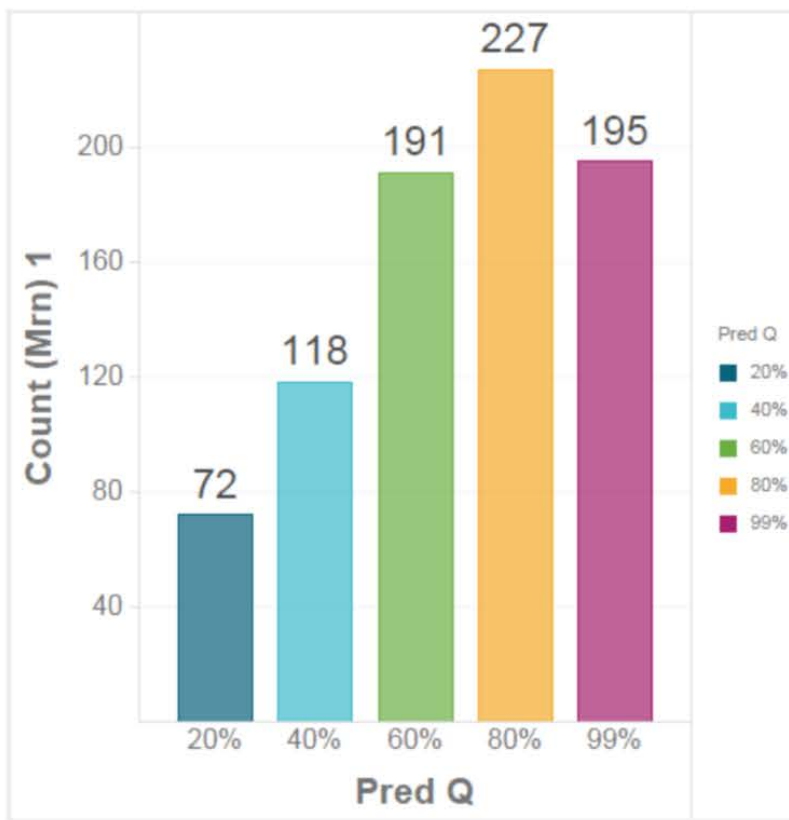
| Adv.Dir | Adv.Dir.D ate | Pow.Att | Pow.Att.D ate | Liv.Will | Liv.Will.D ate | Oohdnr | Oohdnr.D ate | Ment.Hea lth | Ment.Hea lth.D ate |
|------------------|---------------|---------|---------------|------------------|----------------|--------|--------------|--------------|--------------------|
| YES, NOT ON FILE | | | | | | | | | |
| DECLINED | | | | YES, NOT ON FILE | | | | | |
| DECLINED | | | | YES, NOT ON FILE | | | | | |

Comments

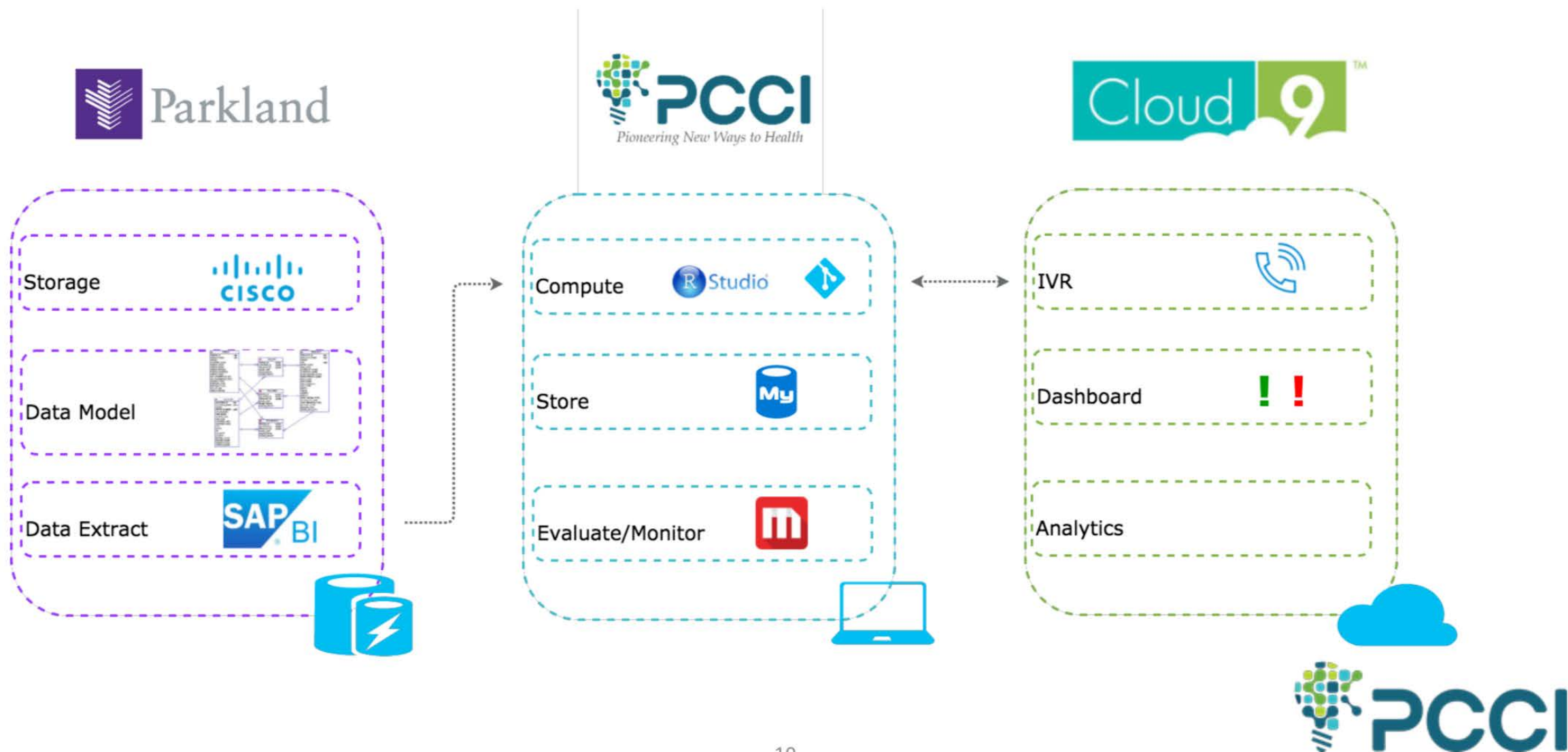
| Real appointment | Transfer | Hold | Dose Reduction | APP visit | IVF | RN Visit | RN Call | Other |
|------------------|----------|------|----------------|-----------|-----|----------|---------|-------|
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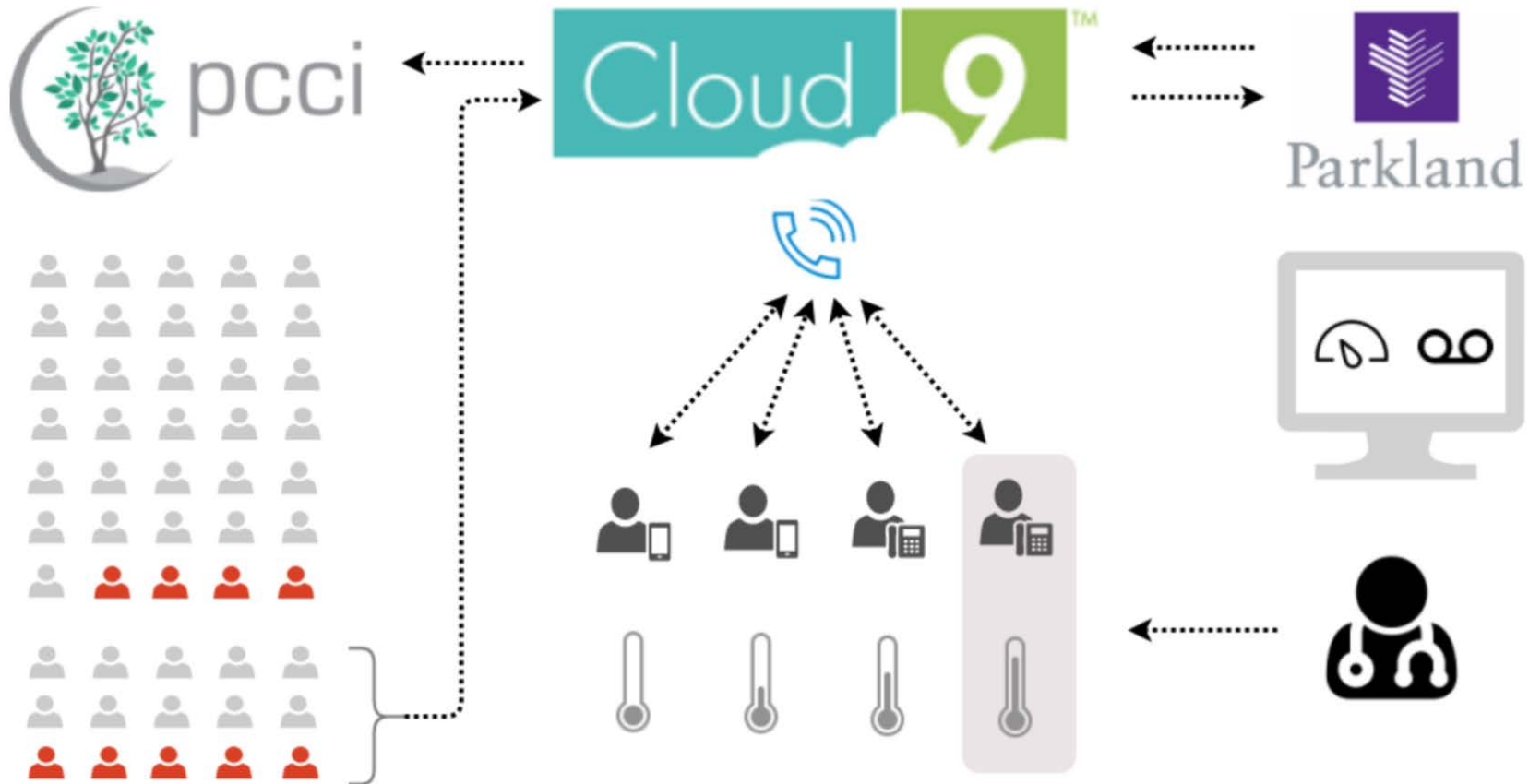
SILENT MODE



DATA FLOW














TEXT SLIDES



Cloud 9 Dashboard



Call Detail

| Question | Threshold | Response |
|---|------------------|---------------|
|  Are you experiencing fever or chills? For yes press 1, for no press 2. | 1: Yes | 1: Yes |
| Have you taken your temperature? For yes press 1, for no press 2. | | 1: Yes |
| Please use the keypad on your phone to enter your temperature. Press the pound key when finished. | 100 | 97 |
|  Have you had any nausea or vomiting? For yes press 1, for no press 2. | 1: Yes | 1: Yes |
|  Please rate how much relief you are getting from your nausea medicine. If no relief press 0, if a little relief press 1, if fair relief press 2 and if good relief press 3. | 1: Little Relief | 0No Relief |
|  Have you been feeling dizzy, faint, or confused? For yes press 1, for no press 2. | 1: Yes | 1: Yes |
|  Please rate your pain on a scale of 0-10, with 10 being the worst pain. Please enter the number followed by the pound sign. | 5: Moderate pain | 9: Worse pain |
|  Please rate how much relief you are getting from your pain medicine. If no relief press 0, if a little relief press 1, if fair relief press 2 and if good relief press 3. | 1: Little relief | 0No relief |
|  Would you like to consider a change in your pain medicine? For yes press 1, for no press 2. | 1: YES | 1: YES |
| Are you taking your medications as prescribed? For yes press 1, for no press 2. | 2: NO | 1: YES |
| Are you experiencing any bothersome side effects from your medications or have you discontinued any of them? For yes press 1, for no press 2. | 1: Yes | 2: No |
|  Would you like to record a message for one of our doctors or nurses? For yes press 1, for no press 2. | 1: Yes | 1: Yes |
| Begin recording after the beep. Please press the pound key when finished.  0:00 / 0:42   | | |



| Timestamp | Data | Minutes |
|---------------------------|---|---------|
| February 19, 2018 8:58 AM | Acknowledged: Agent Donna Betts acknowledged report. | 0 |
| February 19, 2018 8:58 AM | Note by Agent Betts, Donna : pt\'s BP low | 0 |
| February 19, 2018 8:57 AM | Report Action by Agent Betts, Donna : Notified the Dr of the patient issues | 1 |
| February 19, 2018 8:57 AM | Report Action by Agent Betts, Donna : Contacted patient/family for more information | 10 |
| February 18, 2018 3:08 PM | Scan for alerts: Alerts found - notifying responsible contacts. | 0 |
| February 18, 2018 3:08 PM | Alert Notification Error: , - No contact methods defined. | 0 |
| February 18, 2018 3:07 PM | Ending Call: Survey Complete [Chemotherapy - Parkland Study] | 0 |



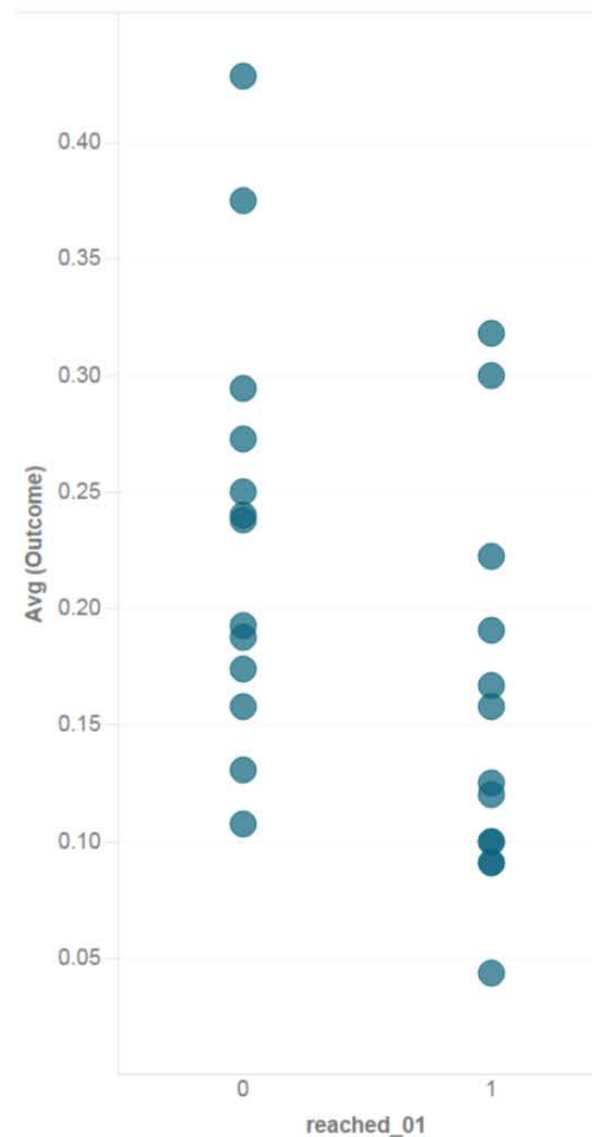
Study Design & Results



| Sent | Reached | # MRN | # Visits | # Outcomes | Average Predicted | Average Observed |
|---------|---------|-------|----------|------------|-------------------|------------------|
| No | | 201 | 444 | | | |
| Yes | No | 121 | 278 | 61 | 0.16 | 0.22 |
| | Yes | 129 | 418 | 68 | 0.14 | 0.16 |
| All now | | 205 | 959 | | | |

3 months

Reached ::: picked up the phone within 0-4 days of treatment date



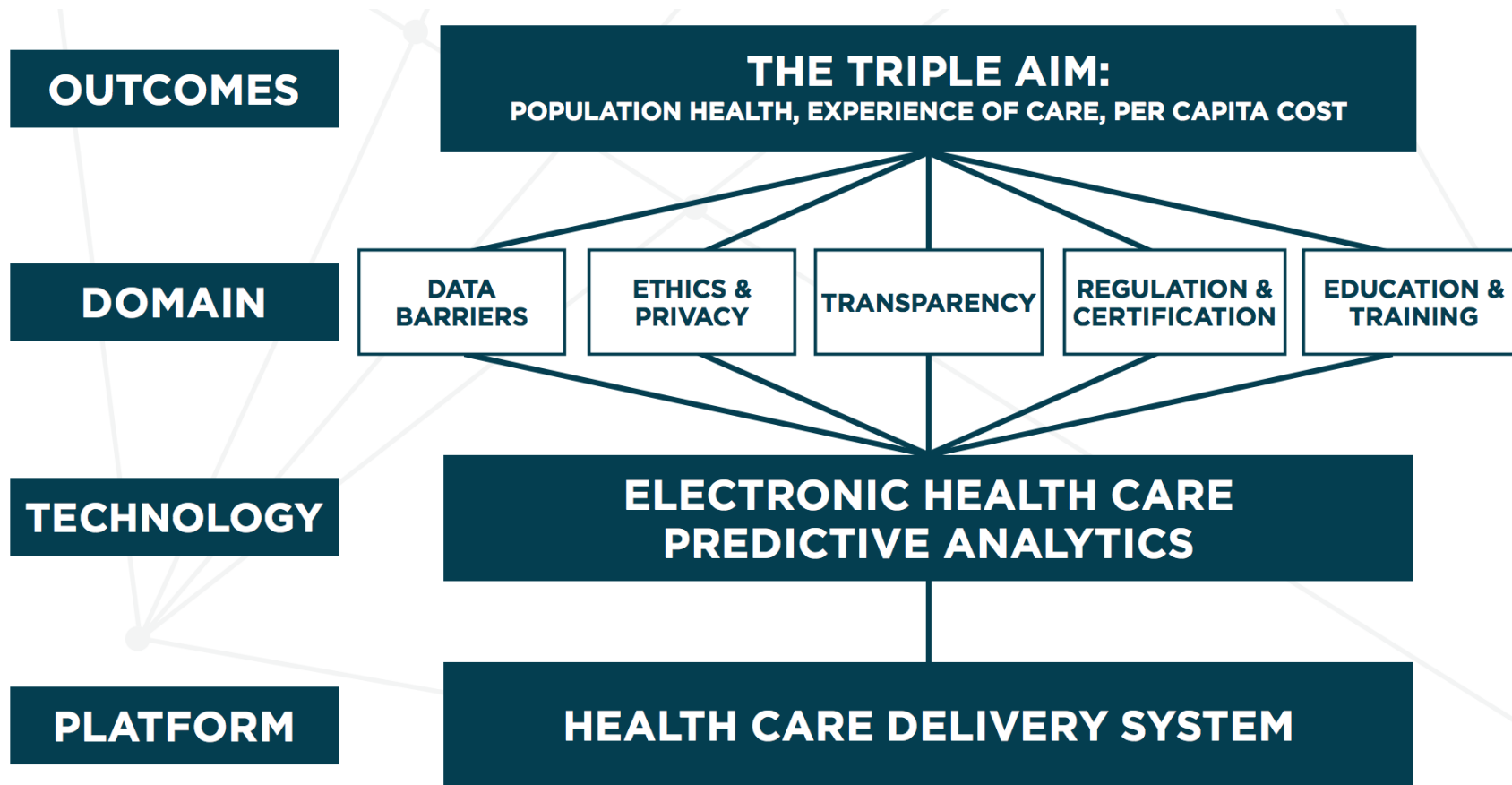
Recommendations



Presenter Name
Month Day, Year



1. Data Barriers: Establish mechanisms within the scientific community to support data sharing for predictive model development and testing.
2. Transparency: Set standards around e-HPA validation based on principles of scientific transparency and reproducibility.
3. Ethics: Develop both individual-centered and society-centered risk-benefit approaches to evaluate e-HPA.
4. Regulation and Certification: Construct a self-regulation and certification framework within e-HPA.
5. Education and Training: Make significant changes to medical, nursing, and paraprofessional curricula by including training for understanding, evaluating, and utilizing predictive models.

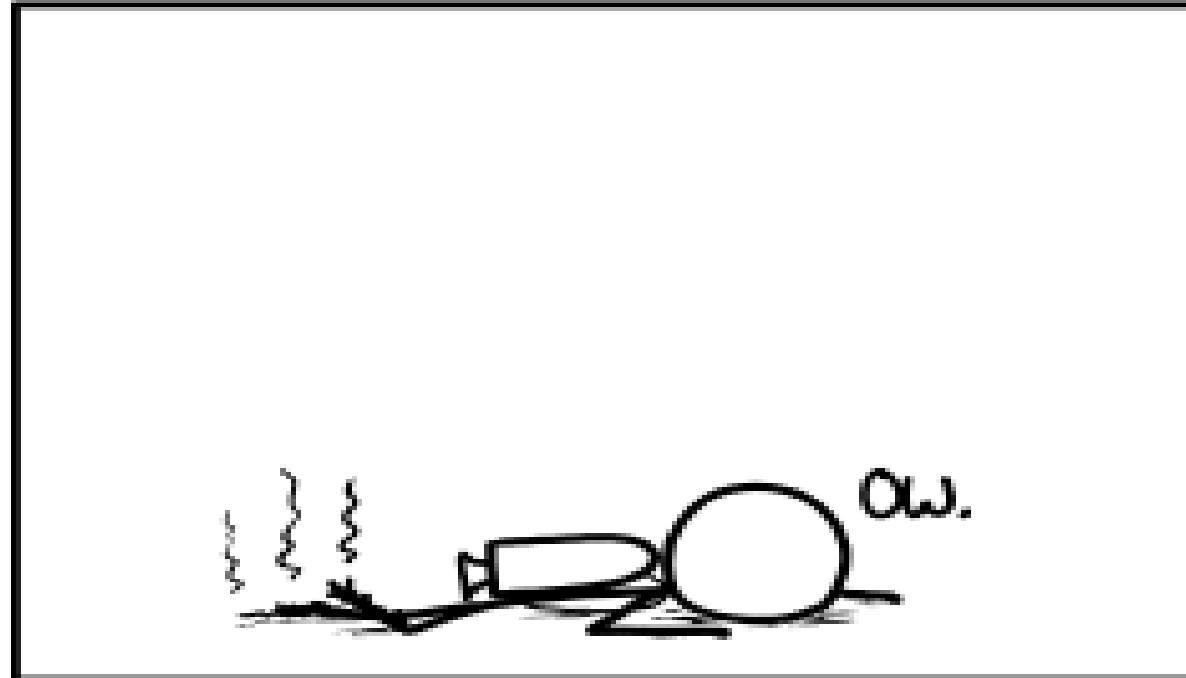


Amarasingham R, Audet AM, Bates DW, Glenn Cohen I, Entwistle M, Escobar GJ, Liu V, Etheredge L, Lo B, Ohno-Machado L, Ram S, Saria S, Schilling LM, Shahi A, Stewart WF, Steyerberg EW, Xie B. EGEMS (Wash DC). 2016 Mar 7;4(1):1163.





ROCKET PACKS ARE EASY.



THE HARD PART IS INVENTING
THE CALF SHIELDS.

Acknowledgements



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GORDON AND BETTY
MOORE
FOUNDATION

Collaborators

John Cox DO, Director Parkland Oncology Services
Sirisha Reddy, MD

Boryana Manz, PhD
Phackdei Mam





THANK YOU





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