
# Driving Action with Machine Learning

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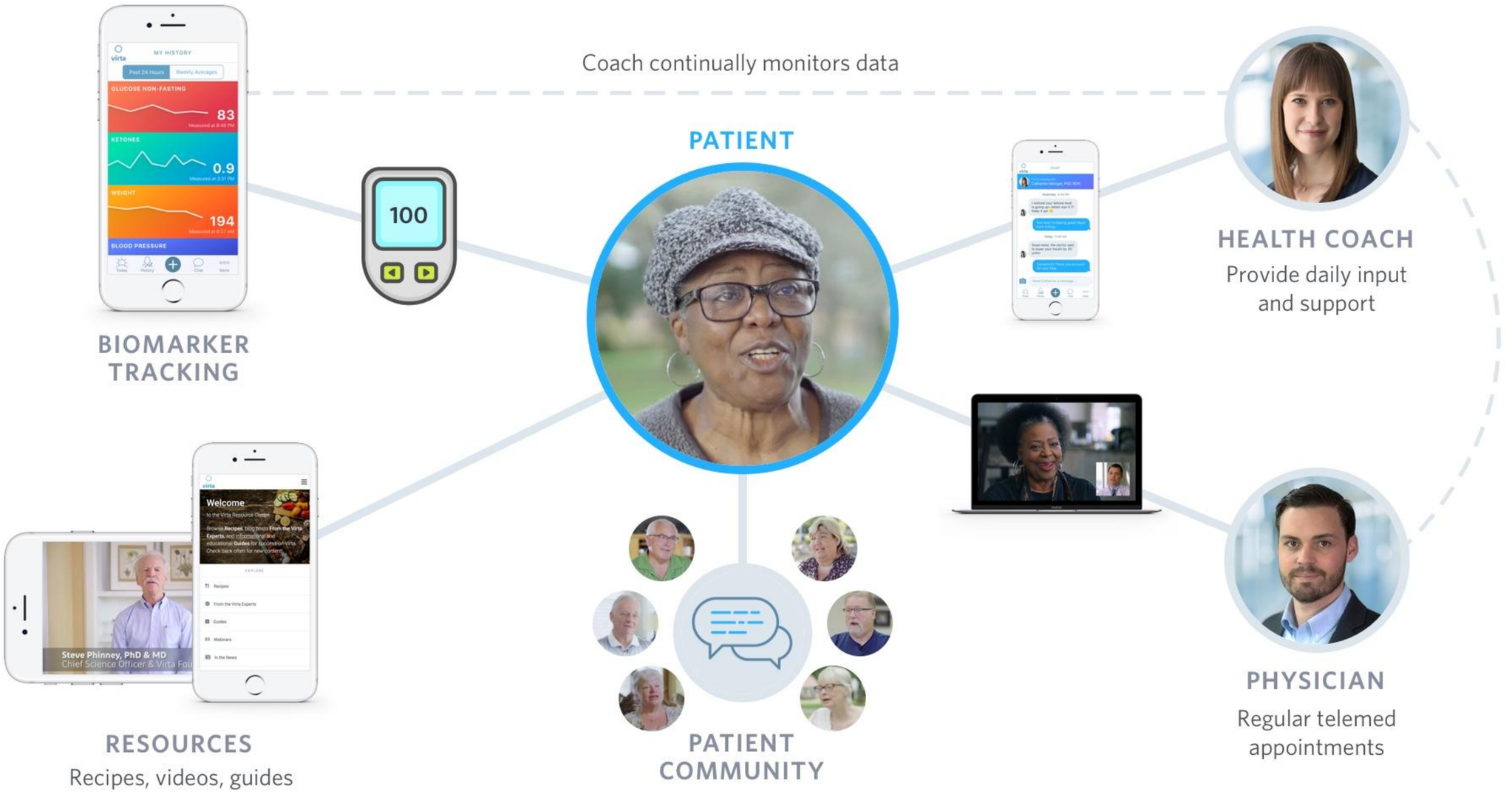
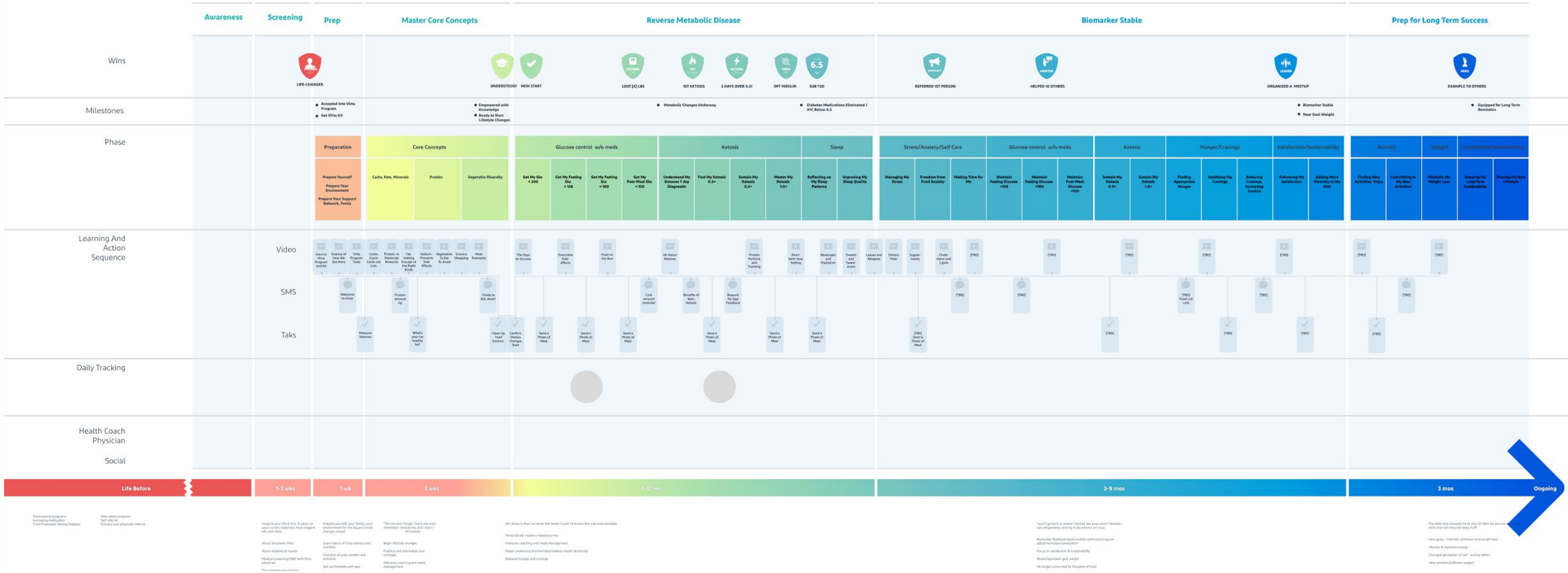
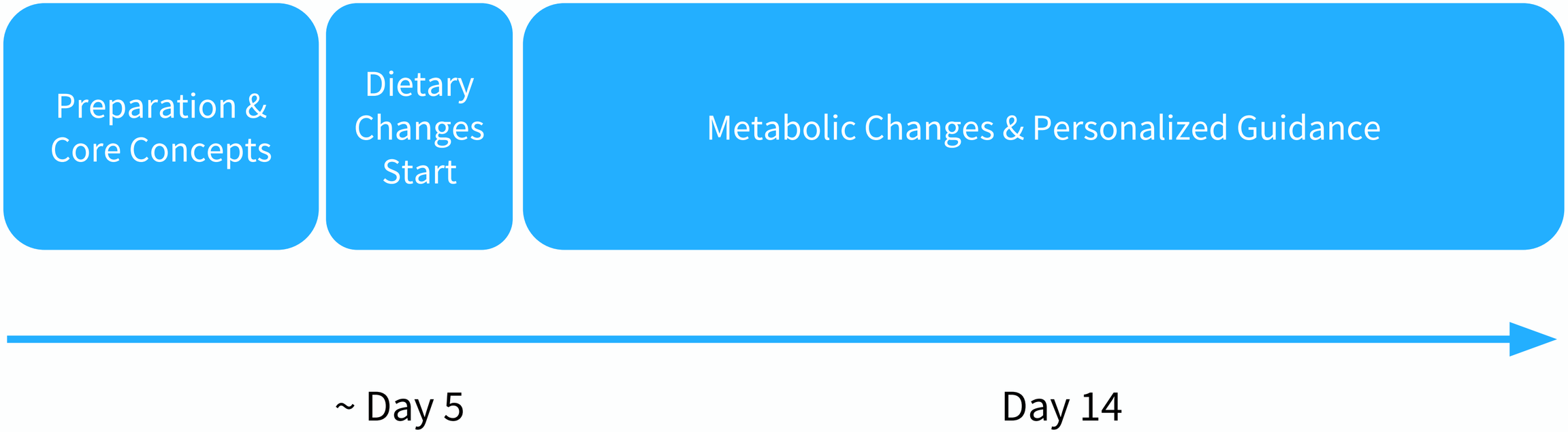
# Online Type 2 Diabetes Reversal Clinic



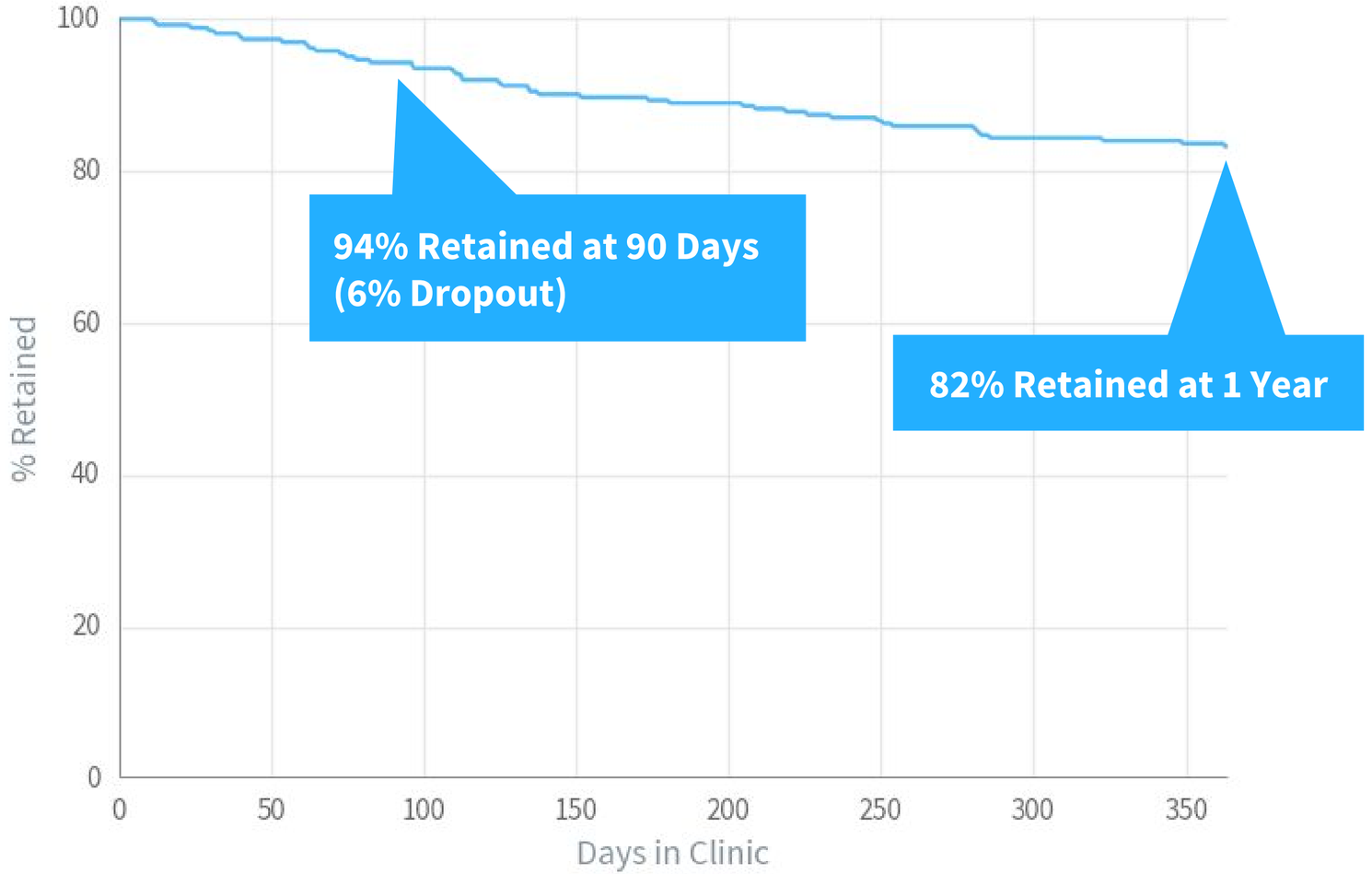
# Virta User Journey



# Early in Journey



# High retention, but can improve




Source: IU Health Arnett - Virta Clinical Trial Data (Hallberg et al., 2017)
N = 158
*Those not “retained” either requested to terminate Virta services (usually because of unrelated health/family issues or undisclosed personal choice) or were removed from the study due to noncompliance and concerns related to safety.

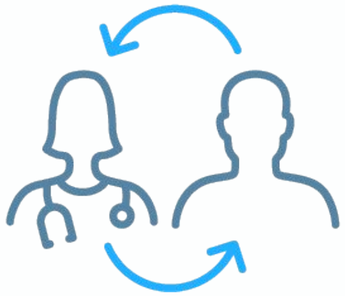
# Machine Learning to Drive Clinical Action and Decision-Making

- **Goal:** Increase long-term retention rate of patients
- **Questions:** Who is at risk of dropping out? *Why* are they dropping out?
- **Users:** Clinicians
- **Model Requirements:**
    1. Easy to communicate to clinicians
    2. Accuracy
- **Model Benefits:** Prioritization and insight into underlying factors

**“All models are wrong, but some are useful”**

George Box, Statistician

# Feature Selection & Algorithm Selection



**Dedicated health coach**

**Text Messages**

- Length
- Count/Freq
- Topic
- Urgency

**App and biomarker tracking tools**

**App Data**

- Weight
- Glucose
- Symptoms
- Medications

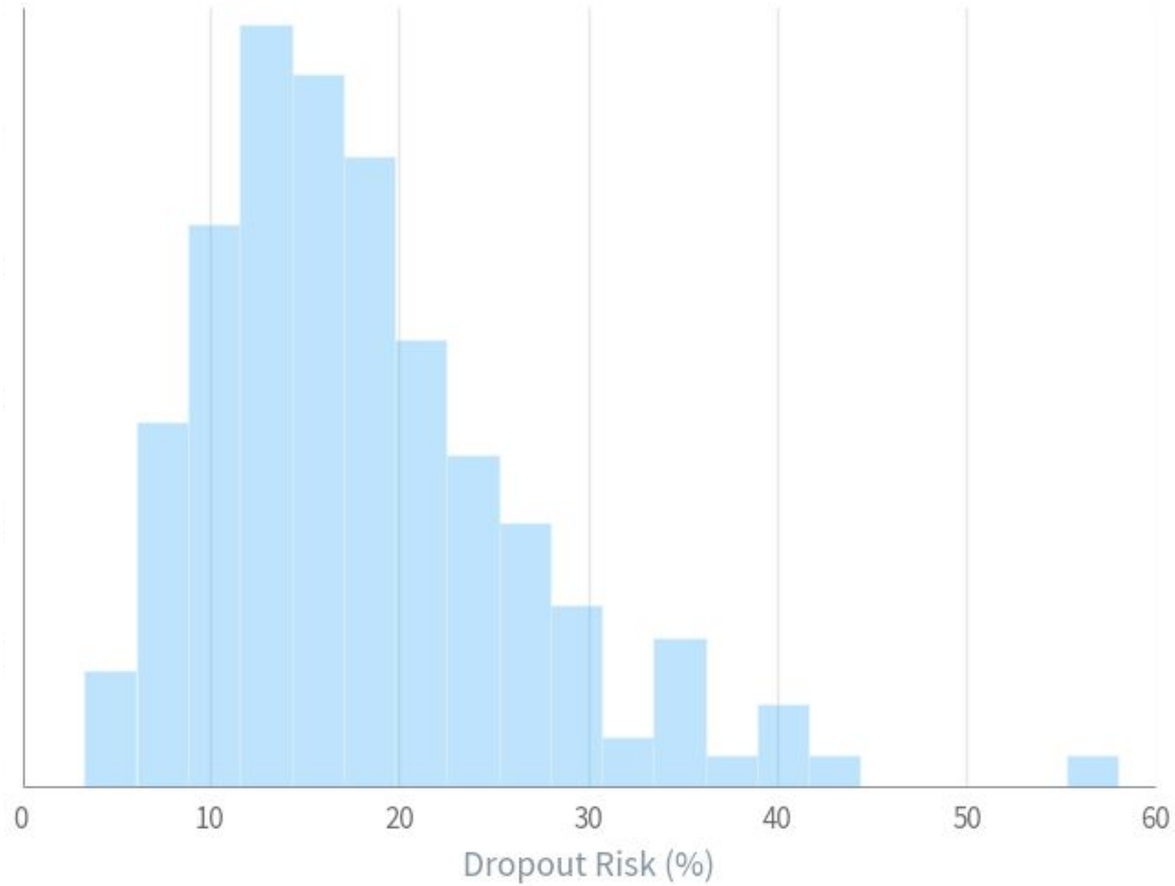
Based on Clinical Data and Research

- 108 Features (Characteristics)
- First 14 days of data
- Feature selection for **Top 15**
  - Random Forest Out-of-bag error
- Logistic regression

# Model Results: Feature Directionality

| Increase Dropout Risk | Decrease Dropout Risk |
|---|---|
| Time to dietary change | Age |
| Texts about discomfort | Texts about challenges |
| Fatigue | Urgent texts |
| Opiate/Pain meds | Weight loss |

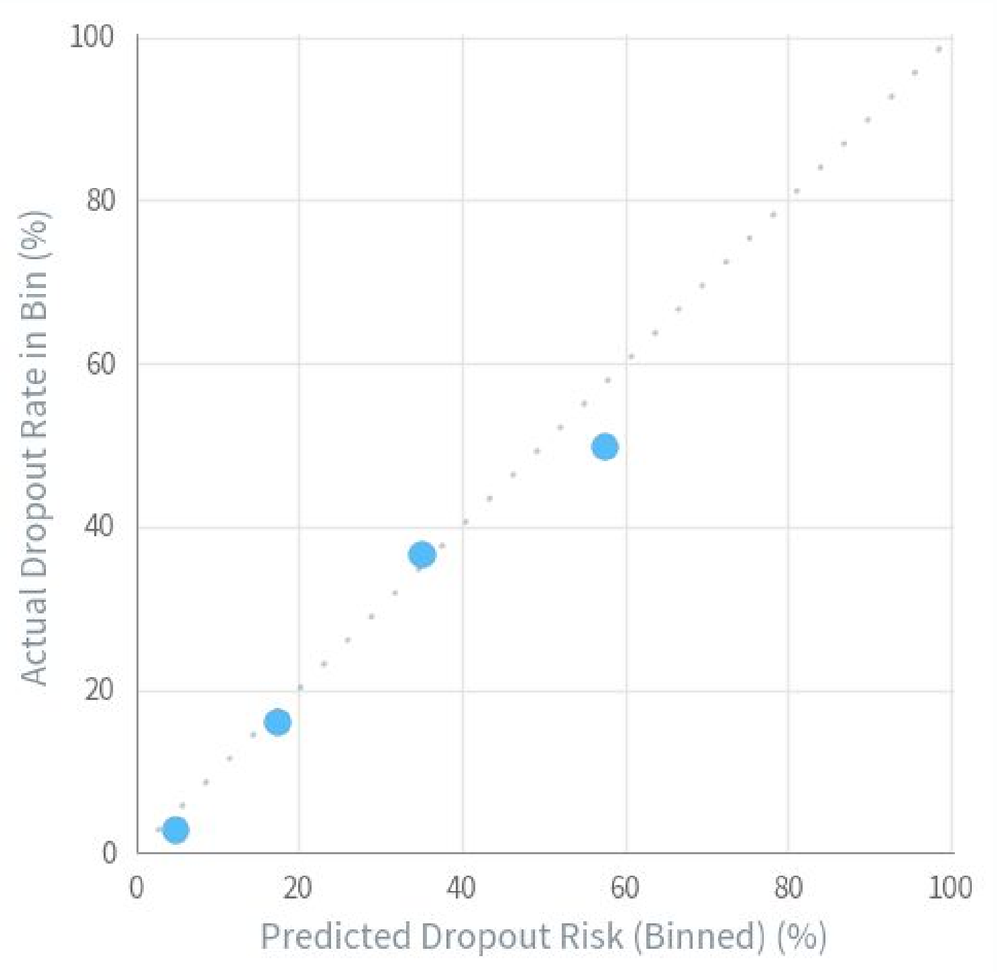
# Model Results: Dropout Risk




Distribution of Dropout Risk

- Average:  18%
- 50th percentile: 16%
- 90th percentile: 37%

# Model Validation




| Risk Level | Dropout Risk |
|---|---|
| Low | 0 - 10% |
| Medium | 10 - 25% |
| High | 25 - 45% |
| Very High | 45 - 70% |
| Extremely High | 70 - 100% |

+ Anecdotal confirmation from coaches

# Actionable Insights

## Who?

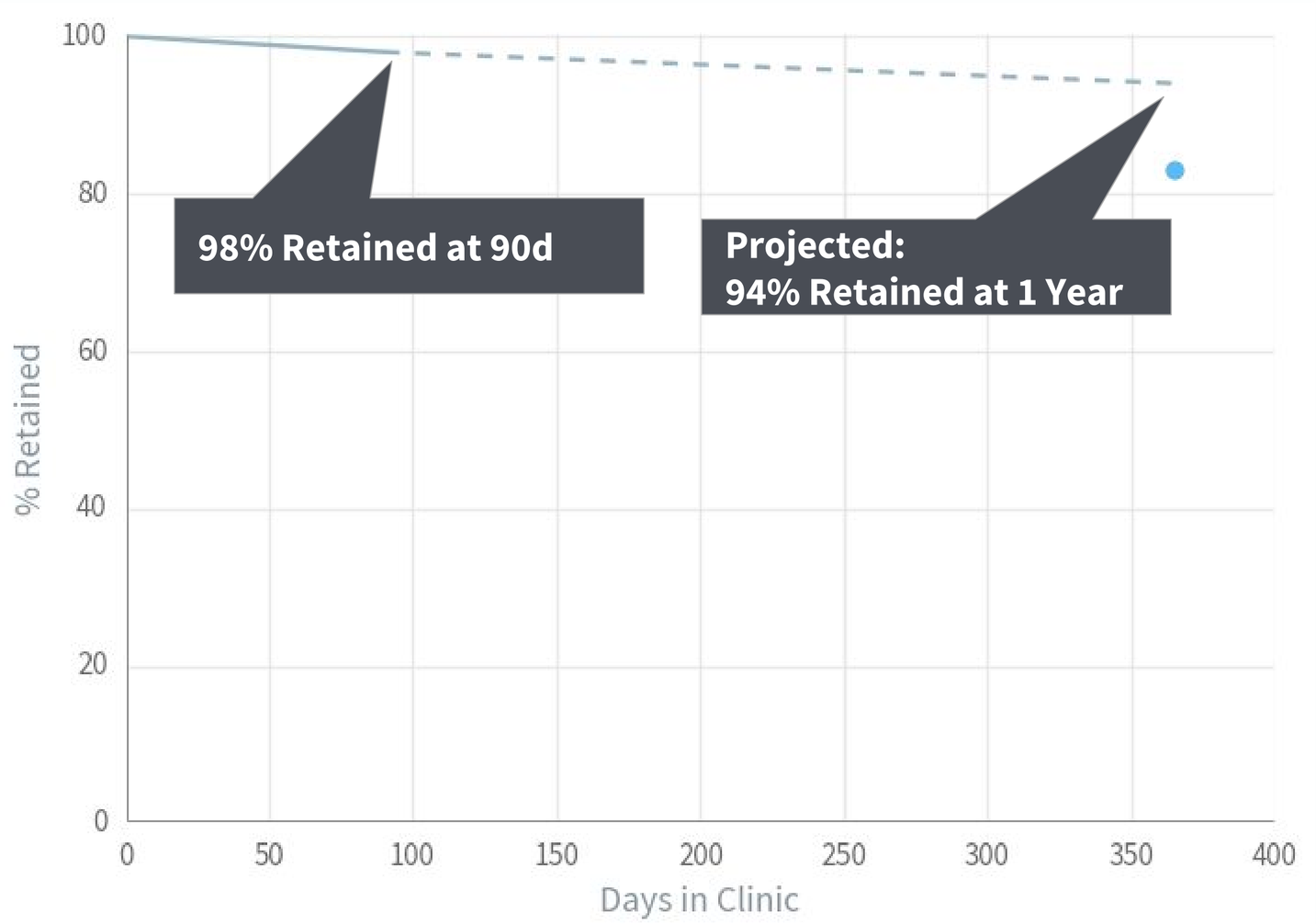
| Patient ID | Dropout Risk |
|---|---|
| 1 | 31.9 % |
| 2 | 30.4 % |
| 3 | 27.4 % |

## Who? Why? (What to do?)

| Patient ID | Dropout Risk | Text Discomfort | Fatigue Count | Weight Change | ... |
|---|---|---|---|---|---|
| 2 | High ~35% | 9 | 5 | -4.3 | |
| 3 | High ~35% | 14.5 | 0 | -4.0 | |
| 1 | High ~35% | 9 | 2 | -1.0 | |

# Impact

- Coach impressions:
  - Prioritize additional outreach
  - Focus efforts
- Dropout rate down **66%**
- *Important caveats*
  - Different population
  - Evolving product



# Key Takeaways

- Interpretable ML is critical to creating actionable insights
- Collaborate with users (clinicians) early and often during model development and delivery
- High frequency data + ML + high touch model = tight feedback loop
- Why we are *really* here

# Thank You

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