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Department of Population Health

Incorporating Mental Health into the EMOD-HIV Model

Daniel T Citron

IDM Symposium 2023

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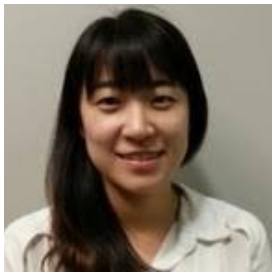

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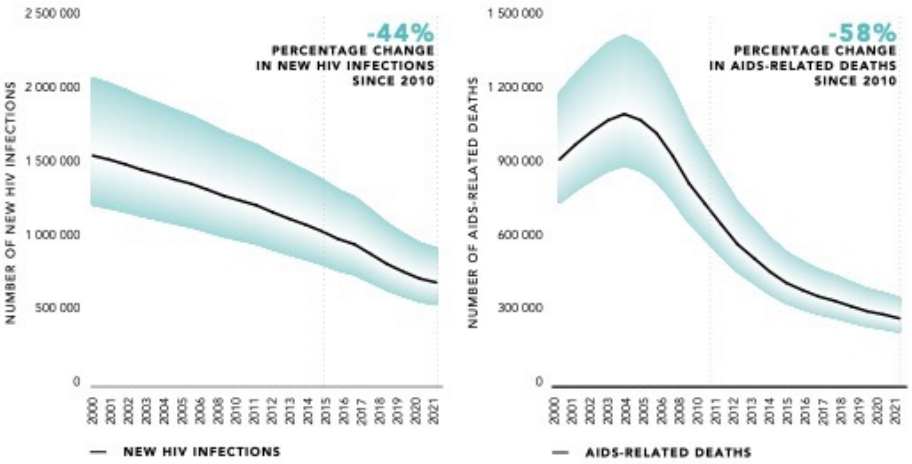
HIV in sub-Saharan Africa (SSA)

- 25.6 million PLHIV in SSA
- 860 thousand new HIV cases in 2021
- 420 thousand HIV-related deaths in 2021
- Considerable progress in the last two decades
- Our team studies cost-effectiveness of new interventions to continue to improve HIV care and treatment

New HIV infections and AIDS-related deaths
Sub-Saharan Africa, 2000-2021



Source: UNAIDS epidemiological estimates, 2022 (https://aidsinfo.unaids.org/).

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Incorporating treatment for NCDs into HIV care

- Resources provided for HIV care in SSA have proved effective in reducing HIV burden
- Other conditions co-morbid with HIV have not been given as many resources
- Can we expand HIV care to include treatment for non-communicable diseases as well?
  - Can we reduce HIV burden by treating other conditions?
  - Do we avert more DALYs overall by including other types of health care with HIV care?
- A step towards universal health coverage

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Depression and HIV

- Depression is the most common mental disorder
- Depression is the highest ranked contributor to morbidity (YLDs) in SSA and globally
- PLHIV in SSA experience high prevalence of mental illness
  - Major depressive disorder is on average 15% among PLHIV in SSA
  - 2-3x higher than in the general population
- Depression can be treated at scale in SSA
  - Interpersonal Psychotherapy (IPT) – WHO recommended
  - Pharmacotherapies

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Interactions between HIV and Depression

- HIV is associated with higher rates of depression
  - 2-3x higher among PLHIV than in the general population in SSA
- Depression leads to worse HIV care outcomes
  - HIV incidence is higher among people with depression
  - Delays to diagnosis, linkage to care, HIV treatment
  - Reduced antiretroviral therapy (ART) adherence and viral load suppression (VLS) outcomes

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Modeling Depression and HIV Together

- Develop conceptual model of how depression interacts with HIV care continuum
  - Systematic literature review
  - Identify interactions and quantify effect sizes
- Incorporate depression into EMOD-HIV
  - Agent-based simulation of HIV and mental health
  - Allow mental health states to interact with behavioral risk and engagement in HIV care
- Simulate
  - Estimate how depression affects HIV – cases, deaths
  - Estimate how depression interferes with HIV treatment – ART coverage and VLS
  - Estimate how much depression treatment alleviates HIV disease burden

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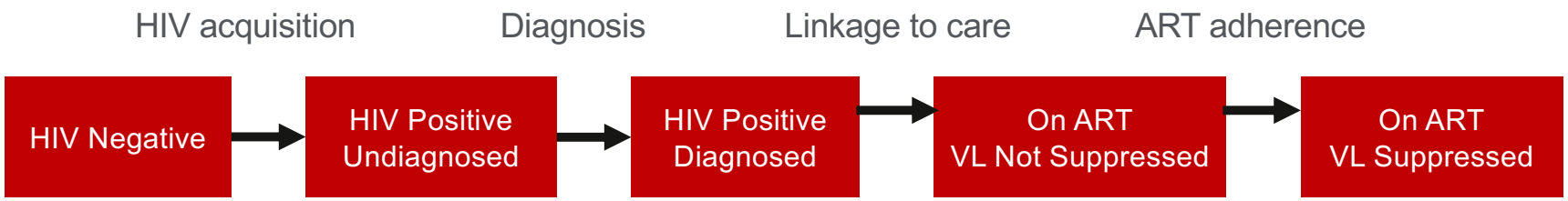
EMOD-HIV Care Continuum



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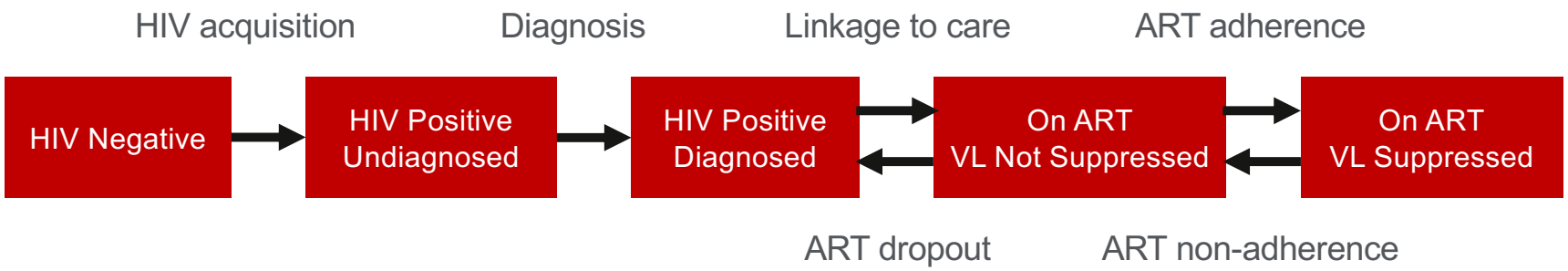
EMOD-HIV Care Continuum



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Model of Depression

- Develop model of depression which reproduces known clinical and behavioral patterns
- Calibrate model to age-specific prevalence of major depressive disorder
  - Kenya World Health Survey 2004
  - Global Burden of Disease estimates
- Input from collaborators – mental health clinicians
  - Depressive episodes last roughly 8-9 months
  - Need to account for each patient's history with depression and care
  - Patients who receive treatment
    - Less likely to suffer relapse
    - More likely to seek treatment in the future

Dr. Rosco Kasujja

STRONGMiNDS MENTAL HEALTH AFRICA

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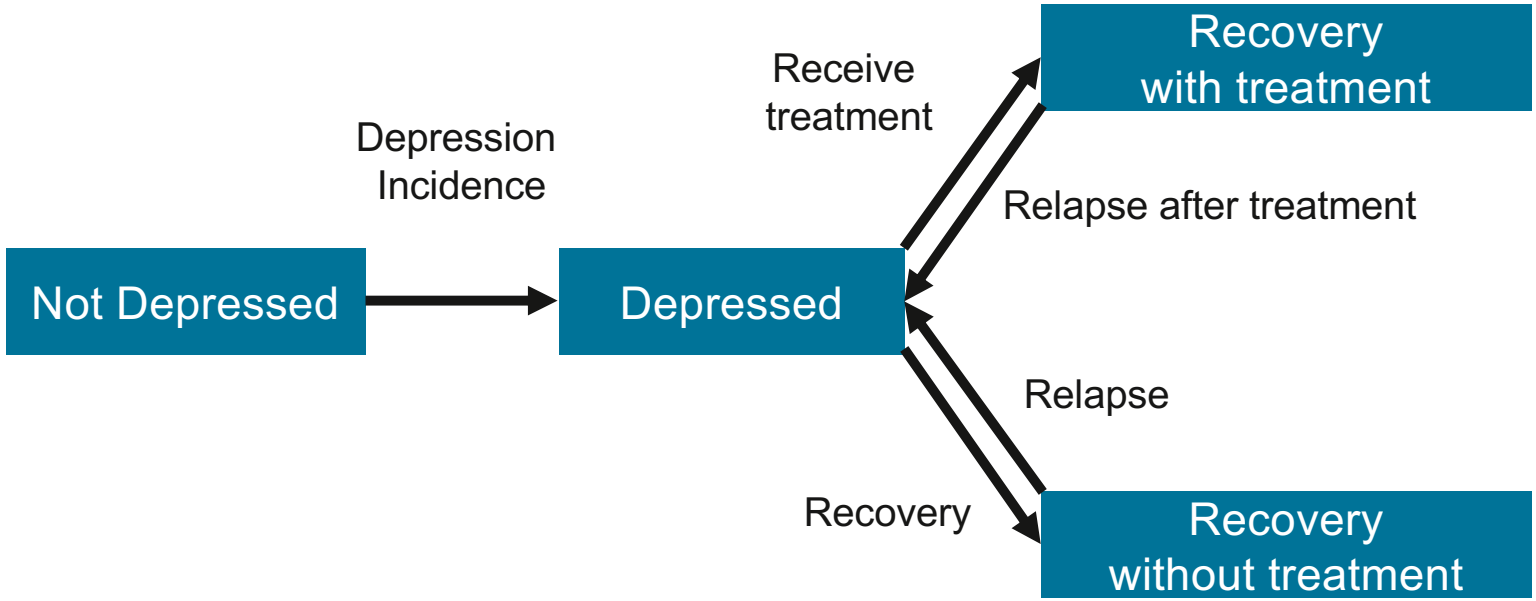
Compartmental Model of Depression



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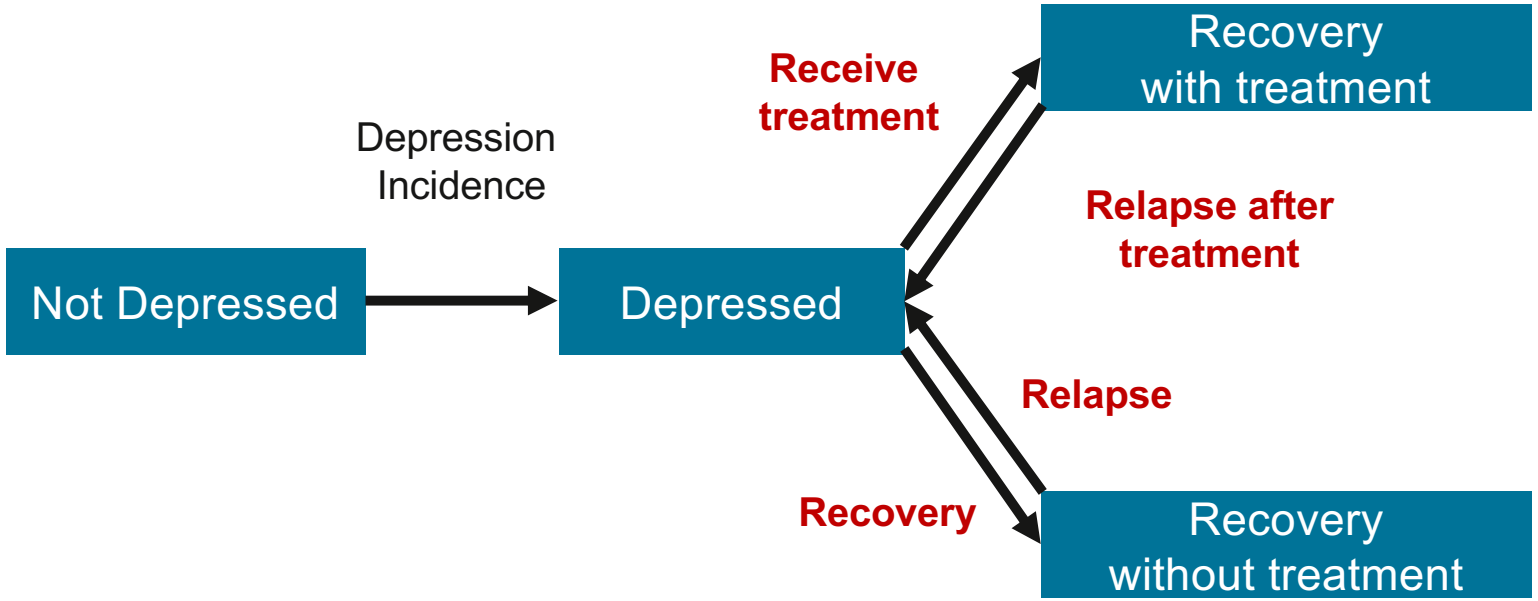
Compartmental Model of Depression



- **Derive rate parameters from literature review**

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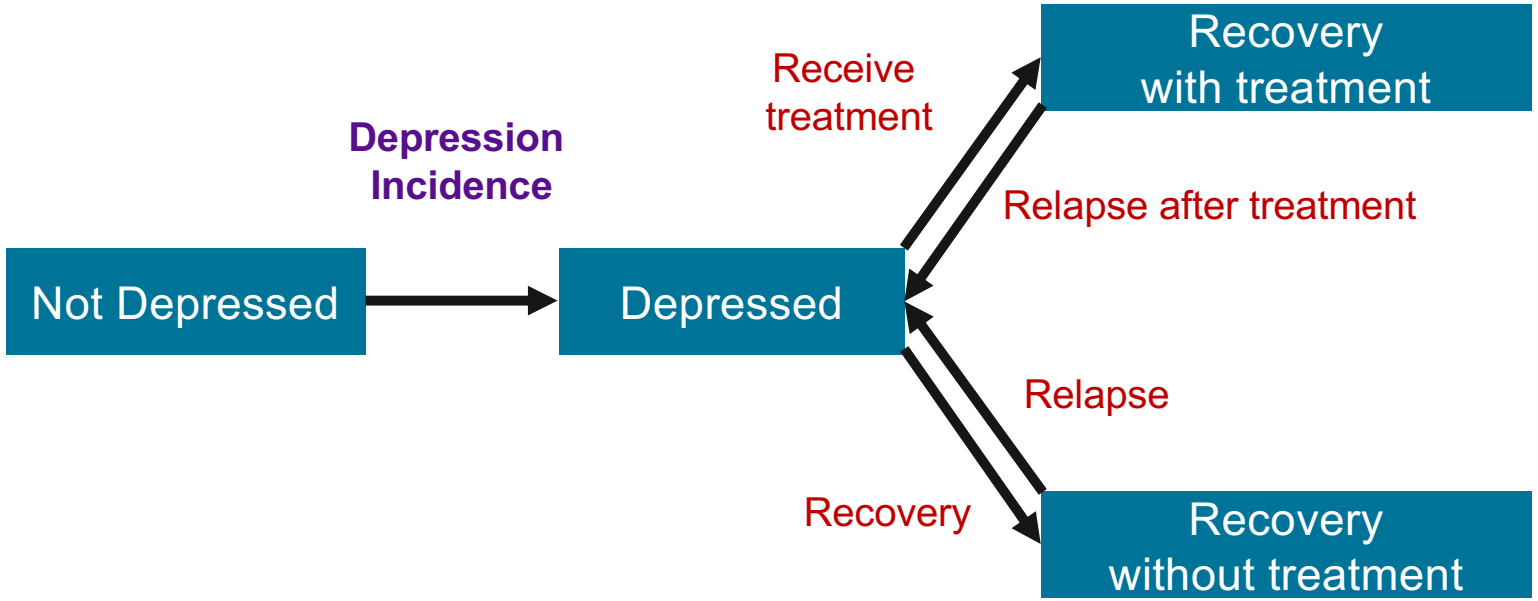
Compartmental Model of Depression



- Derive rate parameters from literature review
- **Calibrate depression incidence based on prevalence**

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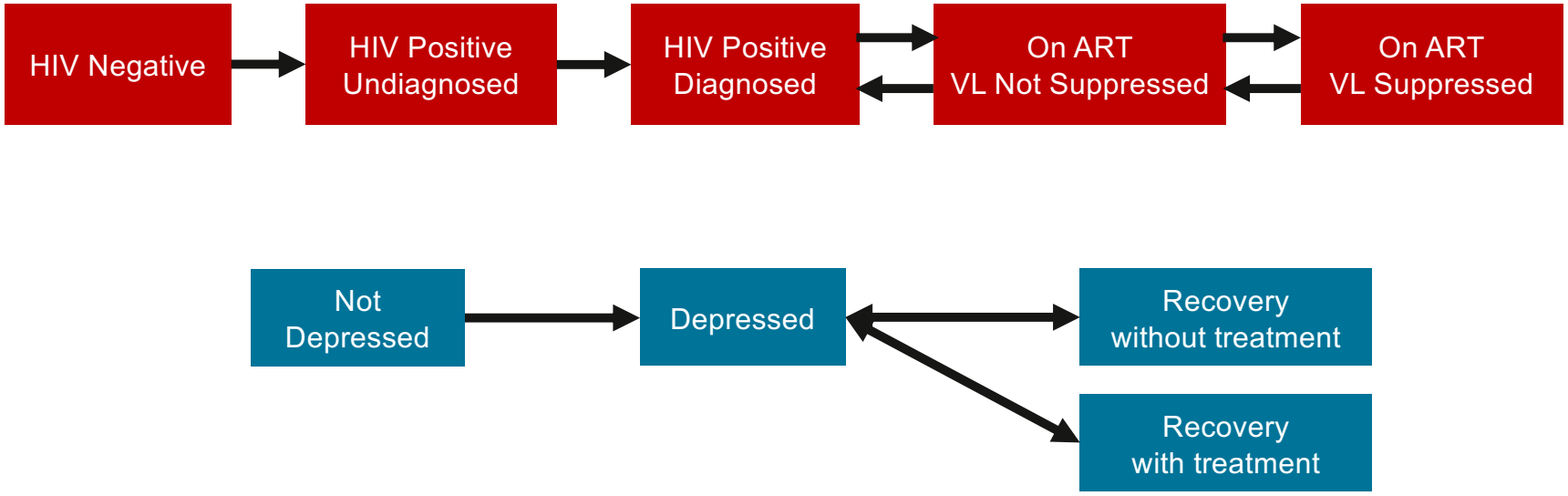
EMOD-HIV + Depression



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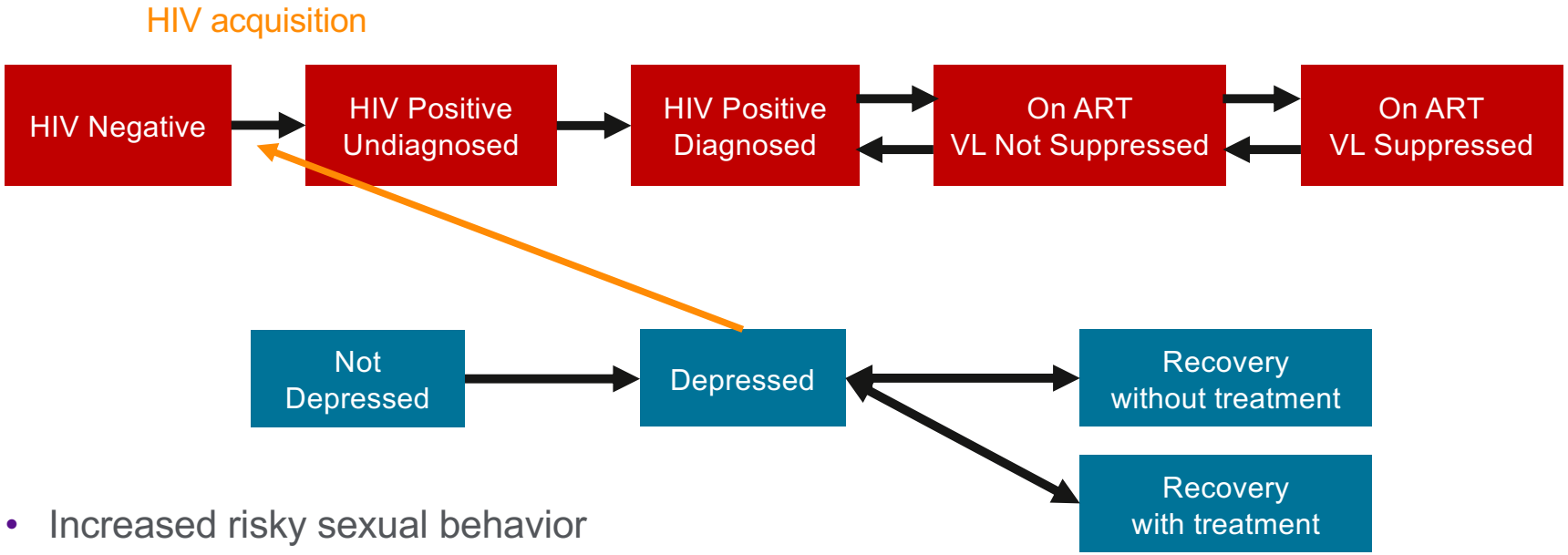
EMOD-HIV + Depression



- Increased risky sexual behavior
- Decreased use of preventative measures

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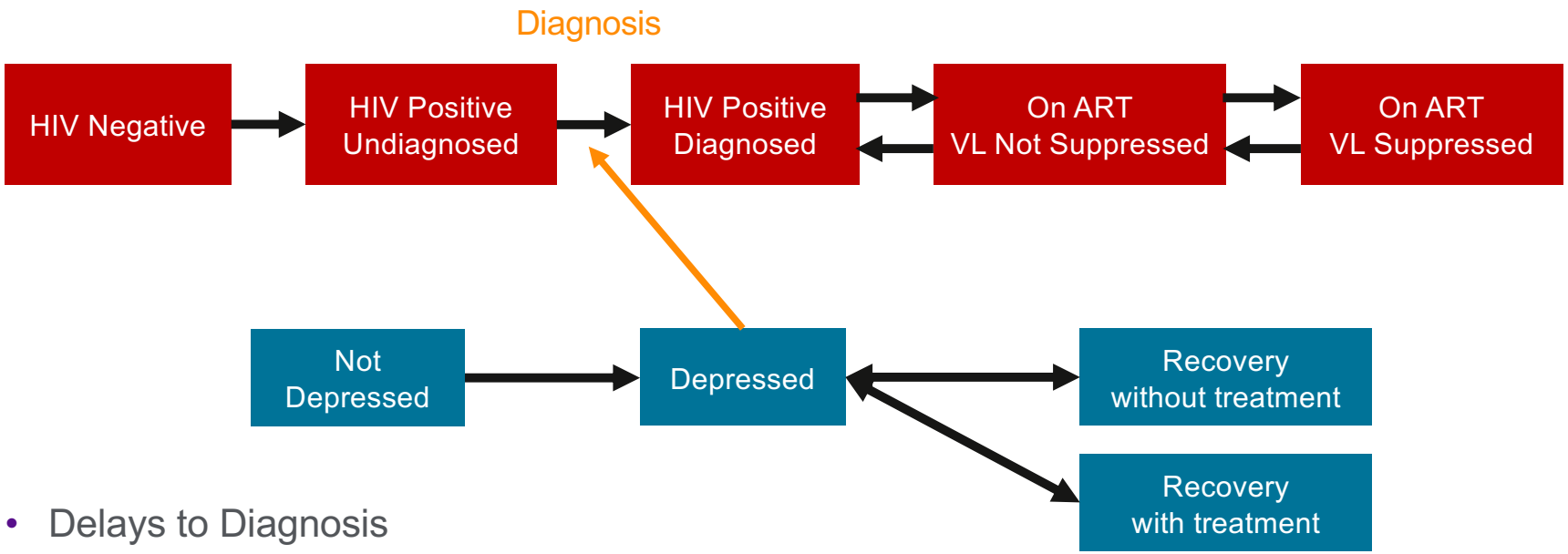
EMOD-HIV + Depression



- Delays to Diagnosis

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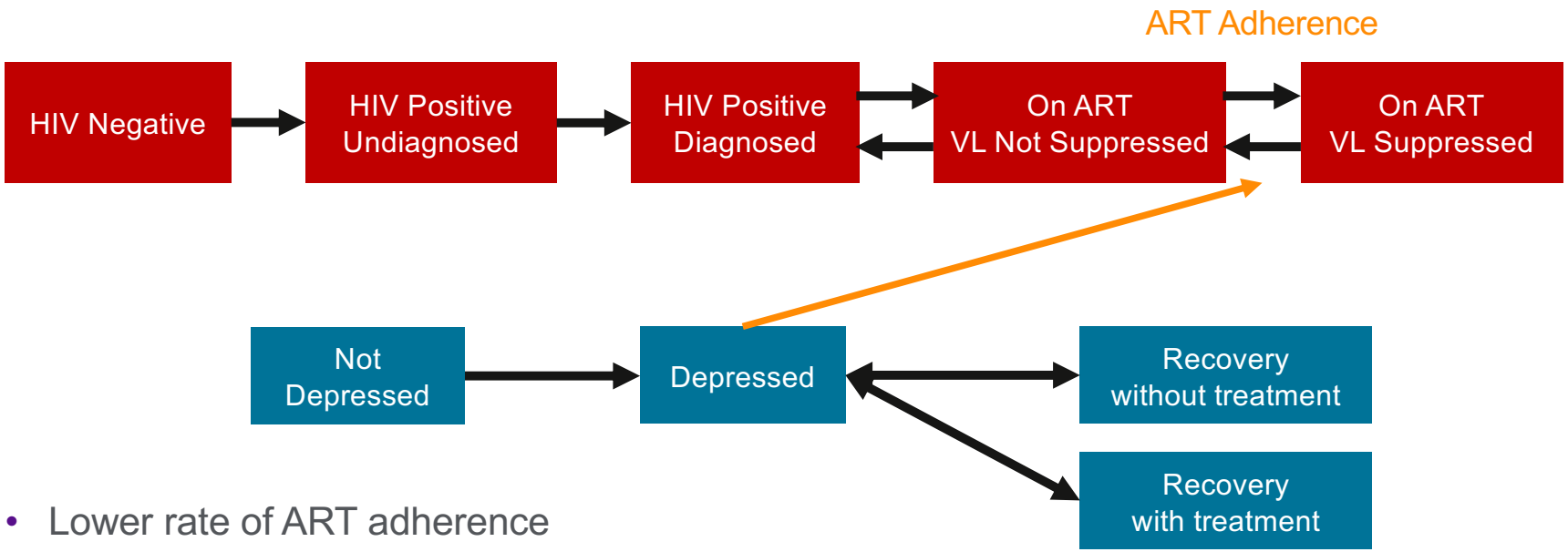
EMOD-HIV + Depression



- Lower rate of ART adherence
- Decreased rate of VL Suppression

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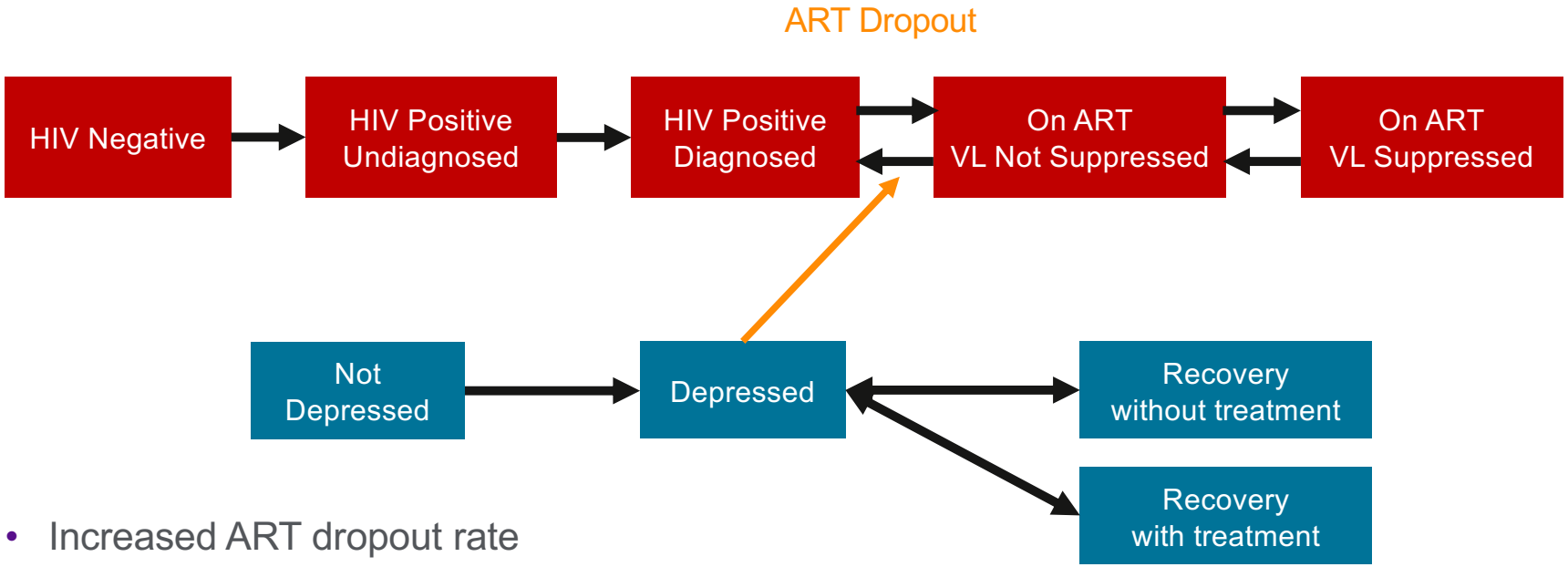
EMOD-HIV + Depression



- Increased ART dropout rate

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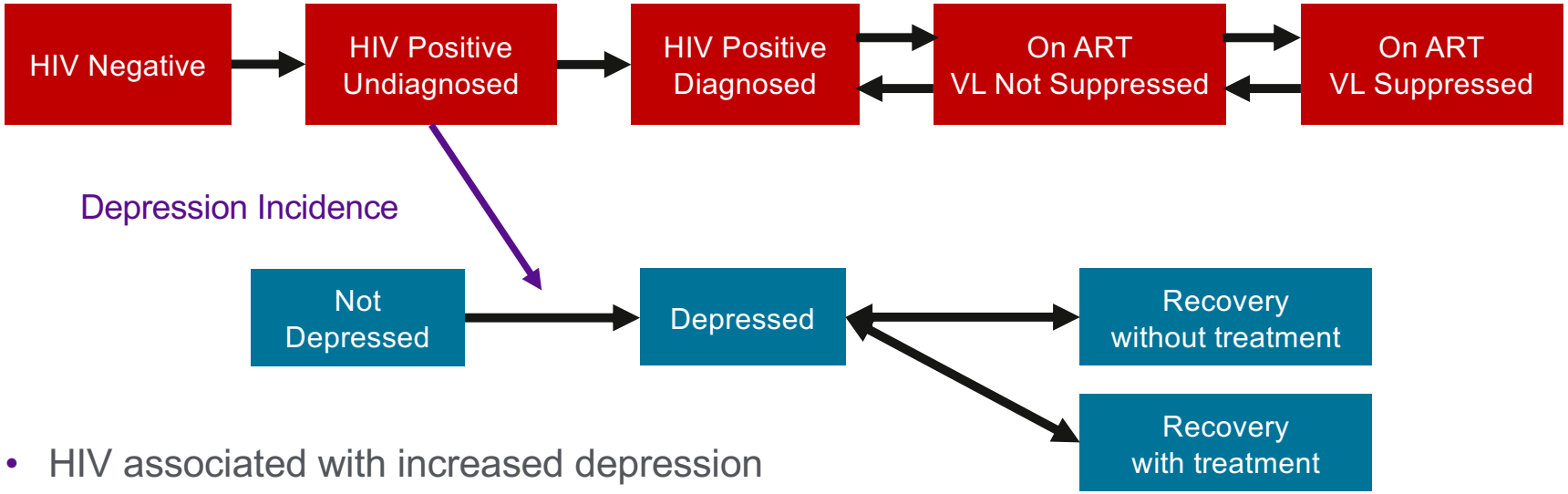
EMOD-HIV + Depression



- HIV associated with increased depression

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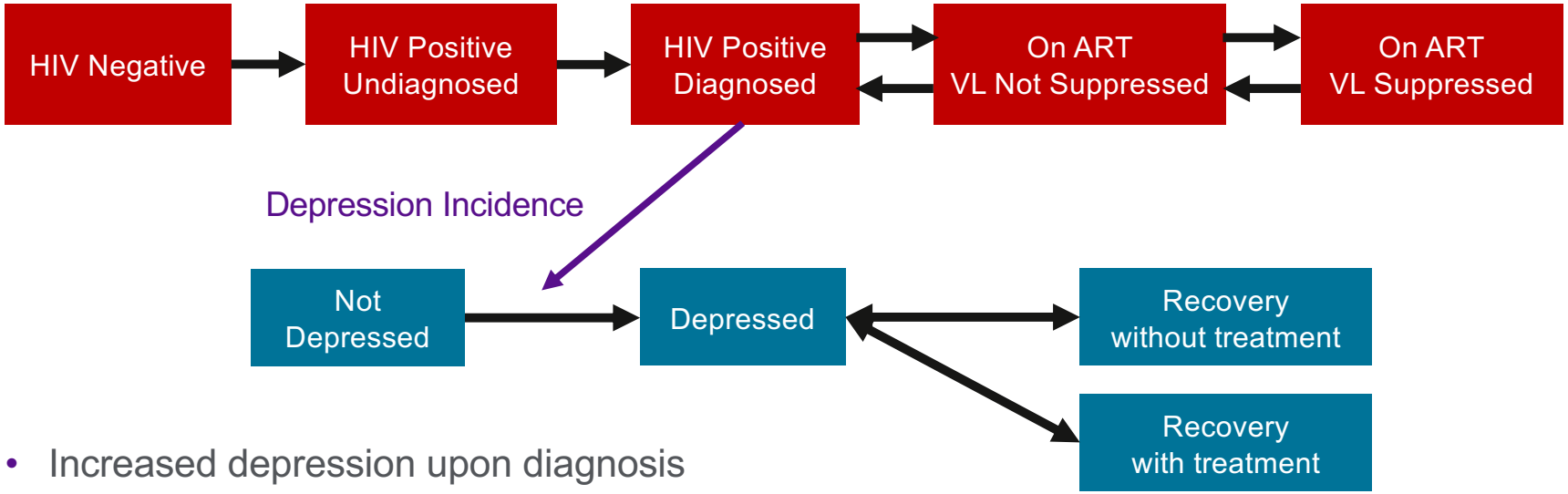
EMOD-HIV + Depression



- Increased depression upon diagnosis

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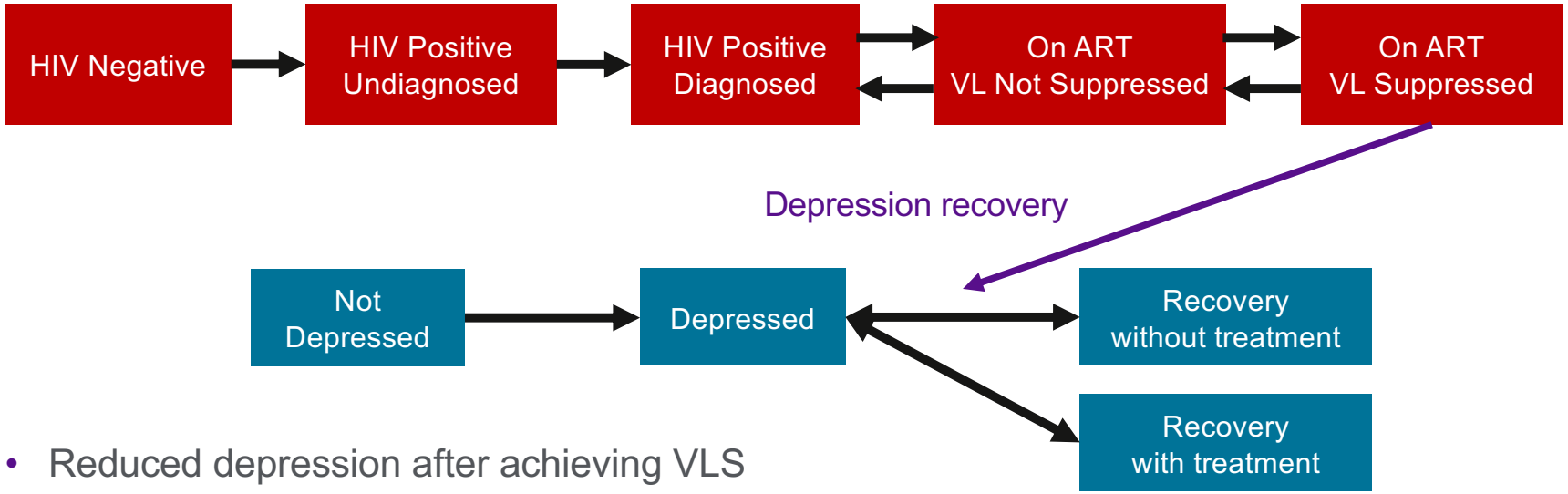
EMOD-HIV + Depression



- Reduced depression after achieving VLS

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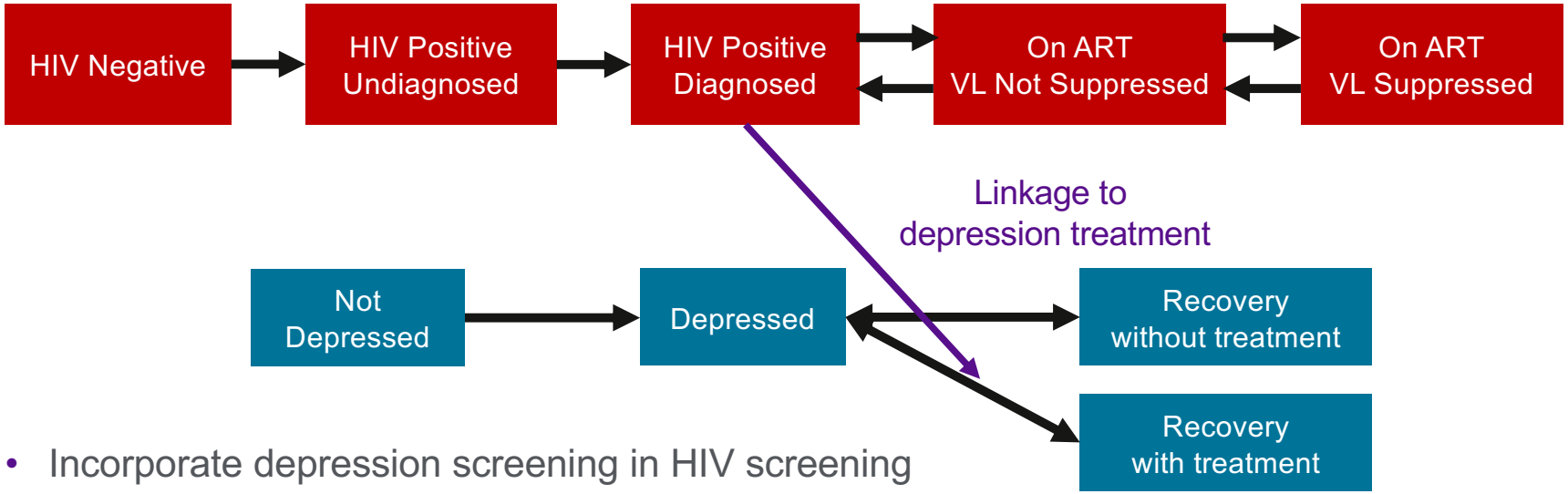
EMOD-HIV + Depression



- Incorporate depression screening in HIV screening
- Increase rate of linkage to depression treatment

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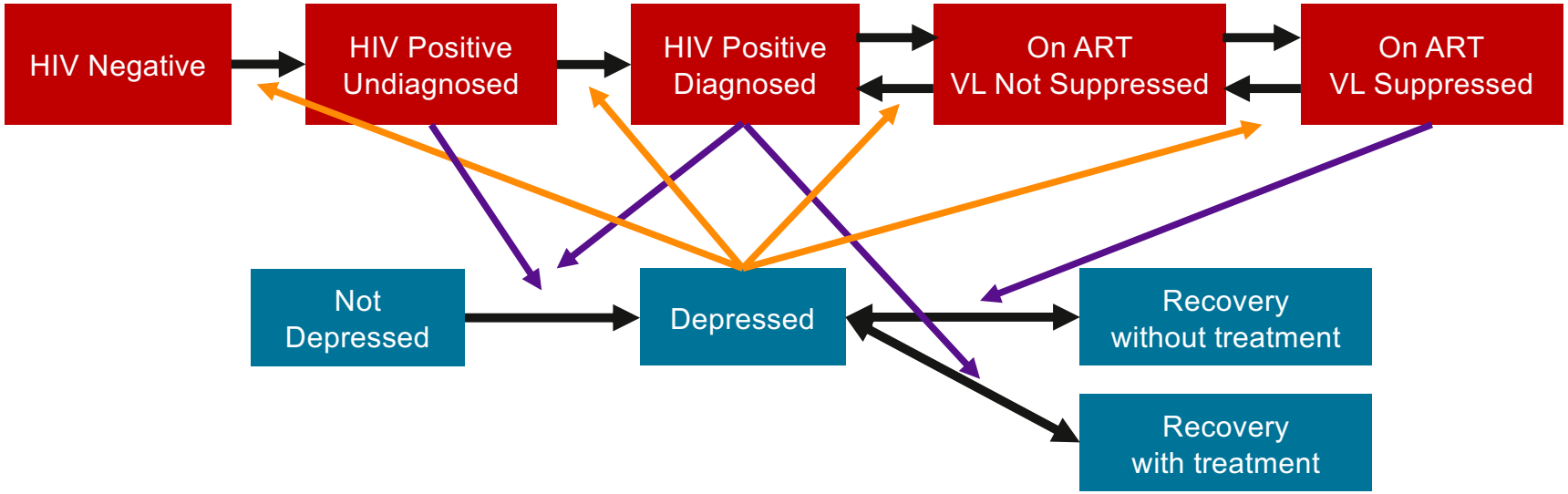
EMOD-HIV + Depression



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Preliminary Modeling Results

- Baseline assumptions
  - Start with HIV model calibrated to HIV in Kenya
  - Calibrate depression model to estimated age-prevalence curves
  - Calibrate depression model to have higher prevalence among PLHIV
- Increase risky behavior among depressed individuals
  - Engage with more concurrent sexual partners at a higher frequency
- Decrease ART adherence among depressed individuals
  - 81% of non-depressed individuals achieve VLS
  - 63% of depressed individuals achieve VLS

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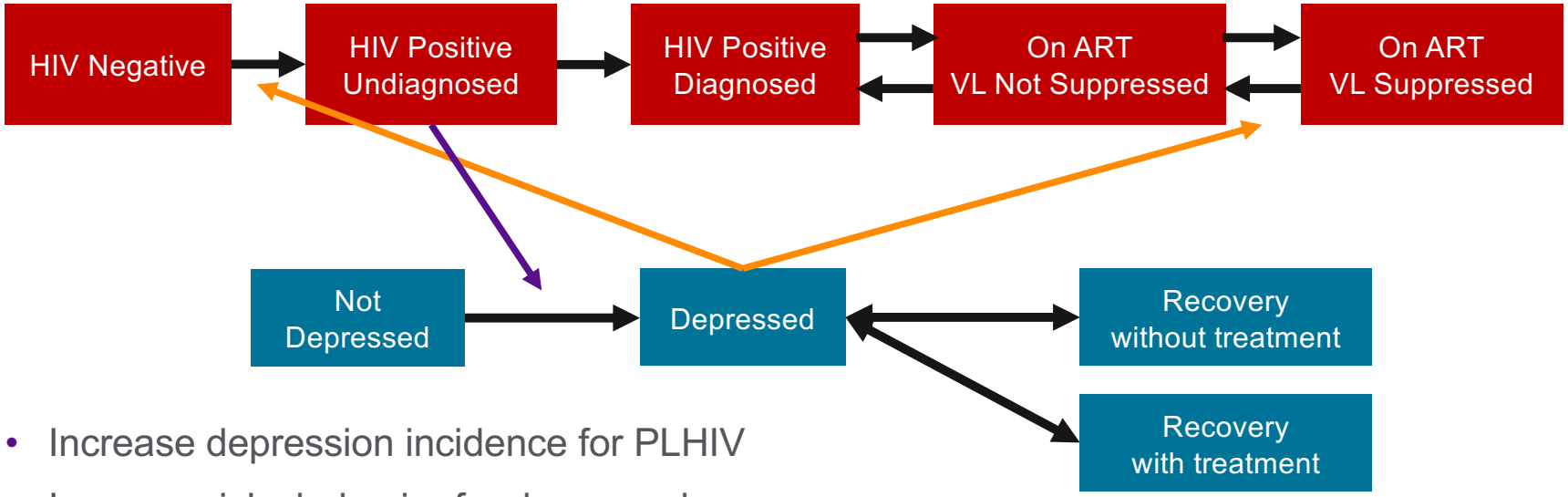
EMOD-HIV + Depression



- Increase depression incidence for PLHIV
- Increase risky behavior for depressed
- Reduce ART adherence and VLS

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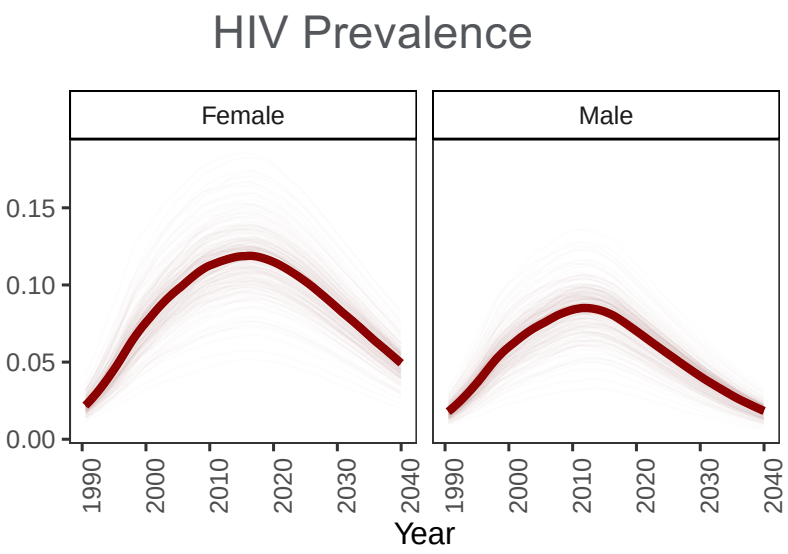
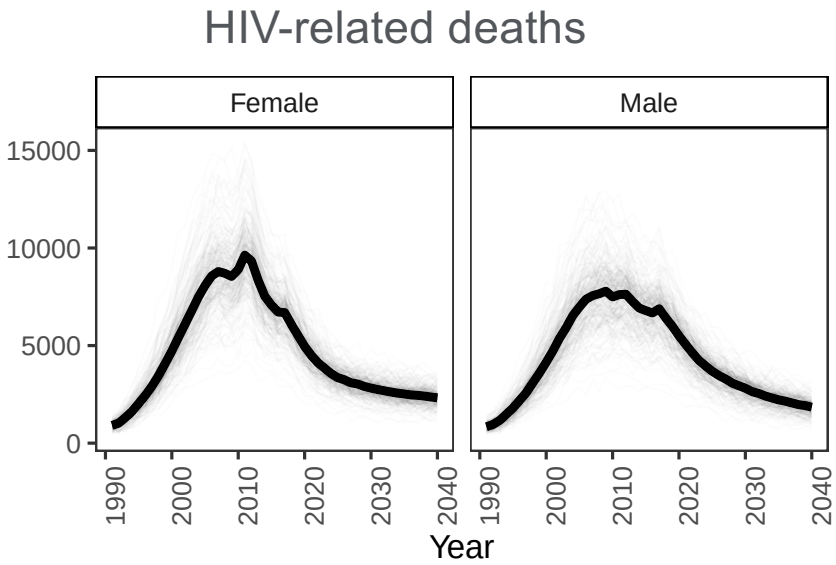
Baseline Modeling Results





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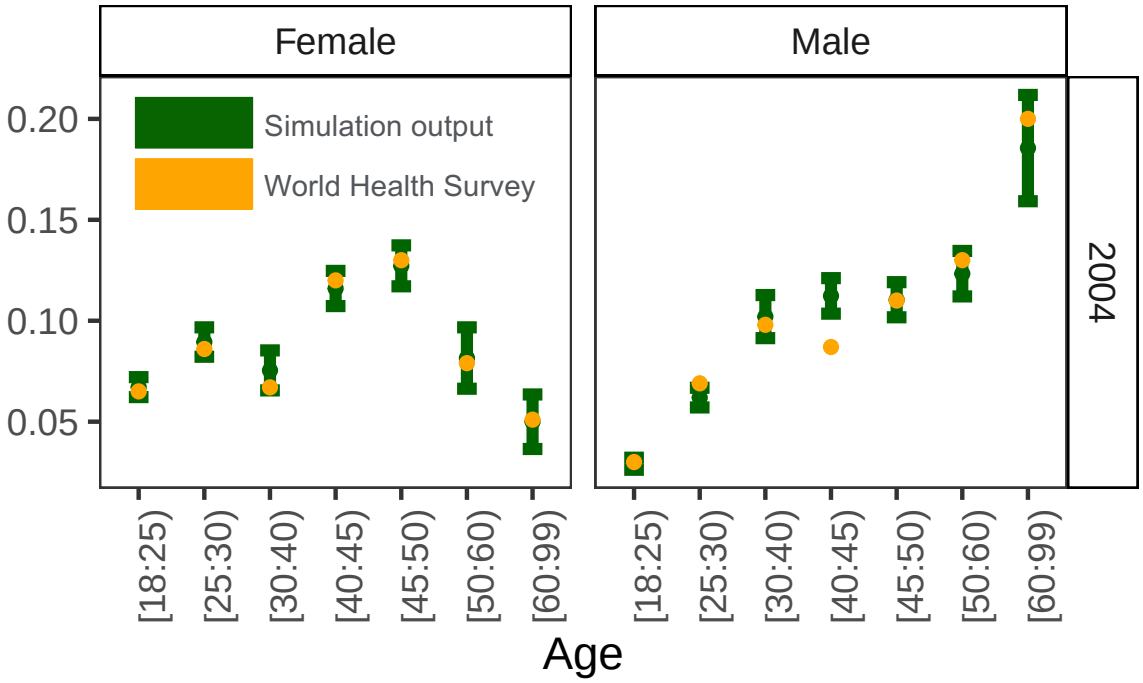
Model Calibration - Depression



- Calibrating to age-specific depression in 2004 World Health Survey in Kenya

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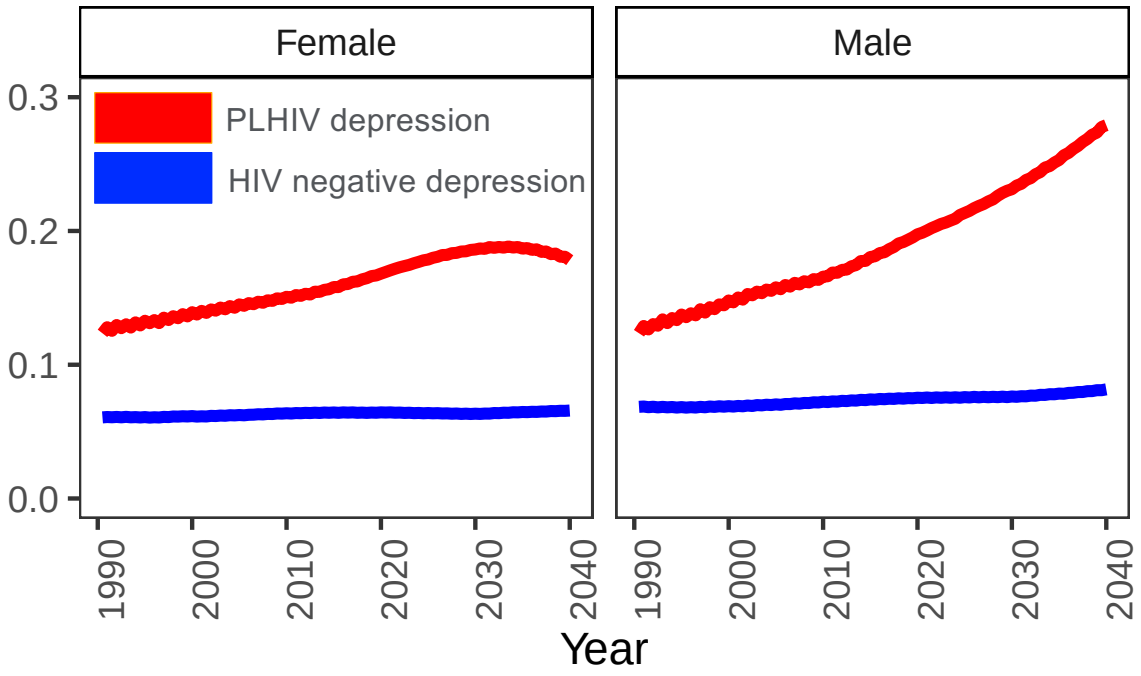
Depression and HIV

All ages depression prevalence given HIV status



- PLHIV have higher prevalence of depression compared to general population
- Depression prevalence changes as HIV-affected cohort ages

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Incorporating Treatment for Depression

- Assume that all episodes of depression receive treatment
- Assume 3-month recovery time with depression treatment

- Reduce risky behavior among those who receive treatment
- Improve ART and VLS outcomes among those who receive treatment

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HIV Cases Averted

- With treatment, avert a few hundred new HIV cases per year

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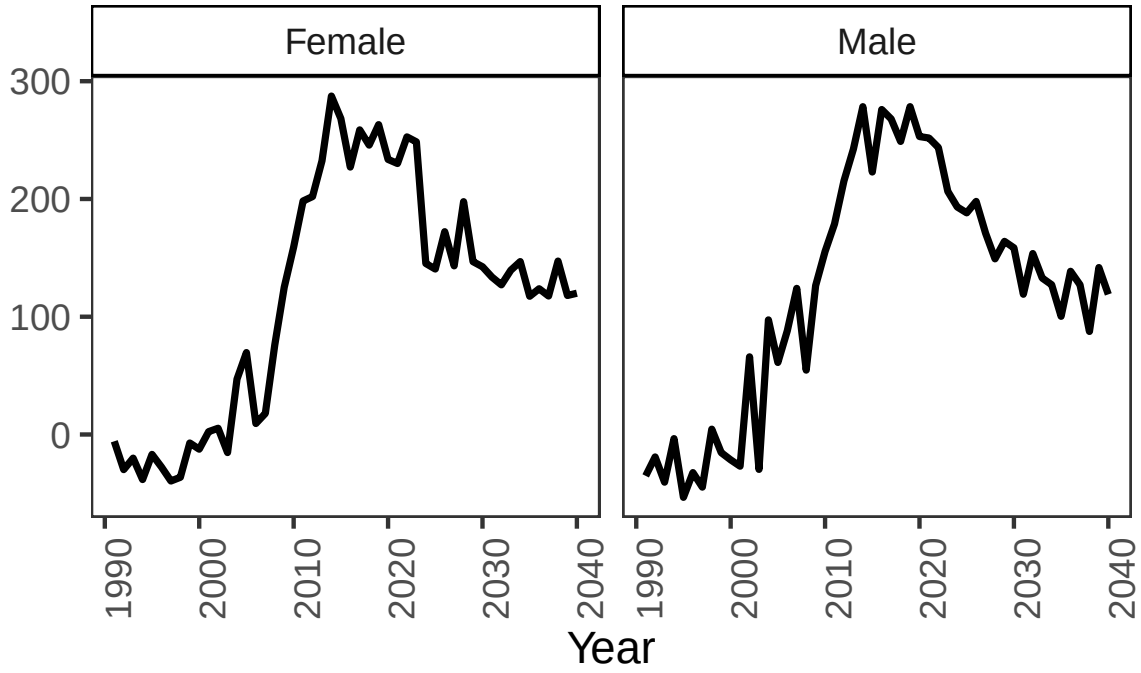
HIV Deaths Averted



- With depression treatment, avert a few hundred HIV-related deaths per year

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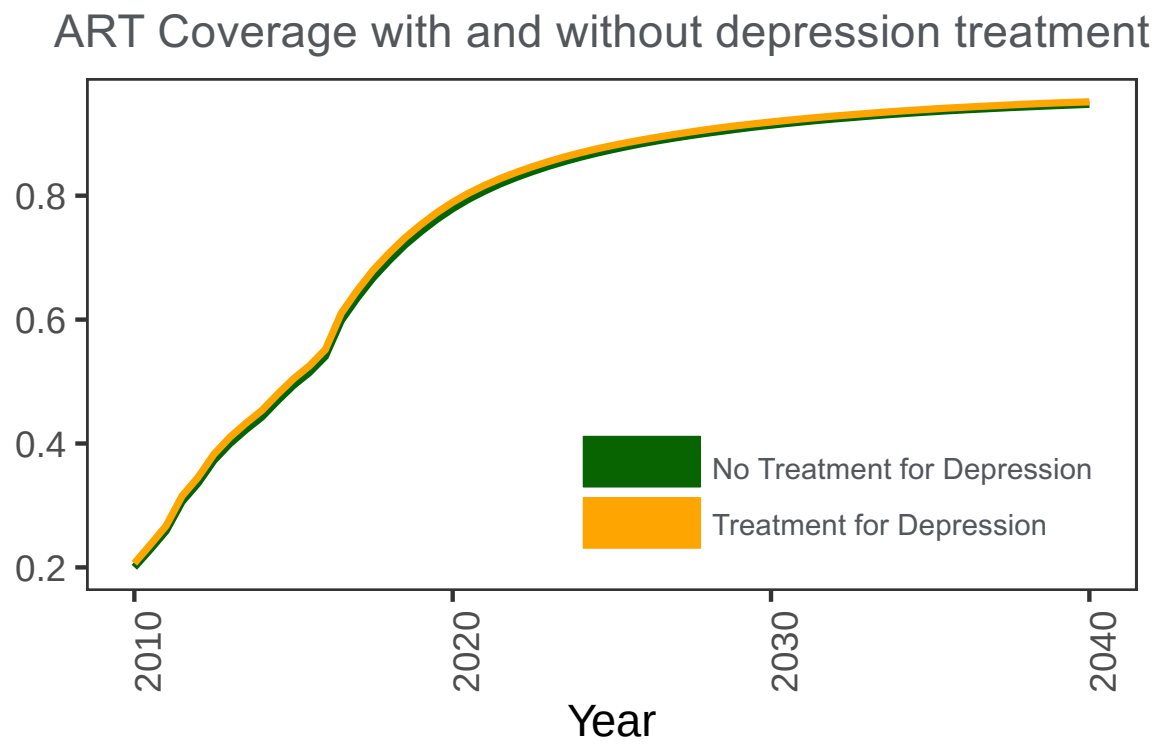
Improvements to ART coverage and outcomes



- ART coverage is about 1% higher when depression is treated
- VLS improves by 1.5% as ART retention improves with depression treatment

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Conclusion

- The interactions between HIV and depression are complex, and require a detailed simulation model to fully explore
- Under strong assumptions of universal successful treatment of depression, the model predicts small improvements to HIV outcomes
  - Treatment prevents new HIV cases and deaths
  - Improved ART coverage and VLS
- Preliminary estimates of DALYs averted suggest that the benefit of treating mental health will be enormous even without accounting for improvements to HIV

- Continue to develop, verify, and validate the EMOD-HIV+Depression model, incorporating interactions and effect sizes determined by our systematic literature review

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Acknowledgments

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