Forecasting Platelet Blood Bag Demand to Reduce Inventory Wastage at the Stanford Blood Center

Stanford Data Science for Social Good
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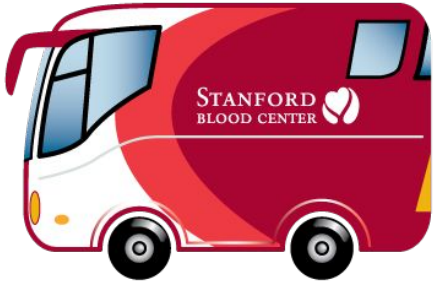
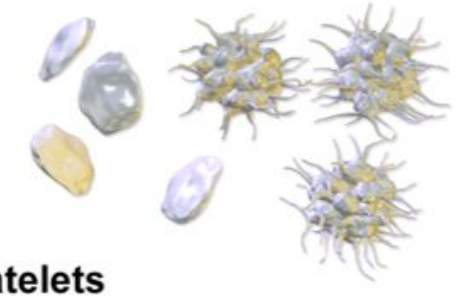


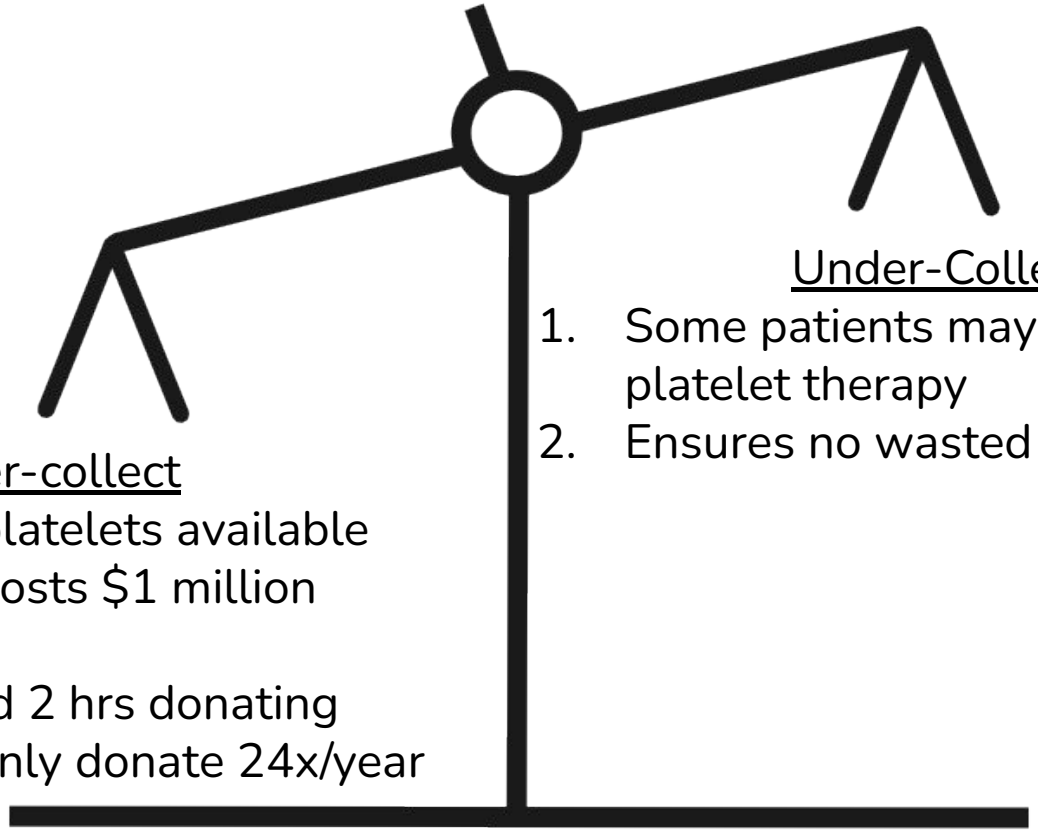
Platelets are valuable resources



Clot formation

- Needed in emergency situations
  - Trauma
  - Surgery
  - Active bleeding
- 3-day shelf life

There are difficulties with platelet inventory



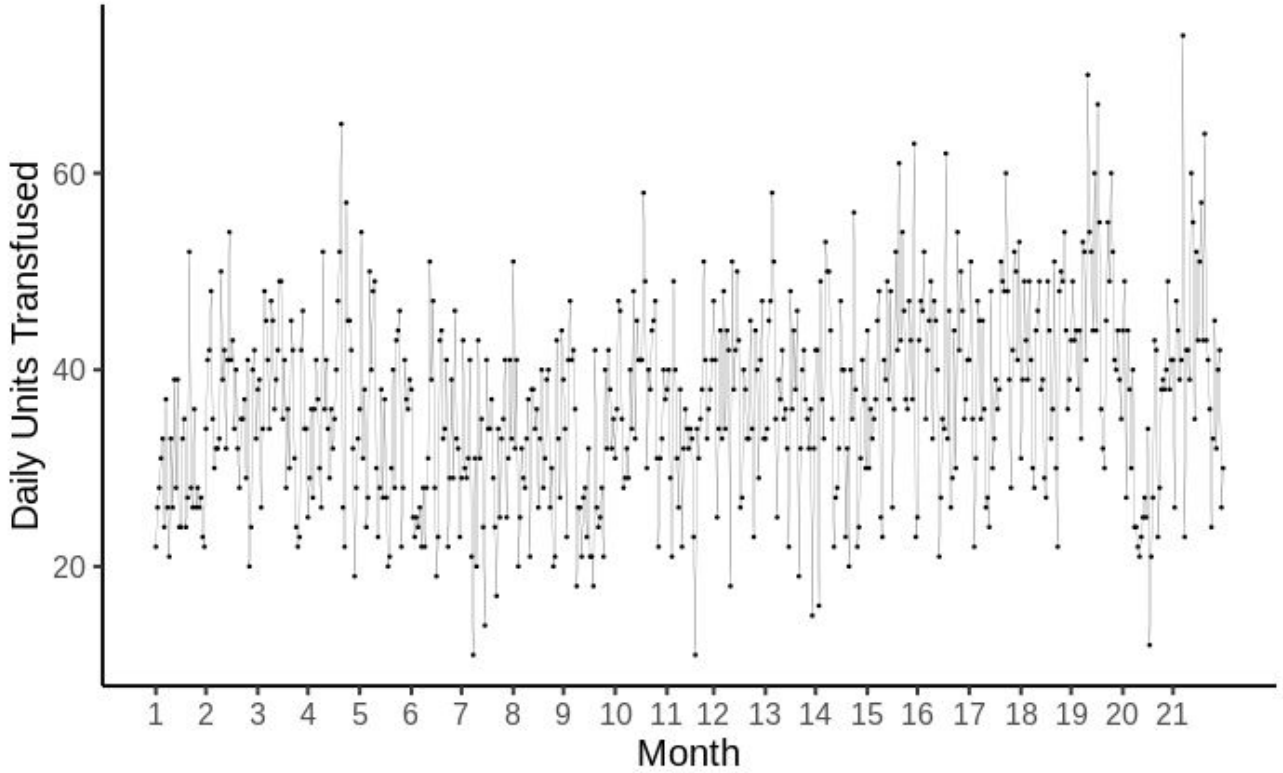
Under-Collect

1. Some patients may go without platelet therapy
2. Ensures no wasted products

Over-collect

1. Guarantees platelets available
2. Expensive - costs $1 million annually
3. Donors spend 2 hrs donating
4. Donors can only donate 24x/year

Daily platelet usage patterns are highly variable



Guan and colleagues (2017) tried to solve this issue

- Reduced wastage from 10.5% to 3%
- Avoided shortages
- Model not implemented because inventory managers don't trust it

Guan, L., Tian, X., et al. (2017). "Big data modeling to predict platelet usage and minimize wastage in a tertiary care system." PNAS (43) 114: 11368 - 11373. Retrieved from: www.pnas.org/cgi/doi/10.1073/pnas.1714097114

Project trajectory

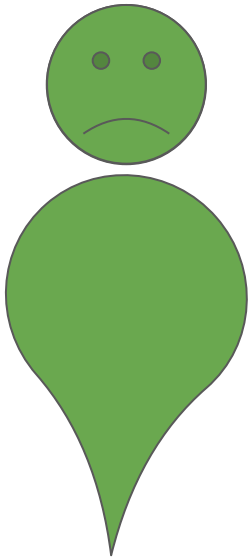
Our task

Blood center's eventual goal

Our datasets include 2 years of data

In-patient records	315,000 adult hospital records
Blood test results	8 million blood tests
Transfusions	100,000 blood transfusions
Surgery	106,000 surgeries

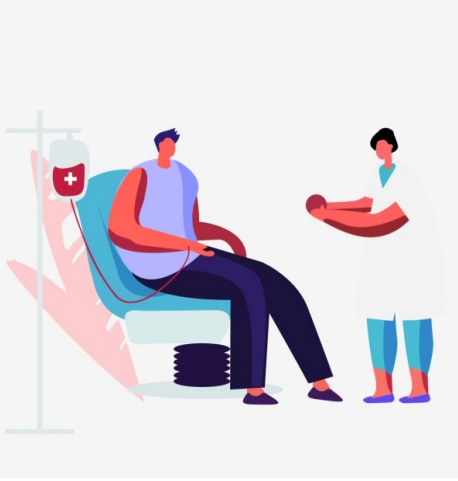
Meet Em



Monday

Em receives a blood test and their results show abnormal platelet count

BLOOD TEST



Tuesday

Em receives a platelet blood transfusion

TRANSFUSION

Wednesday

Em needs immediate cardiac surgery

SURGERY

Thursday

Em is assigned a bed in the hospital so they can recover from surgery

INPATIENT RECORDS

Strategy: Create four different models for each patient group

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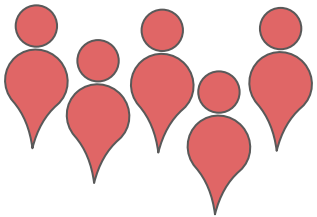
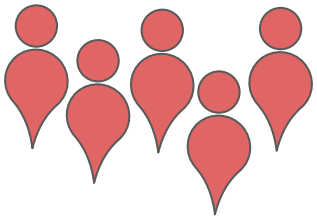


Child patients

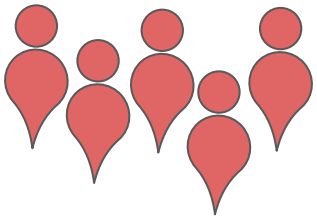
Strategy: Create four different models for each patient group



Child patients

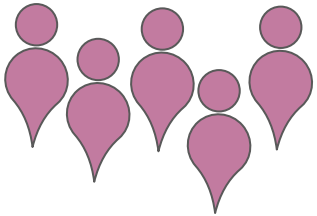
Adult inpatients

Strategy: Create four different models for each patient group



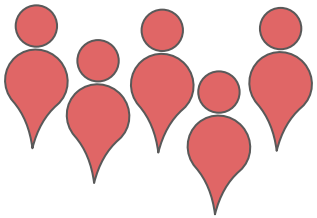
Child patients

Adult inpatients



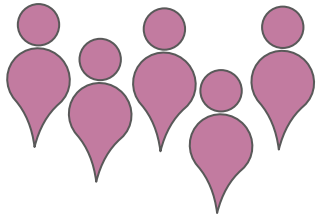
Surgery patients

Strategy: Create four different models for each patient group

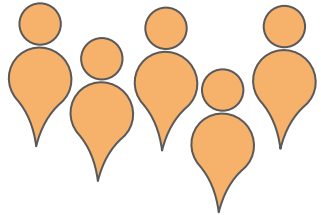


Child patients

Adult inpatients

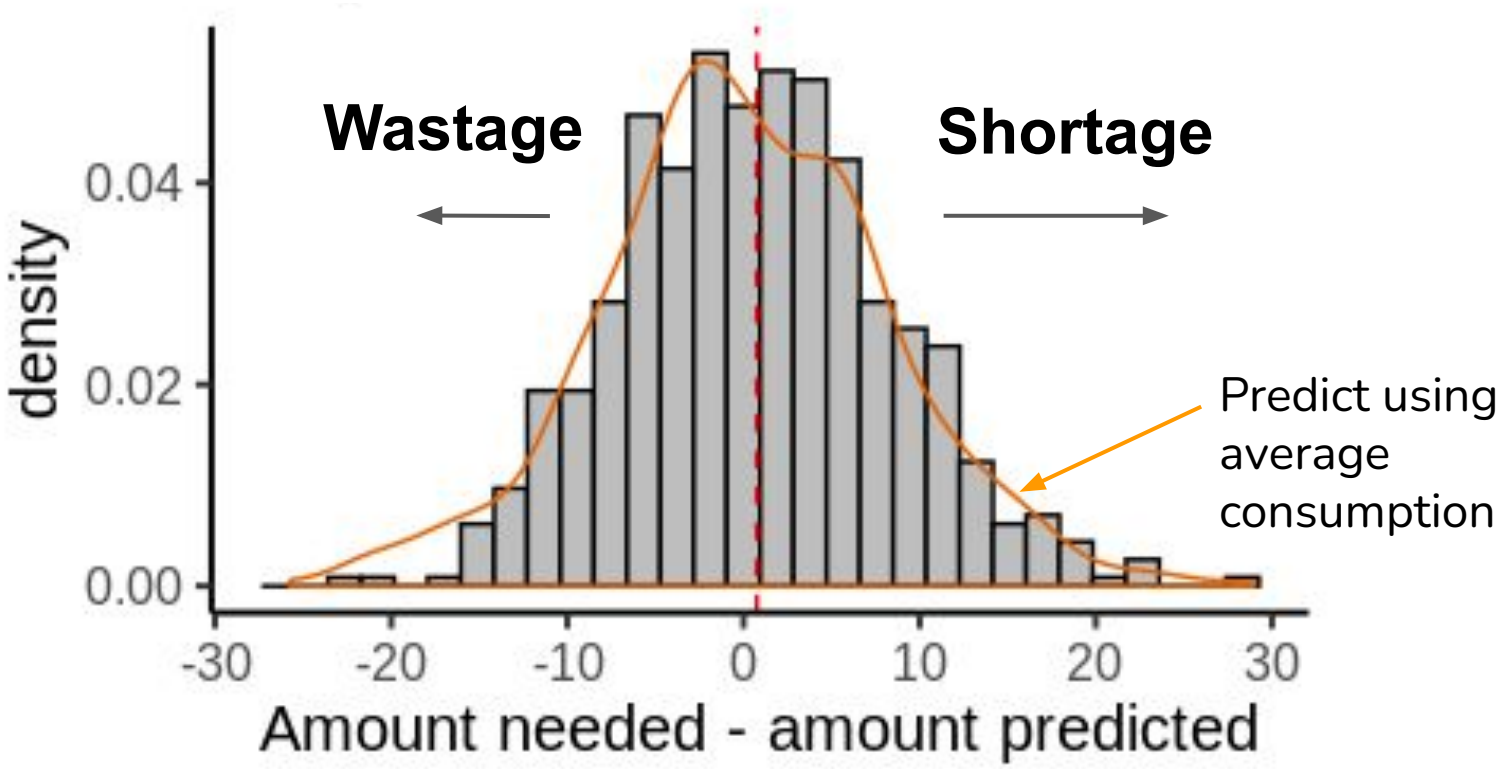


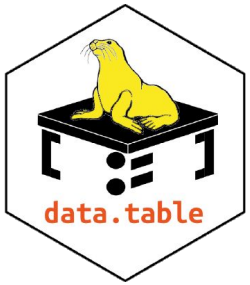
Surgery patients

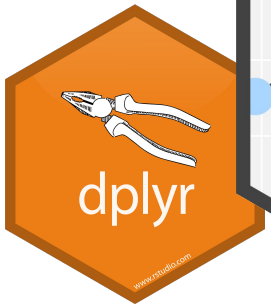


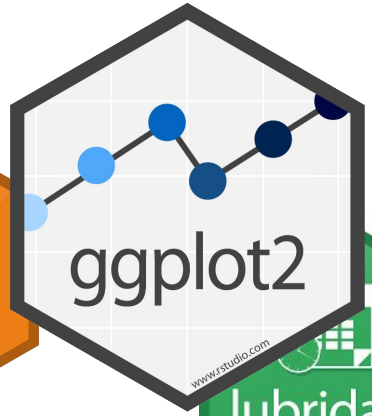
Random arrivals

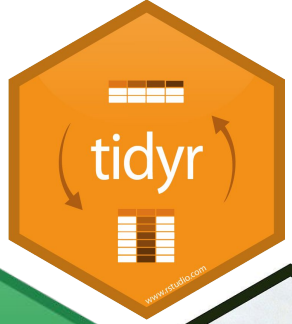
Model out-performs using weekday-weekend average

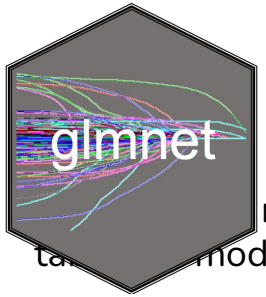






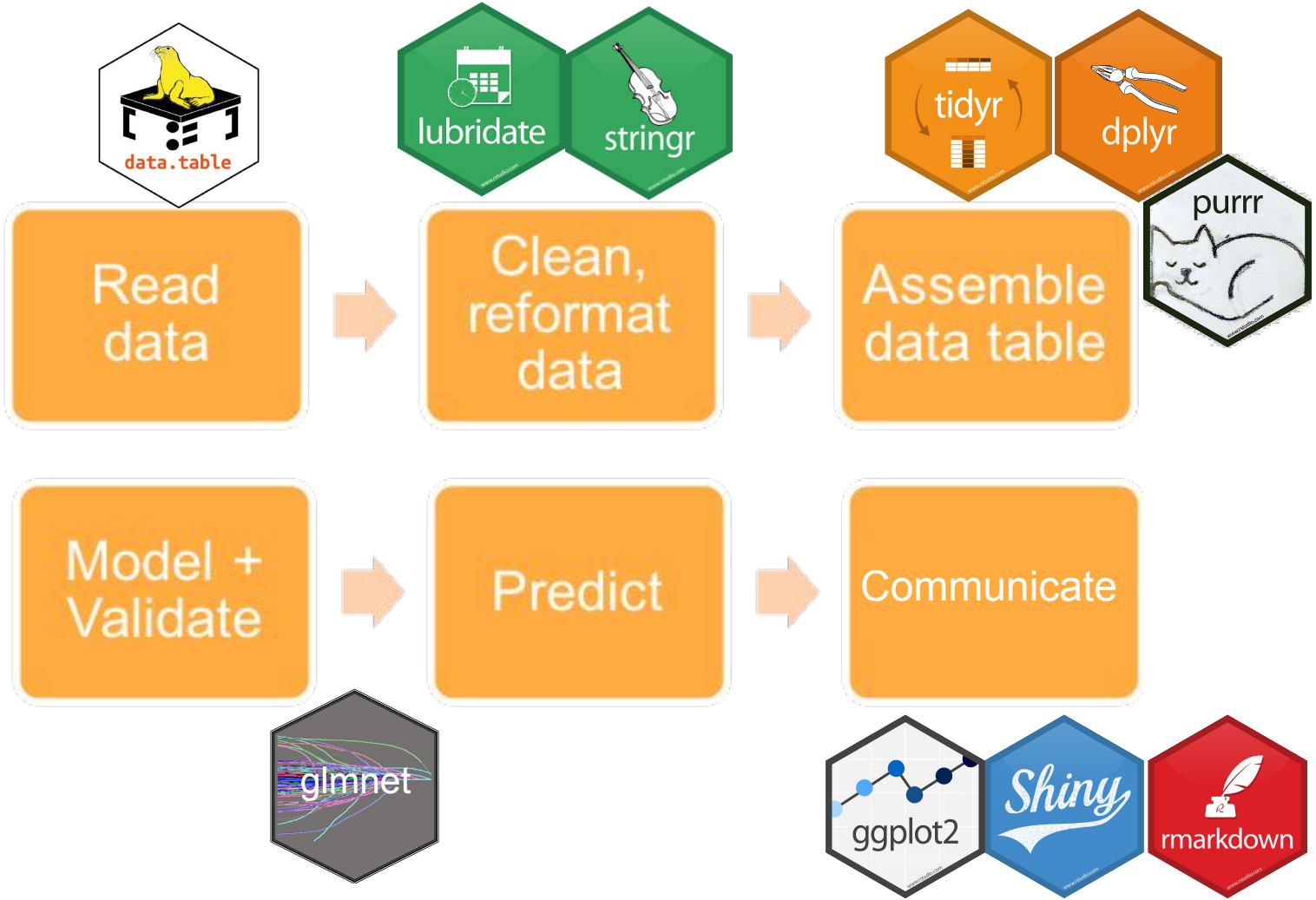




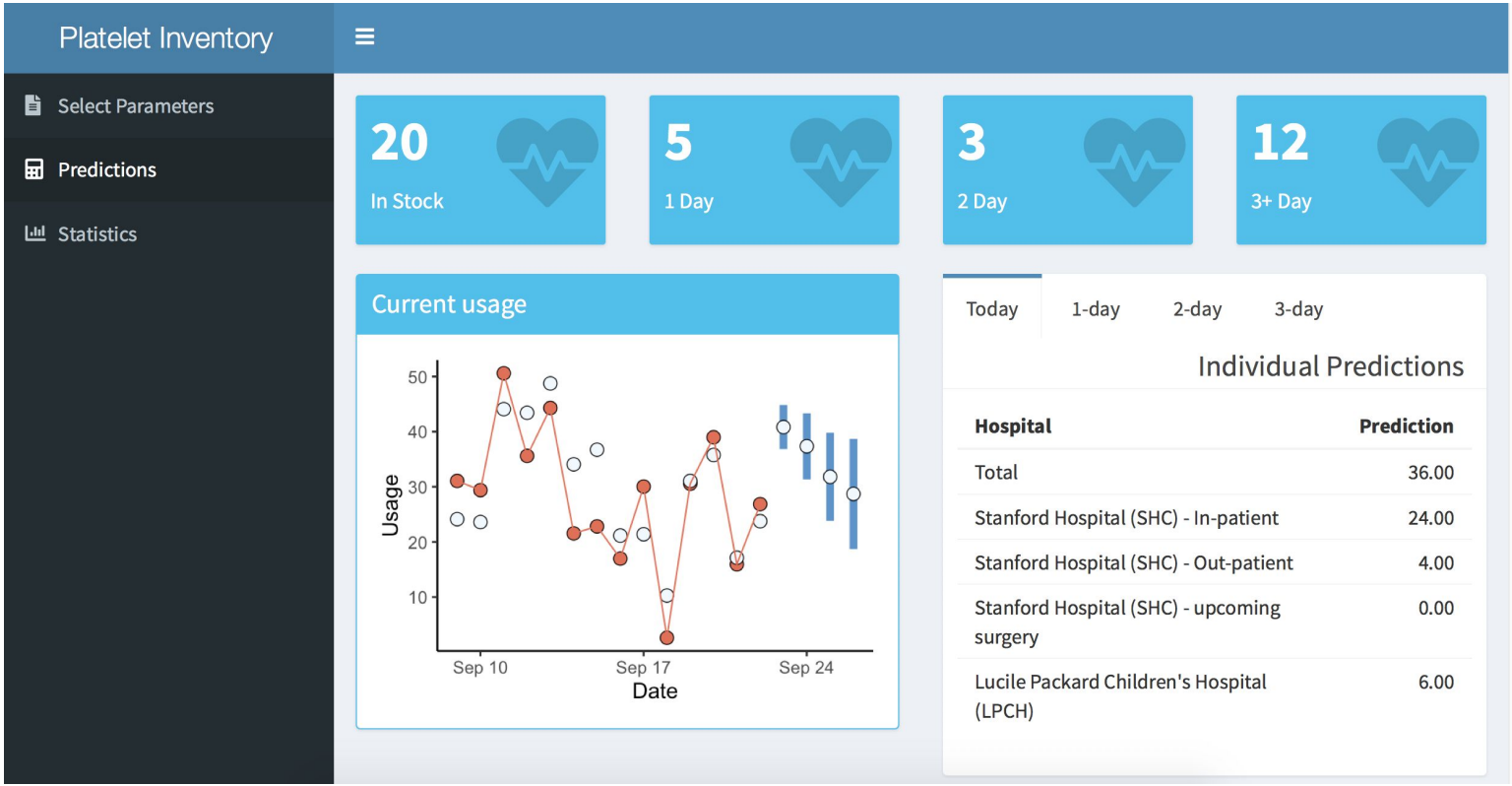


reformat + clean → assemble data

model + validate → predict → present


data.table
lubridate
stringr
tidyr
dplyr
purrr
Read data
Clean, reformat data
Assemble data table
Model + Validate
Predict
Communicate
glmnet
ggplot2
Shiny
rmarkdown

Visualize model predictions



Generate summaries and reports

Platelet Inventory

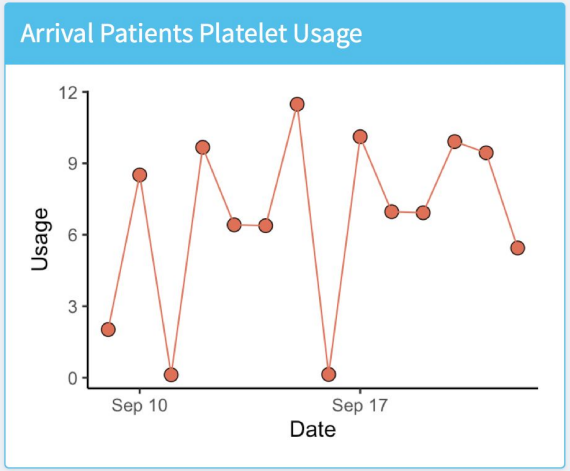
Select Parameters

Predictions

Statistics

Census patients | Surgery Info | Statistics

location_name	location	patient number
E1	E1 (BMT)	10.00
E2-ICU	E2ICU (Neurosurgery)	6.00
E29-ICU	E29ICU (Cardiovascular ICU)	8.00
FGR	FGR (Fground, Oncology: Hematology, Medical Oncology, Radiation Oncology)	12.00



Conclusion

Communicate with community partners

Design interpretable algorithms

Create automated pipeline to process data, fit model and make predictions

Enable users to interact with the software

Thank you!