

Supplementary Materials: SUPPLEMENTARY FILE S1: MACHINE READABLE CONFIGURATION for COMPUTATIONAL VALIDATION OF A CLINICAL SUPPORT ALGORITHM FOR LAI-PREP BRIDGE PERIOD NAVIGATION AT UNAIDS SCALE

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Supplementary File S1: Machine-Readable Configuration Files

This supplementary file provides the machine-readable configuration files and parameter specifications that drive the LAI-PrEP bridge period decision support algorithm. These files enable reproducibility, external validation, and adaptation of the model to different clinical contexts and populations.

S1.1 Configuration File Structure

The algorithm implements a configuration-driven architecture using JavaScript Object Notation (JSON) format. This approach separates algorithmic logic from clinical parameters, enabling:

- Rapid updates as new evidence emerges without modifying code
- Version control and comparison across parameter sets
- External audit and sensitivity analysis
- Local adaptation based on implementation experience
- Prospective validation with alternative assumptions

S1.2 Core Configuration Parameters

The configuration file specifies:

Population Baseline Rates Success rates by population, source evidence, and confidence tier (Tier 1: LAI-PrEP data; Tier 2: Oral PrEP data; Tier 3: Cross-therapeutic extrapolation)

Structural Barriers Barriers to bridge period completion (n=21), with impact weights as percentage-point reductions in success probability, evidence sources, and implementation indicators

Evidence-Based Interventions Interventions to address barriers (n=21), effect sizes, evidence levels (High/Moderate/Emerging), mechanisms of action, overlap penalties, and implementation complexity ratings

Modeling Parameters Diminishing returns factors (default 70%), barrier combination method (multiplicative default), overlap penalty structure, and validation checksums

Version Control Configuration version number, timestamp, change log, and backward compatibility settings

S1.3 Population-Specific Baseline Rates

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Table S1. Population-Specific Bridge Period Success Rates (Baseline)

Population	Baseline Success (%)	Source Tier	Evidence Reference
Cisgender men who have sex with men (MSM)	52.9	Tier 1	HPTN 083, PURPOSE-1
rrrr	Transgender women	Tier 2	PURPOSE-2 trial analysis
	People who inject drugs (PWID)	Tier 3	Oral PrEP cascade data
	Adolescents (13–24 years)	Tier 3	HVTN 702 analog, expert consensus
	Sub-Saharan Africa (general population)	Tier 2	HPTN 084 implementation data
	North America/Europe (high-income)	Tier 1	Trial data + implementation

S1.4 Structural Barriers (n=21) with Impact Weights

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Table S1.1 in the complete configuration file documents all 21 barriers with:

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- Barrier name and category (financial, logistic, clinical, educational, social)
- Impact weight as percentage-point reduction in baseline success
- Evidence source (published literature, qualitative studies, expert consensus)
- Implementation indicators (how to identify barrier presence)
- Mitigation requirements for each barrier

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S1.5 Evidence-Based Interventions (n=21) with Effect Sizes

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Table S1.2 documents all 21 interventions with:

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- Intervention name and mechanism of action
- Effect size (percentage-point improvement in bridge period success)
- Evidence level (High: RCT or robust implementation data; Moderate: quasi-experimental or observational with controls; Emerging: pilot or expert consensus)
- Published references for effect size derivation
- Complexity rating (Low/Medium/High) for implementation
- Overlap penalties with other interventions (to account for synergistic effects and ceiling constraints)

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S1.6 Validation Checksums and Data Integrity

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All configuration files include SHA-256 checksums for each parameter section. These enable:

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- Detection of unintended modifications
- Verification that external users are working with identical configuration
- Retrospective confirmation of which version was used for published analyses

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S1.7 Configuration Version History

The configuration file maintains a complete version history:

v1.0.0 Initial configuration (used for primary validation analysis)

v2.0.0 Updated intervention effect sizes based on 2024 real-world implementation data
(HPTN 083-02, Trio Health Cohort)

v2.1.0 (Current) Includes new published evidence on transportation barriers and financial navigation support

Each version includes timestamp, substantive changes, and backward compatibility notes.

S1.8 JSON Configuration File Example Structure

The complete machine-readable configuration file follows this structure:

Listing 1: Configuration File Structure Example

```

1  {
2      "metadata": {
3          "version": "2.1.0",
4          "date": "2025-12-12",
5          "algorithm_name": "LAI-PrEP Bridge Period Decision Support",
6          "doi": "10.5281/zenodo.17873201"
7      },
8      "populations": [
9          {
10             "name": "MSM",
11             "baseline_success_rate": 0.529,
12             "source_tier": "Tier 1",
13             "evidence_reference": "HPTN_083_2024"
14         }
15     ],
16     "barriers": [
17         {
18             "id": "B001",
19             "name": "Financial barriers",
20             "impact_weight": -0.12,
21             "evidence_level": "High",
22             "mechanism": "Insurance gaps, copayment burdens"
23         }
24     ],
25     "interventions": [
26         {
27             "id": "I001",
28             "name": "Financial navigation support",
29             "effect_size": 0.15,
30             "evidence_level": "High",
31             "complexity": "Medium"
32         }
33     ],
34     "modeling_parameters": {
35         "diminishing_returns_factor": 0.70,

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36     "barrier_combination_method": "multiplicative",  
37     "max_attrition_ceiling": 0.95  
38   }  
39 }
```

S1.9 Accessing Configuration Files

Complete machine-readable configuration files are available at:

- GitHub Repository: <https://github.com/nyx-dynamics/lai-prep-decision-support>
- Zenodo Archive: DOI <https://doi.org/10.5281/zenodo.17873201>
- MDPI Supplementary Materials: Attached configuration files with checksums

S1.10 Customization and Adaptation

Sites implementing this tool can adapt configurations by:

1. Modifying population baseline rates based on local epidemiology
2. Adjusting barrier impact weights using local implementation data
3. Updating intervention effect sizes as new evidence emerges
4. Maintaining version control to document all modifications
5. Validating checksums before deployment to ensure data integrity

All changes should be documented with timestamp, rationale, and evidence source.

S1.11 Validation and Testing

All configuration parameters undergo automated validation:

- Parameter bounds checking (probabilities constrained to 0–1 range)
- Mathematical consistency (no circular dependencies, invalid diminishing returns)
- Evidence source verification (all cited references available)
- Sensitivity analysis across parameter ranges
- Robustness testing with alternative assumptions

S1.12 Documentation and Audit Trail

Each configuration file includes:

- Complete data dictionary with definitions
- Source documentation for every parameter value
- Confidence intervals or uncertainty ranges where available
- Date of last validation
- Contacts for questions about specific parameters

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