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Reducing Recidivism

with Targeted Mental Health Outreach in Johnson County

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MLPP Final Presentation

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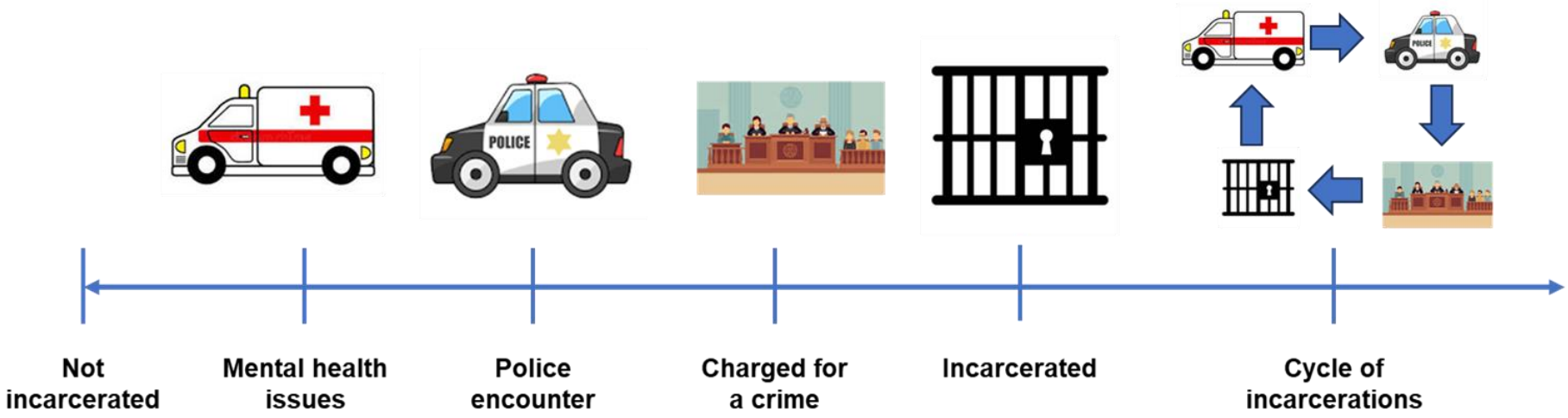
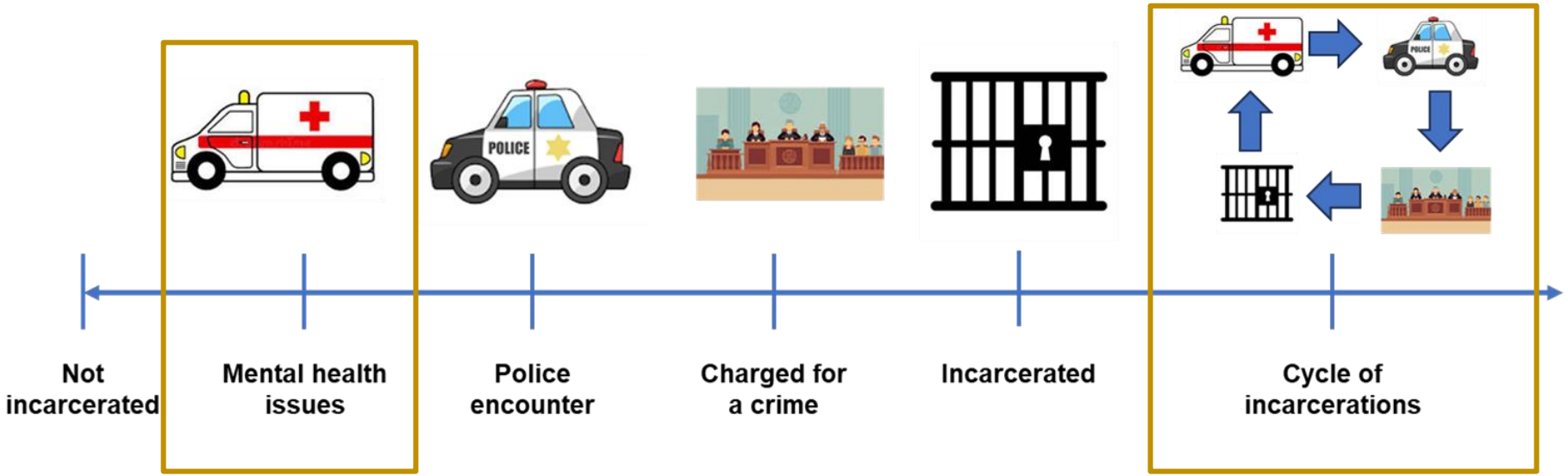
Problem: cycle of incarcerations

- Incarceration has a debilitating effect on an individual's well-being and can be hard to recover from without assistance.



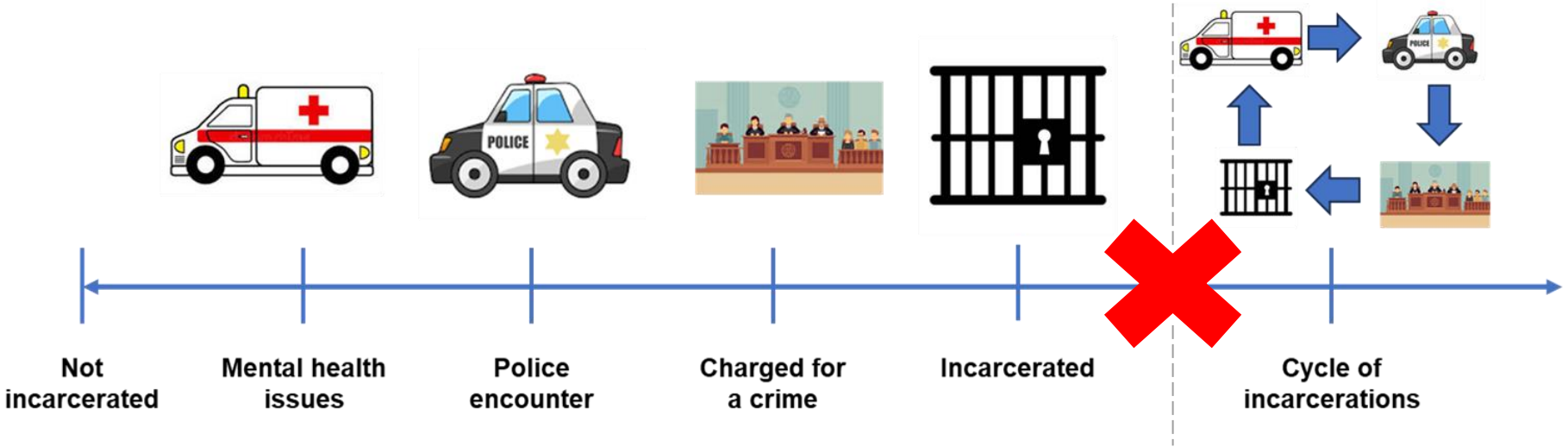
Problem: cycle of incarcerations

- Incarceration has a debilitating effect on an individual's well-being and can be hard to recover from without assistance
- Untreated mental health conditions are a significant contributing factor to high recidivism rates in Johnson County often resulting in a cycle of incarcerations.



Goal: Assist JCMHC in helping people break the cycle

- The Johnson County Mental Health Center (JCMHC) struggles to identify the right residents at the right time
- The goal is to break this vicious cycle of re-incarcerations stemming from mental health issues.



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Strategy: Identify at-risk individuals to target outreach

- **Machine Learning**: Identify **100 individuals** at highest risk of re-incarceration based on history of booking(s) and mental health record(s)
- **Field Evaluation:** Measure effectiveness of intervention for different groups

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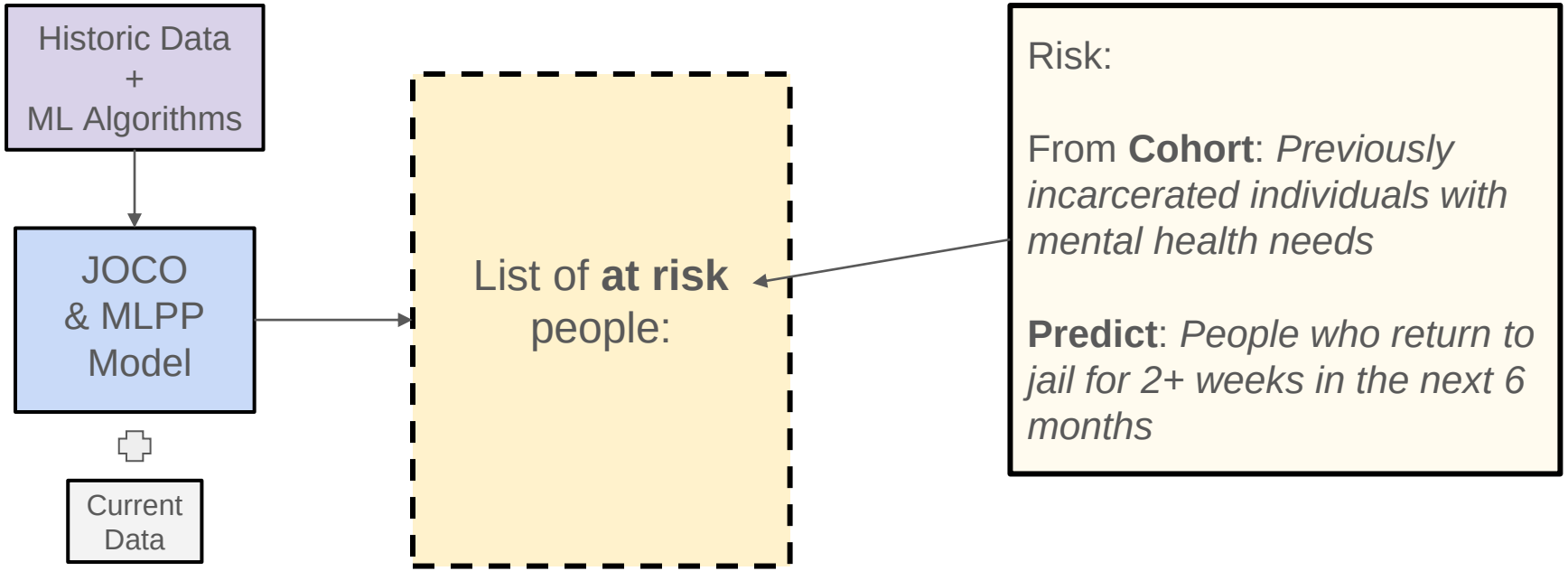
Strategy:

- Use ML to predict **risk**



JOCO = Johnson County

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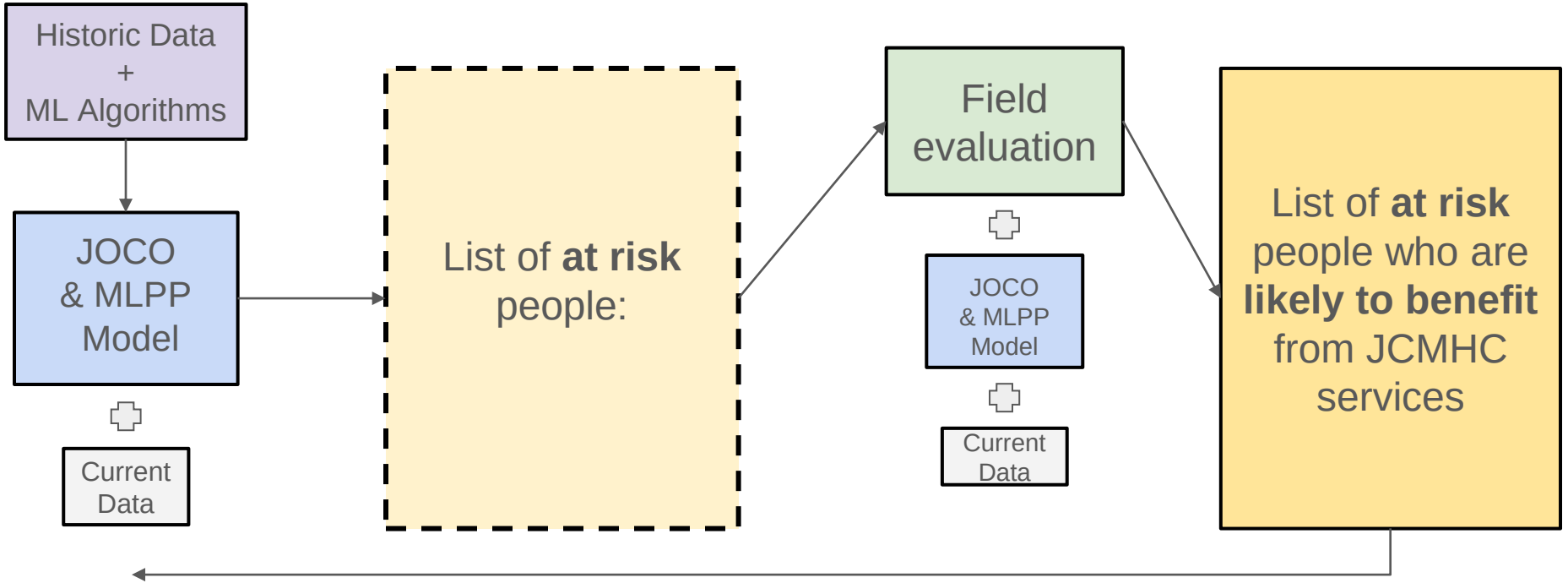
Strategy:

- Use ML to predict **risk,** then use a field evaluation to measure **effectiveness**



Data Overview:

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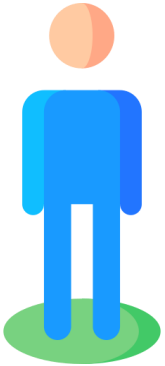
Police Arrests / Encounters

Johnson County Resident



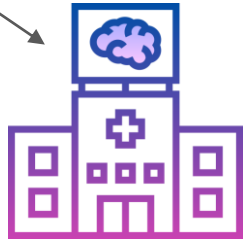
Department of Health

Charges

Medical Emergency Records

Jail Bookings

Mental Health Center



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Data Limitations:

- Conflicting and inaccurately measured data
- Potential of data measured by biased/untrained individuals
- Incomplete data coverage of key features such as mental health surveys
- Data coverage: based on interaction with Johnson County public entities
    - might miss high-risk people whose mental health status was not documented
    - might exclude high-risk people who moved to Johnson County from outside

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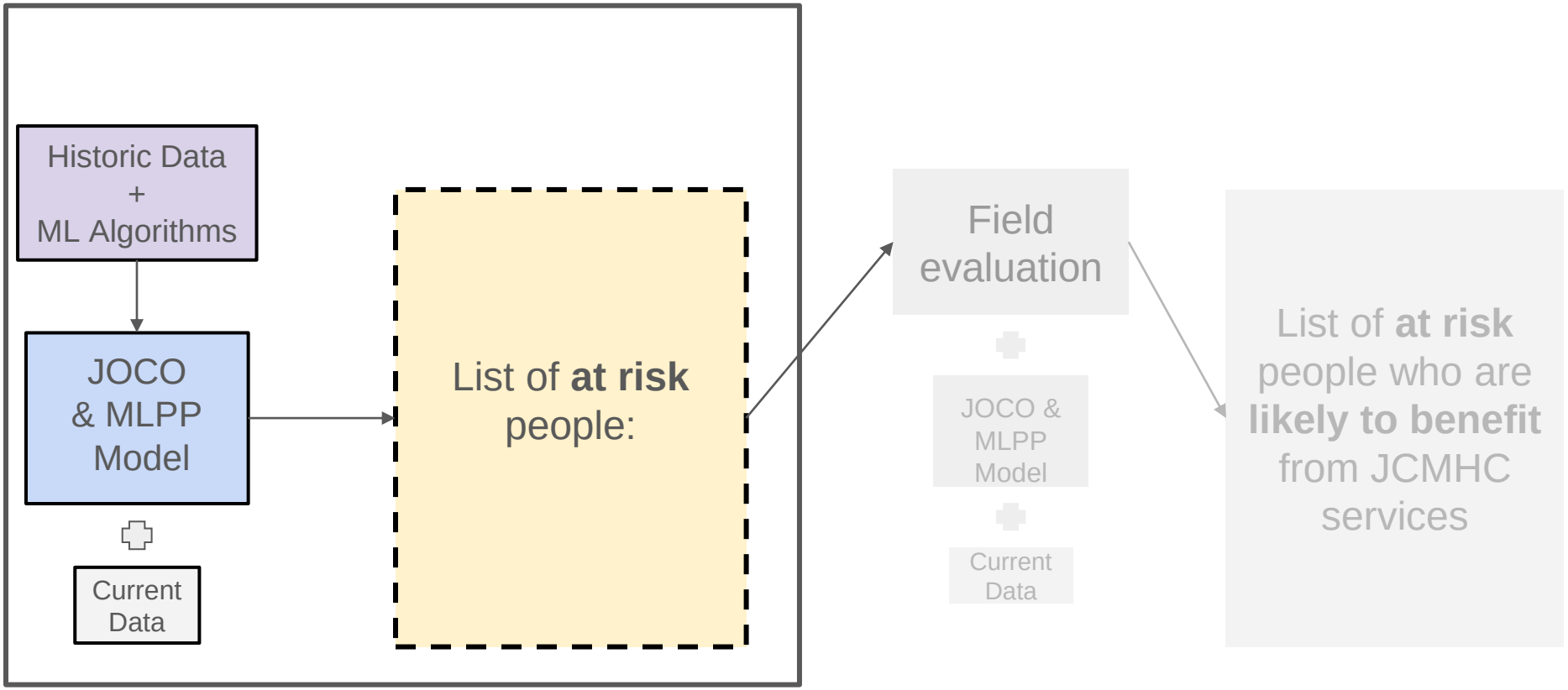
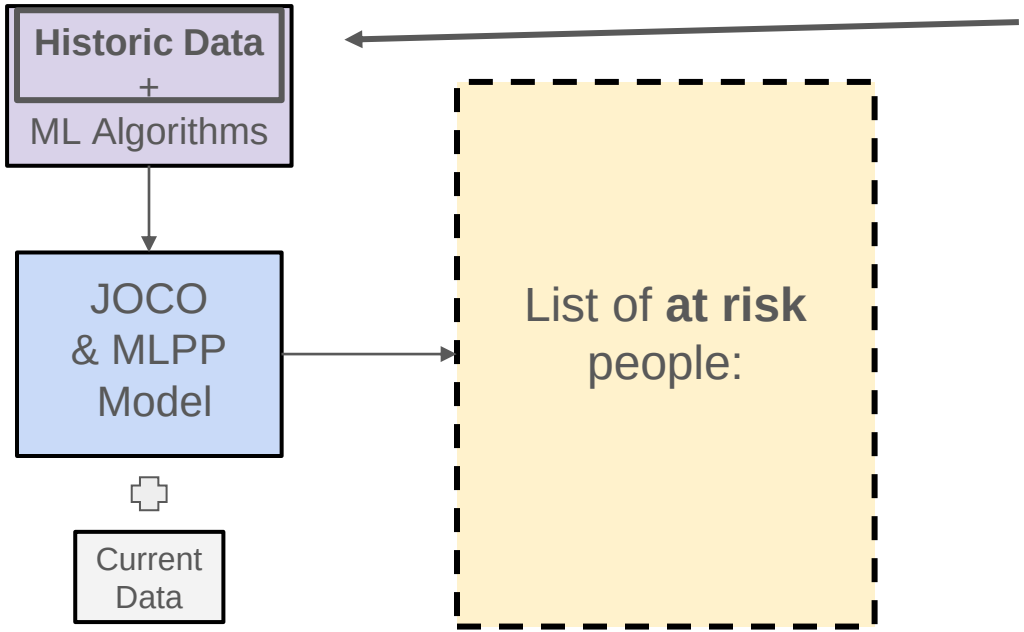
Machine Learning Formulation



Row/Label definition



Row: A JOCO resident at a particular point in time
(matching our cohort definition)

Label: An indicator denoting whether or not that person returned to jail for 2+ weeks in the next 6 months

Cohort:

- Mental health needs
- & Incarcerated 1+ times in last 5 years

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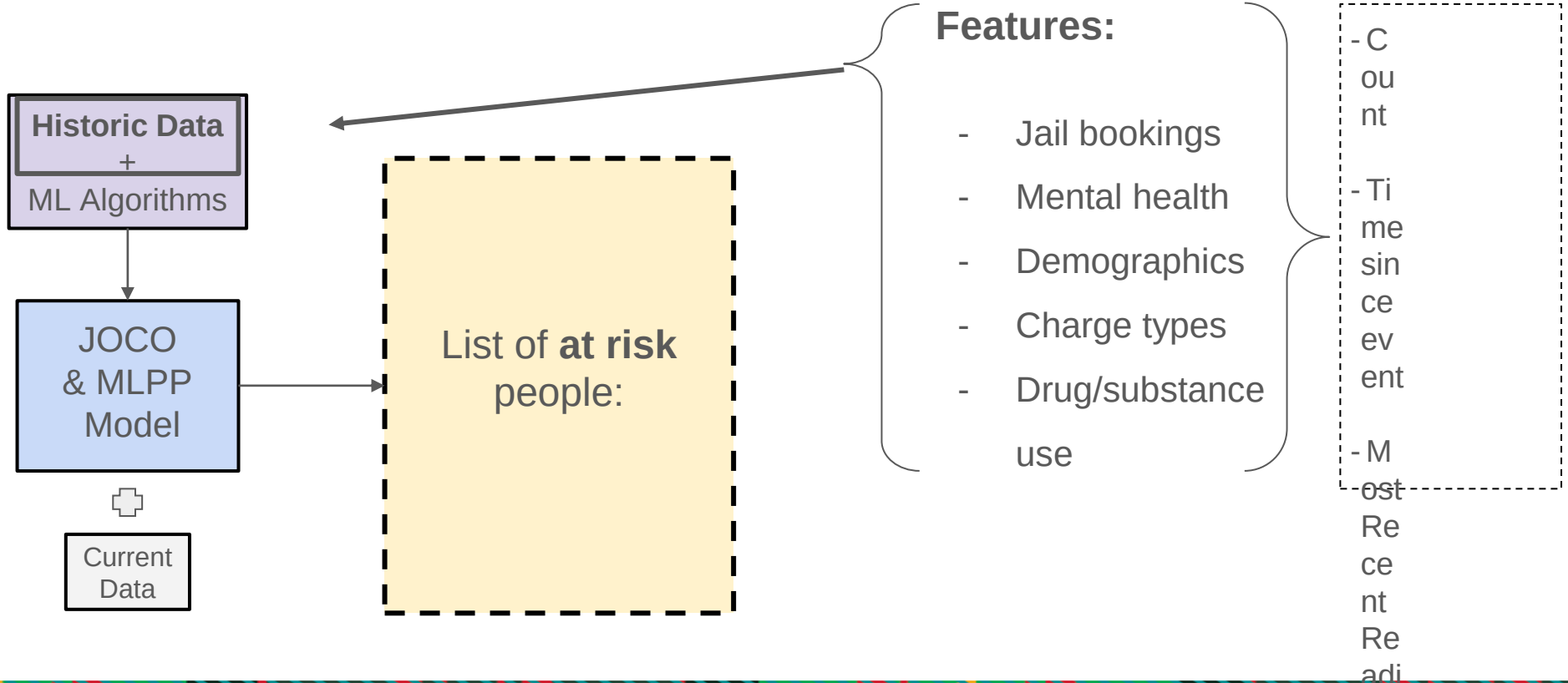
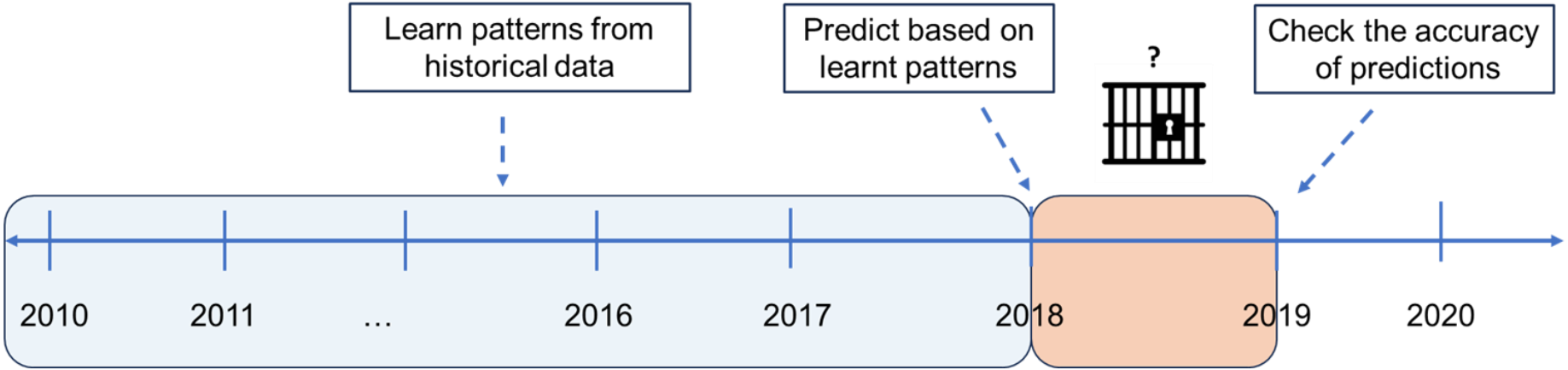
Turning Historical Data into Features



Validating our model

Ensure past patterns generalize to the future



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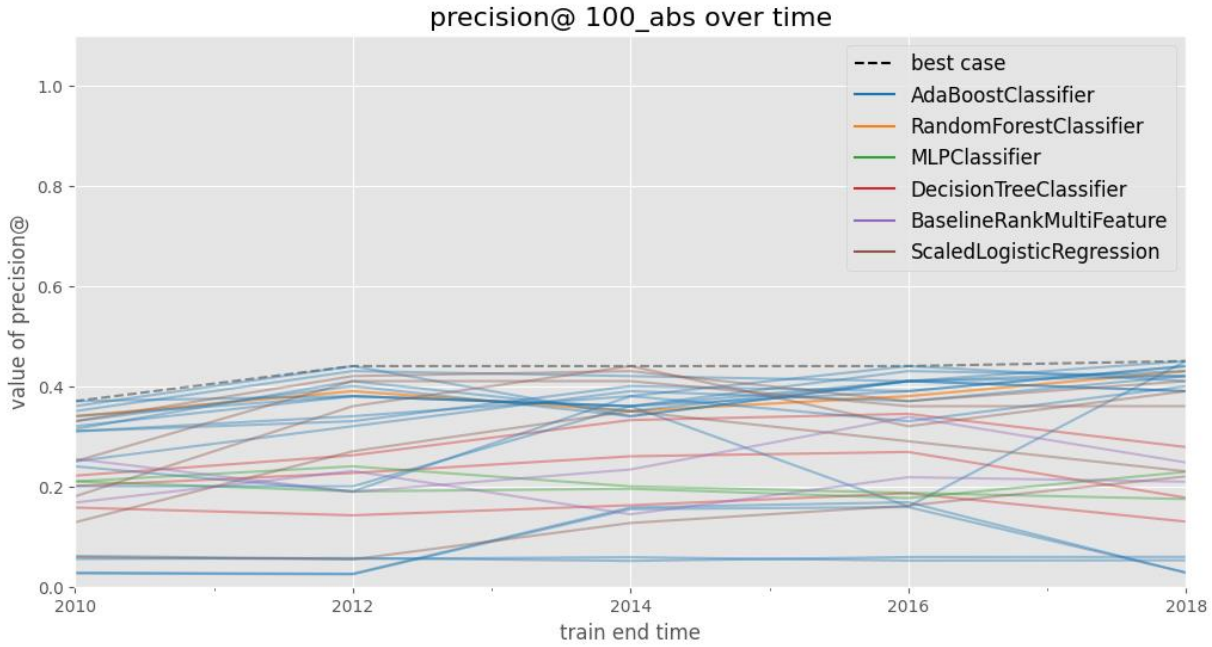
How we evaluated our ML models:

- **Precision @ 100:** out of 100 individuals we identify as having the highest risk of going to jail for 2+ weeks again the next 6 months, **how many actually end up in jail**?

- **Why Precision @ 100?:** Since JCMHC resources are limited to only target 100 individuals every month, we want to ensure that these interventions find as many high-risk people as possible

Model precision over time

Determine AdaBoost is best due to highest average precision@100 over time



What if JCMHC has more resources?

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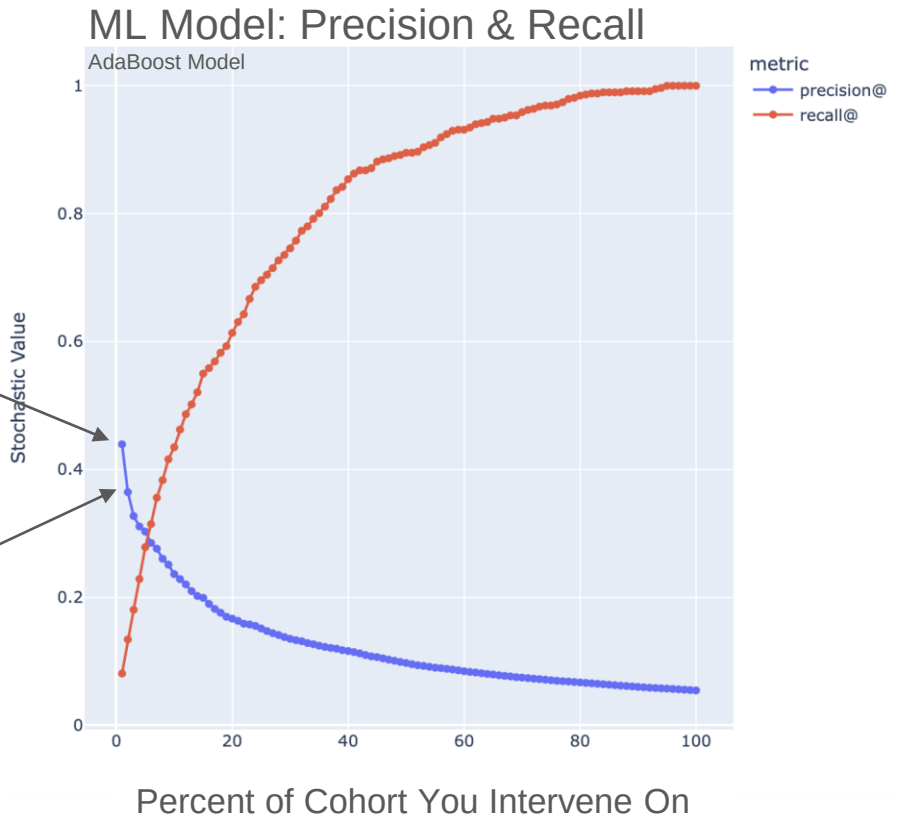
Increasing interventions finds more at risk people, at a lower precision rate

- If we give you a list of **100** people, around **43** of them will go to jail

  *(**43%** precision)*

- If you increase that list to **200**, around **76** of them will go to jail

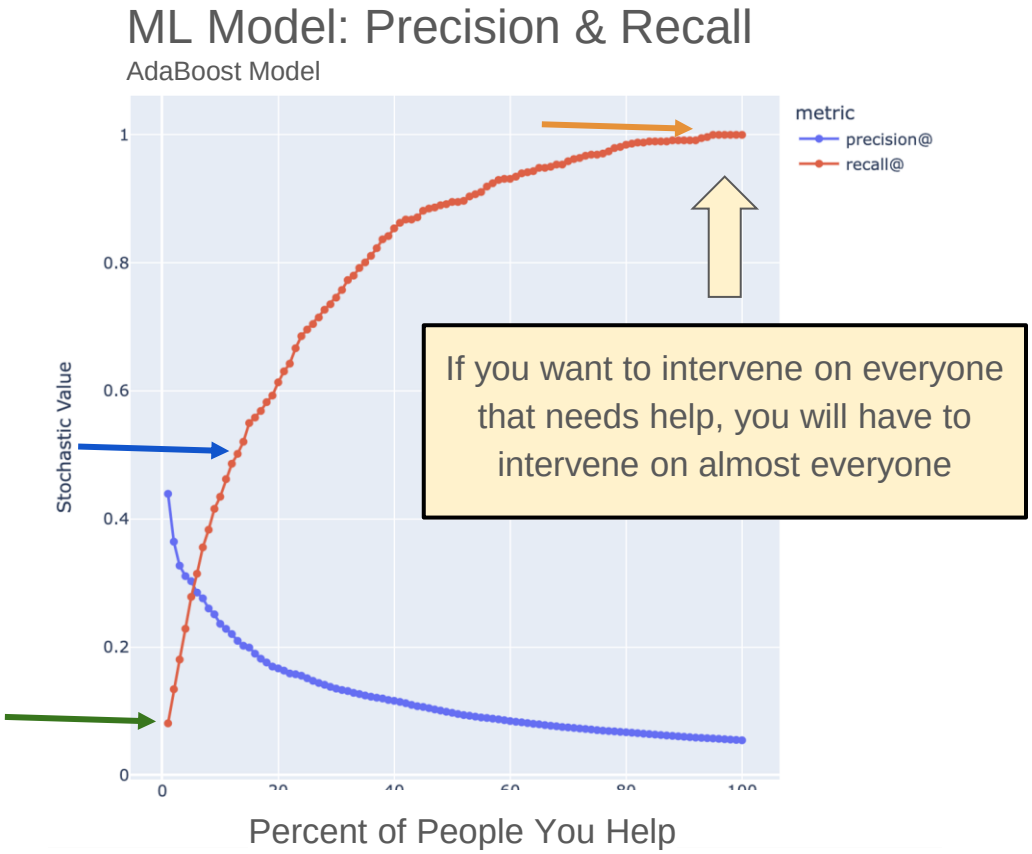
  *(**38%** precision)*



How hard is it to identify all at risk people?

Analyzing the recall of our model

- If **600** out of **10,000** people are truly at risk, you will need to intervene on:
  - **1%** (100) …
    to find **7%** (42)
  - **10%** (1000) …
    to find **50%** (300)
  - **97%** (9700) …
    to find **100%** (600)



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Comparison of best model to baseline

- Baseline model: a simple/interpretable approach based on some common heuristics for comparison

Our baseline models:

- For individuals with mental health needs rank them based on:
  - The amount of bookings
  - The recency of bookings

Number of Interventions:	**100** interventions	**1000** interventions
Machine Learning Model Finds:	**43** found *(43% precision)*	**250** found *(25% precision)*
Best Baseline Model Finds:	**25** found *(25% precision)*	**150** found *(15% precision)*

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Understanding the model

Most important features in our model:

- **Jail-related features:** time since last booking, average jail time, number of previous bookings
- **Mental health-related features:** time since last indication of mental health issue (through LSIR questionnaire)
- **Demographic features:** age at last booking, current age, sex: male

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Who is the model identifying?

Compared to non-selected individuals, our ML model finds people who:

- Have been booked more **recently**
- Have been to jail **2x** as many times
- Stay in jail **47%** longer on average (25 days vs 17 days)
- Are **8** years younger on average
- Had an incarceration **later** on in their life
- Are **33%** more likely to be Male

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Is our model biased against certain groups?

- Goal: ensure our predictions of who goes to jail is accurate for all groups
  - *Otherwise, JCMHC might perpetuate inequalities by not finding and helping certain groups*
- Model could be biased for many reasons:
  - For example, data quality could differ by group
- Question: How to check if our model is “fair”?

Our predictions should be balanced across groups, but in what way?

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Should we balance who we select across by:

- Population Rates?
- At Risk Rates?
- Model performance metrics?

Johnson County Population: **613,000**			
White Residents: ~ **85%***		Black Residents: **~ 5-9%***	
White Residents Potentially At Risk: **8,617**	*White residents not at risk*	Black Residents Potentially at Risk: **2,002**	*Black residents not at risk*

*percentage from US census

We focus on “Recall Parity” and confirm our model is fair

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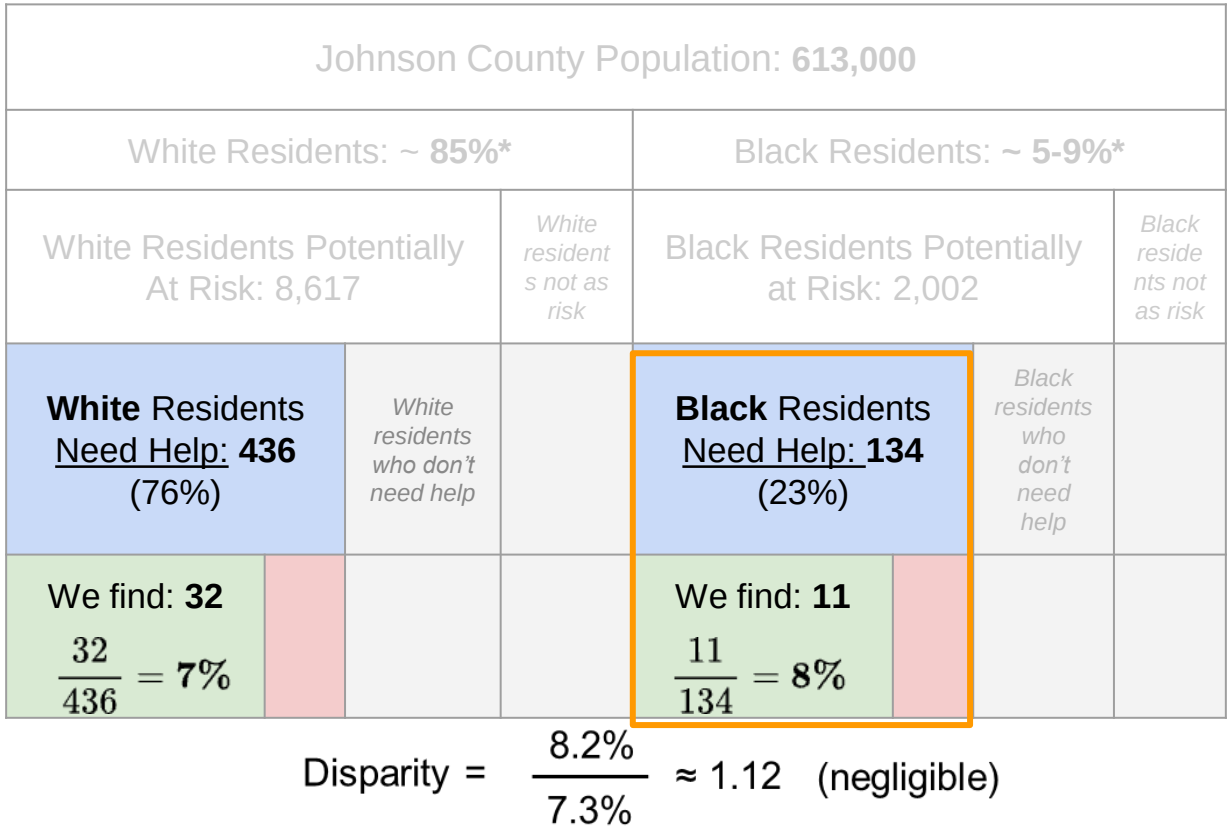
Recall Parity = Helping groups equally proportional to their need

We look at:

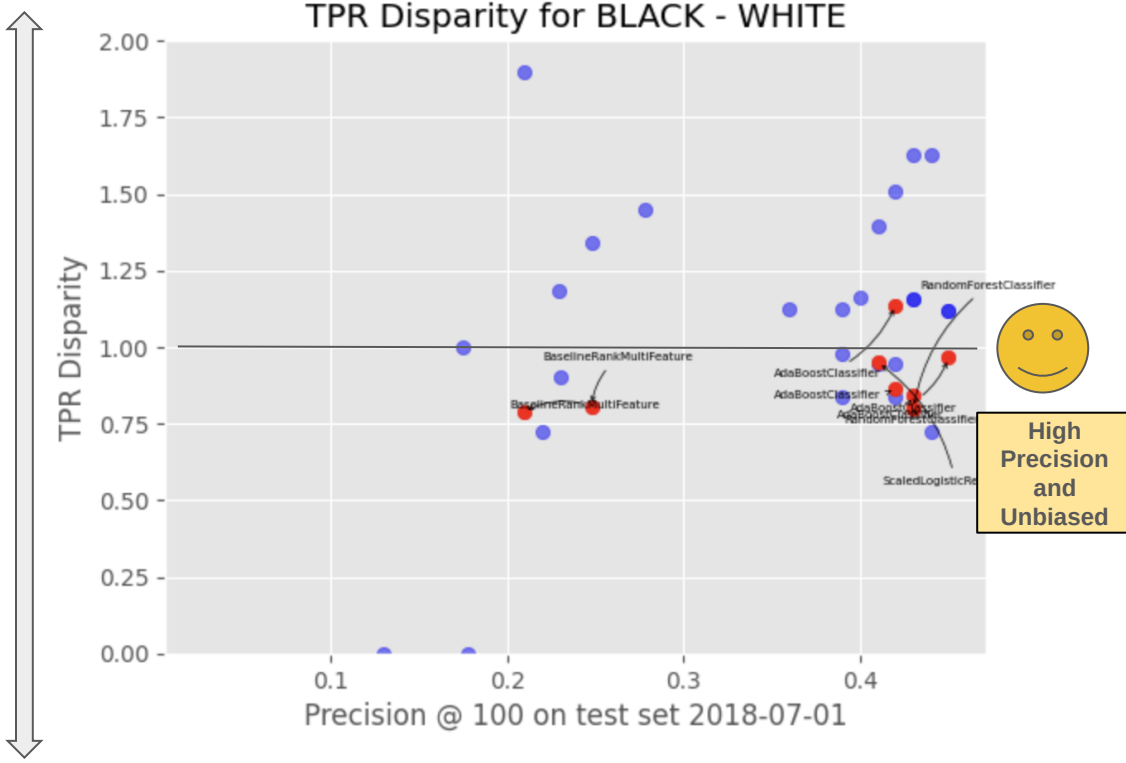
- **Black** vs **White**
- **Female** vs **Male**
- **Low-Income** vs **Not Low-Income**



*percentage from US census

For our scenario, there is no tradeoff between model efficiency and equity

- Similar low bias across all groups for most accurate models
- Any residual disparities could be addressed by adjusting selection strategy from high risk list
  - Negligible impact on accuracy



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Caveats:

- Need to test our model in the real world to ensure precision@100 is truly 43%
  - Insurance against poor model construction

- Need to determine effectiveness of intervention for different groups with field trial
  - Does the intervention work? For who?

- Data limitations: only predicts on people in the Johnson County services data system

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Policy recommendations:

- Observe one cohort of people in real world and confirm model is predictive
- Run field evaluation(s) to determine efficacy by groups such as gender, race, income status.
- If not effective:
  - Design new intervention
- If unequally effective
  - build additional model to predict effectiveness
  - Make hard policy choices about tradeoffs between efficiency and equity
- If equally effective
  - Deploy model as is

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Future work

- Test and refine model assumptions (with stakeholders)
  - Is 6 months the correct prediction window for returning to jail?
  - Is 2 weeks of jail an appropriate cutoff?
  - How to define “Mental Health” conditions
  - What counts as being “High Risk?”
- Build more features and understand source data
- Add additional data from other services + other counties + census
- Apply similar predictive model to other Johnson County use cases

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In Conclusion:

- We built an **ML model** that finds **2x** as many at risk people compared to a simple heuristic model, and it **performs consistently well over time**
- The model makes predictions using nuanced data about individuals **incarceration** history, **mental health** history and **demographic** data
- The model performs well **for all groups**
- The recommended next steps are to:
  - **Validate** the model's predictive power
  - Run a field evaluation to **assess the effectiveness** of the intervention

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Thank you!

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Appendix