Comprehensive System Dynamics (SD) Model of the HIV Care Continuum

Overview Manual

Developed by

The Institute for Community Research, Hartford, CT

and

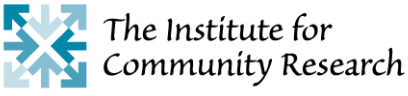
Albert Einstein College of Medicine, Montefiore, NY, NY

in collaboration with

The Greater Hartford HIV System Dynamics Modeling Task Force

January 2020

(DRAFT 01-24-2020: Model v388)



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Introduction to the HIV Care Continuum System Dynamics (SD) Model

Available effective ways to prevent and treat HIV have created the possibility of eliminating the epidemic. This requires focused and coordinated community efforts to prevent new infections, test people who may become infected, and provide medical care and ongoing social supports to all people living with HIV (PLWH) so they can quickly achieve viral suppression (VS) and maintain it throughout their lifetimes. Many communities have broad goals to eliminate health disparities and the HIV epidemic altogether. Yet in most of them, healthcare and support services for people at risk or PLWH are fragmented, limited, and uncoordinated. Stakeholders in these efforts seek greater understanding of the complex healthcare delivery *system* so they can improve the effectiveness of their care efforts. Collaborative and participatory *system dynamics modeling* allows stakeholders to engage in a *systems thinking* process to ask critical questions about how a system like healthcare delivery works and, with the aid of computer tools, they can simulate complex systems-level problems and potential alternative solutions.

This booklet describes a system dynamics (SD) simulation model of the HIV Care Continuum (CC) system in one geographic region (referred to as the "catchment area"). It is designed to help community members understand how system feedback, delays, and other dynamics and complexity of the system's structure affect how well the HIV CC delivery system functions to achieve the health goals of preventing HIV and caring for those infected and affected.

This SD simulation model can be used to learn about the dynamics of an HIV CC system by using the "base case scenario run" to simulate system results. Model users can also test different "hypotheses" or "what-if scenarios" to see which combination of resources and actions generate the best improvements to the system. The "base case scenario" was designed to reproduce the epidemic in the initially selected catchment area, namely, the Hartford TGA (Transitional Grant Area), a HRSA-designated Ryan White (RW) funding area that includes Hartford County, Middlesex County, and Tolland County in Connecticut. We used 2015, 2016, and 2017 epidemiological and RW service utilization data to establish the trends in the base case scenario. The model projects a 5-year time horizon into the future in simulating system dynamics over time. This model can also be tailored to other communities' epidemics and local services to better understand the challenges and opportunities to improve the HIV CC system in their region. This model is not designed to predict the future, but can simulate potential results of various strategies intended to achieve better health related outcomes to care for all PLWH and eliminate the HIV epidemic.

To build this SD model of the HIV CC system, our research team collaborated with a coalition of 25 community stakeholders called the **HIV System Dynamics Modeling Task Force**. The Task Force included doctors, nurses, and support staff from community clinics, directors, front line case managers and outreach workers from HIV/AIDS service organizations, consumers (PLWH), community advocates and activists, and representatives of the Hartford and CT departments of health. Using SD "group model building," we conducted a series of 16 systems modeling workshops over an 18-month period (Jan. 2017 – July 2018) to diagram and simulate the regional HIV CC system. The goals of these sessions were to engage all members of the Task Force in critiquing their HIV CC system and to build their capacity to use SD modeling language and techniques so they could help design and validate the SD simulation model. More information about the process of building this SD simulation model can be found in the publically available publication at https://www.ncbi.nlm.nih.gov/pubmed/29154393/.

This SD simulation model has 9 "modules" that contain one or more models. However, all modules are connected to each other in various ways, which make up the full model of the HIV CC system. We have created the modules to help organize and group the different types of services and community actions that link to and affect the central HIV care continuum.

The **9 modules** in the full SD simulation model include the following:

The central module:

1. **HIV Infection and Treatment as Prevention** (including "the treatment cascade"),

4 "Basic Services" modules:

2. **HIV Testing and Prevention Services**
3. **Medical Care Services for PLWH**
4. **Ryan White Case Management Services**
5. **Housing, Substance Use Treatment, and Mental Health Services for PLWH**

4 "Action Strategies" modules:

6. **Peer Outreach to Promote HIV Testing**
7. **Peer Advocacy to Support PLWH**
8. **Expanded HIV Testing and Comprehensive Sexual Health Screening in Primary Care**
9. **Mobilizing Community Leaders and Organizational Partnerships to Support PLWH**

The "Action Strategies" are designed to improve delivery and effectiveness of the "Basic Services." Similarly, the "Basic Services" are designed to improve the effectiveness of the central HIV Care Continuum and reduce community-level viral load (CVL).

Organization of This Manual

The next page provides a "cheat sheet" with a quick overview of some key terms and explanations of common images used in SD modeling. This will help prepare the reader to be able to understand the images and diagrams presented in the chapters below.

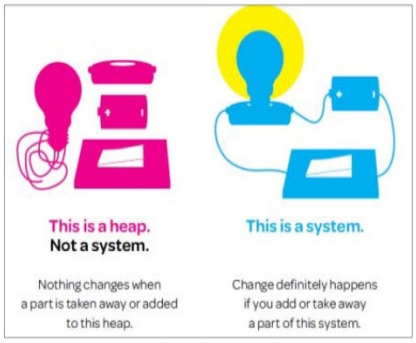
Following that, each chapter presents one of the 9 modules, beginning with the "landing page" of the full simulation model and highlighting the module to be presented. We start with the central HIV Infection and Treatment as Prevention module. Chapters are organized to provide four kinds of information on each of the modules, organized as follows:

1. Causal Loop Diagram (CLD): This is a conceptual diagram of the key *"variables"* in the module and how those variables relate to each other to form *"feedback loops."*
2. Stock/Flow Model(s) (some modules contain more than one stock/flow model): These are images of the simulation model structure that includes all variables built into the models. The SD stock/flow models are used to simulate the different *"simulation runs."*
3. Key Modifiable Variables Table: These tables list the variables in the stock/flow model that can be changed (indicated with green in the color stock/flow models) in order to run different "what-if" simulations to test various strategies or service conditions expected to improve the system outputs or to tailor the model to a different local community.
4. Base Case Run Output Graphs: Results of the simulation runs are represented in *"graphs over time"* of key variables from the stock/flow model. Graphs show changes in trends in that variable created by different scenarios or conditions. The base case run output graphs show results of the simulation model "as is," without changing any modifiable variables.

The SD model also has a *"user interface"* to facilitate use of the model as a tool for community decision making. Several screen shots of the interface are included at the end of this manual to illustrate the general design and functions of interface components. When finalized, the user interface will be accessible through a website portal for public access and use.

Acknowledgements and copyright information can be found at the end of this booklet. For more information about the model and the research studies that supported its development, contact Margaret (Peg) Weeks at mweeks@icrweb.org.

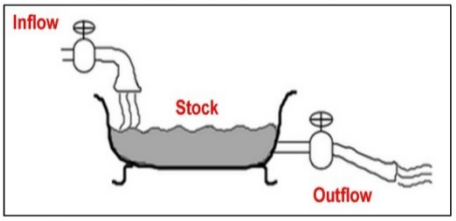
Definition of Words Commonly Used in System Dynamics (SD) Modeling*



System: A set of parts that is organized and interconnected in a pattern, or a "structure," that produces a characteristic set of behaviors (for example, the HIV continuum of services is a system).

Dynamics: Change or movement, positive and/or negative, and interactions among things that create, increase/decrease, delay, or stop change and movement.

Modeling: Creating a visual diagram of a system and its dynamics. This visual diagram of a system can also be simulated with a computer.



Stocks: An accumulation of units (for example, water in a tub, people infected with HIV).

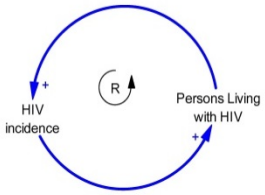
Flows: The movement of units into, out of, or between stocks.
- **Inflow:** Units moving into the stock (like water coming from the faucet).
- **Outflow:** Units moving out of the stock (water flowing down the drain.)

Variables are elements, features, factors or components of a system that are likely to vary or change.

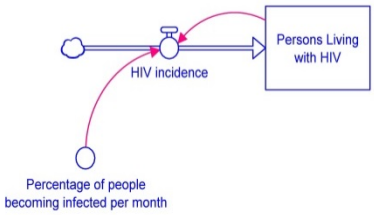
Feedback loops are created by 2 or more variables interacting with each other in a system. Feedback loops can be represented in several ways, including a **causal loop diagram**, **stock-flow diagram**, and **graphs over time diagram (also called reference modes)**.

Positive or "reinforcing" feedback loops magnify or amplify change. Usually that means slow change becomes extremely rapid, sometimes called exponential change. These can be "vicious" or "virtuous" cycles.

Causal Loop Diagram



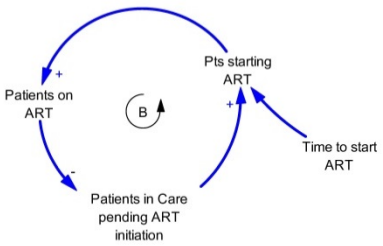
Stock-Flow Diagram



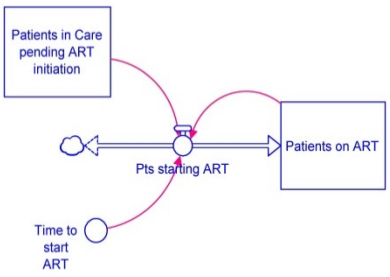
Reference Mode, or Graph-Over-Time Diagram

Negative or "balancing" feedback loops tend to create a balance. In these loops, one or more forces oppose or reverse the direction of change of one or more other forces. When two competing forces in a negative feedback loop interact, the resulting change can take many forms.

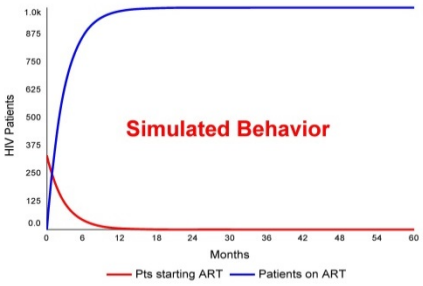
Causal Loop Diagram



Stock-Flow Diagram



Reference Mode, or Graph-Over-Time Diagram



Time delays refer to a temporary interruption in the flow or movement of units in a system.

These and additional system dynamics (SD) definitions of terms can be found in:
Meadows DH. Thinking in Systems: A Primer. White River Junction, VT: Chelsea Green Publishing; 2008

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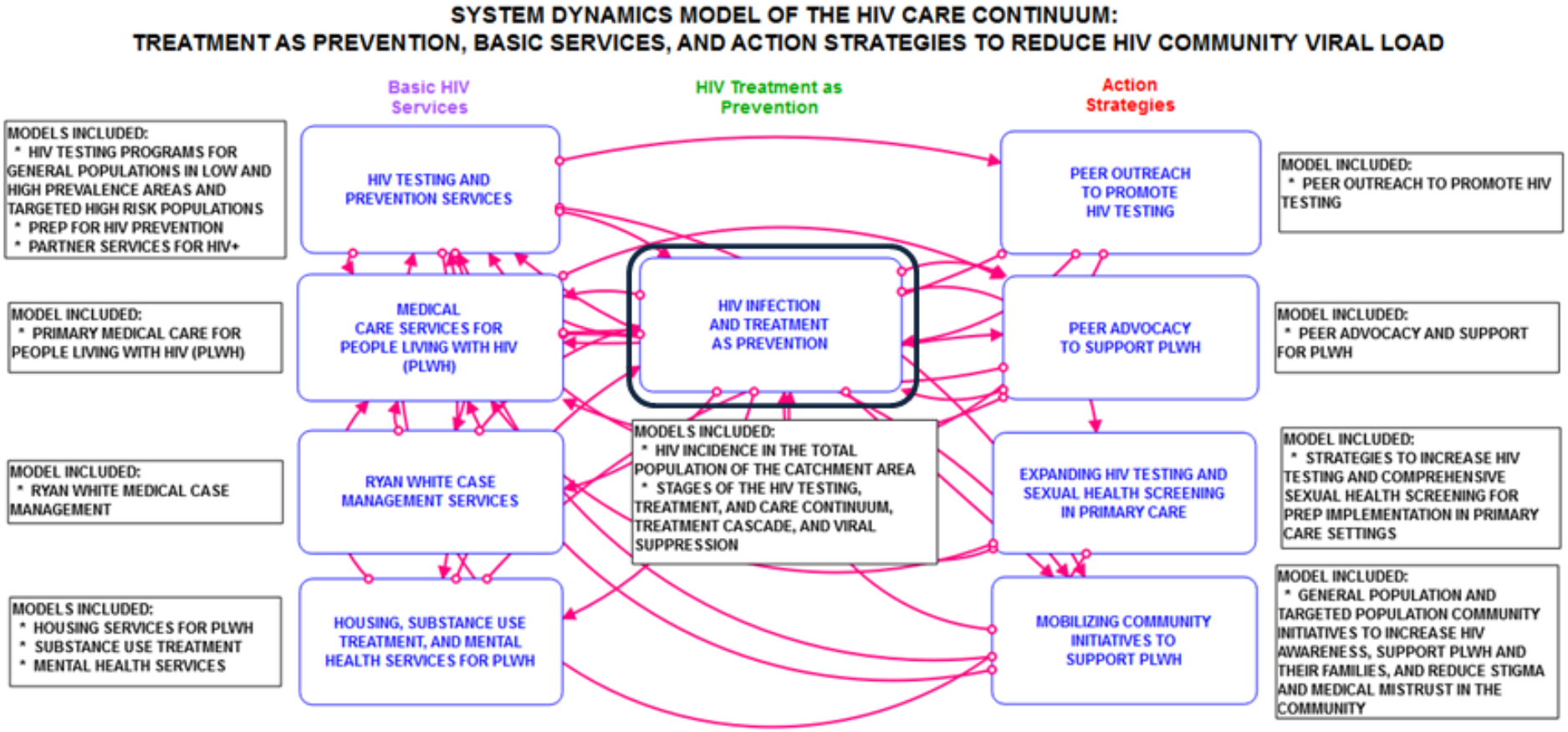
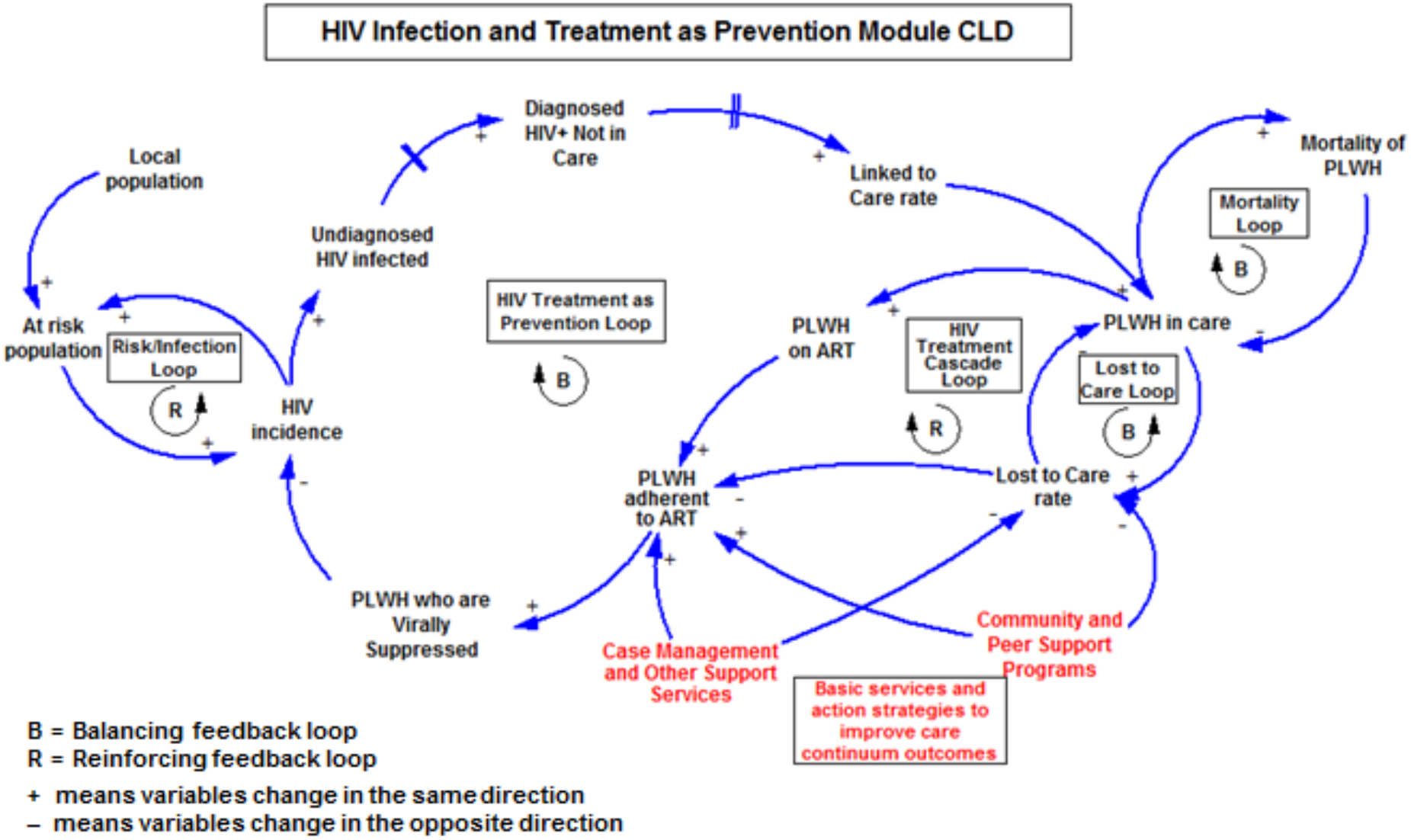
* This document was developed by the Institute for Community Research in Hartford, CT. For more information, contact Margaret R. Weeks, Ph.D., Executive Director and Senior Scientist, mweeks@icrweb.org.

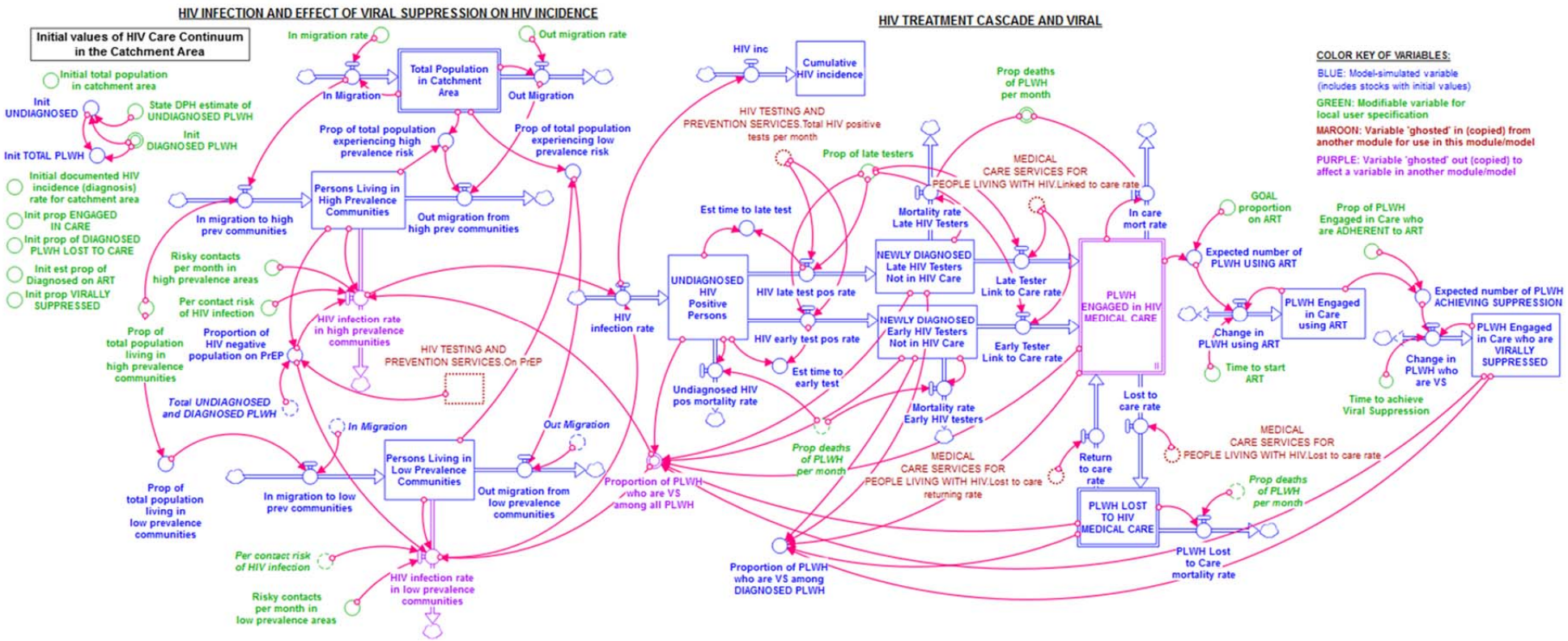
Chapter 1: HIV INFECTION AND TREATMENT AS PREVENTION MODULE



HIV Infection and Treatment as Prevention Module: Causal Loop Diagram (CLD)

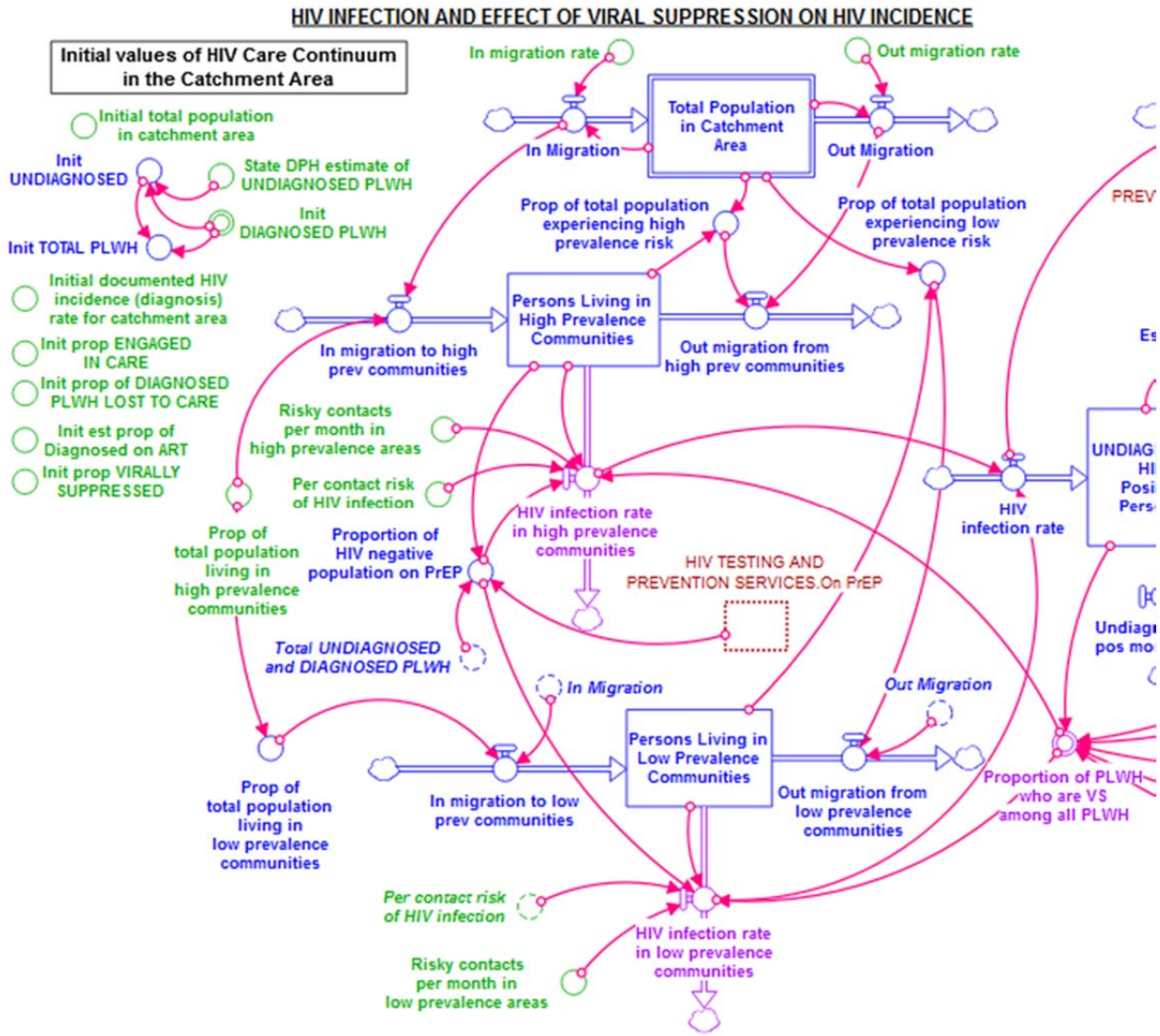


HIV Infection and Treatment as Prevention Module: Stock/Flow Model



(Details of each model on subsequent pages)

HIV Infection and Treatment as Prevention Module:
Stock/Flow Model:
HIV Infections Model Detail



COLOR KEY OF VARIABLES:

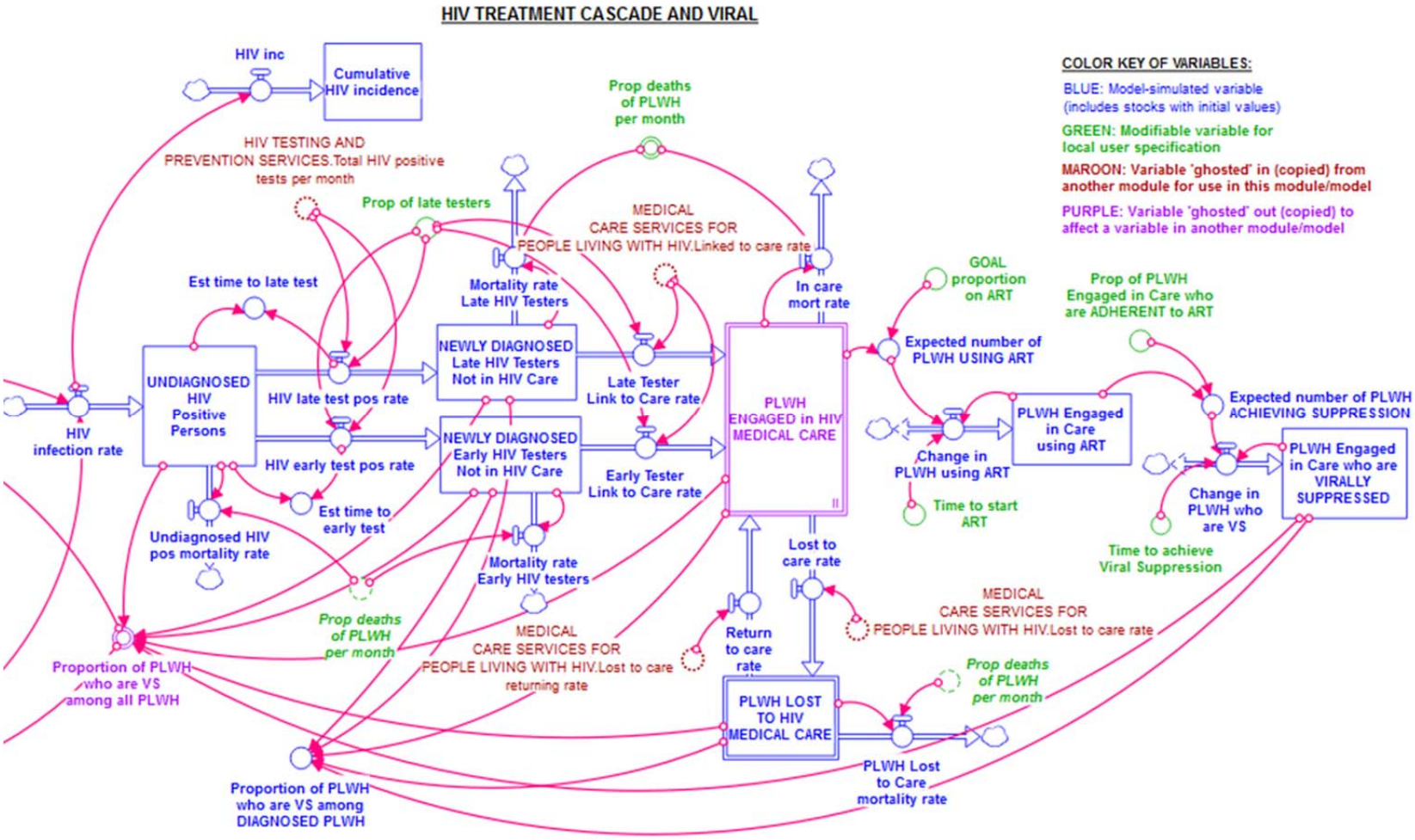
BLUE: Model-simulated variable (includes stocks with initial values)

GREEN: Modifiable variable for local user specification

MAROON: Variable 'ghosted' in (copied) from another module for use in this module/model

PURPLE: Variable 'ghosted' out (copied) to affect a variable in another module/model

HIV Infection and Treatment as Prevention Module:
Stock/Flow Model:
HIV Treatment Cascade Model Detail



HIV Infection and Treatment as Prevention Module: Key Modifiable Variables

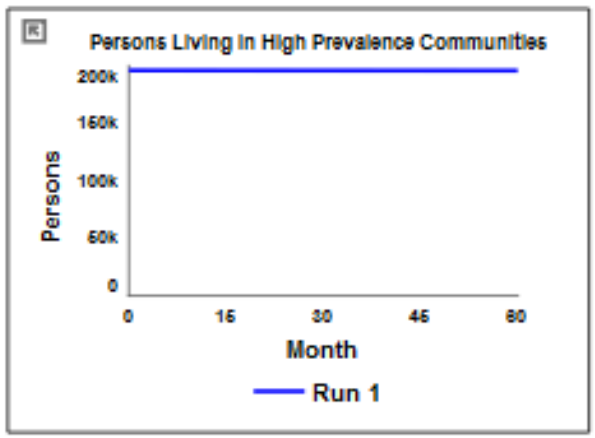
HIV INFECTION AND TREATMENT AS PREVENTION MODULE CALIBRATION WORKSHEET

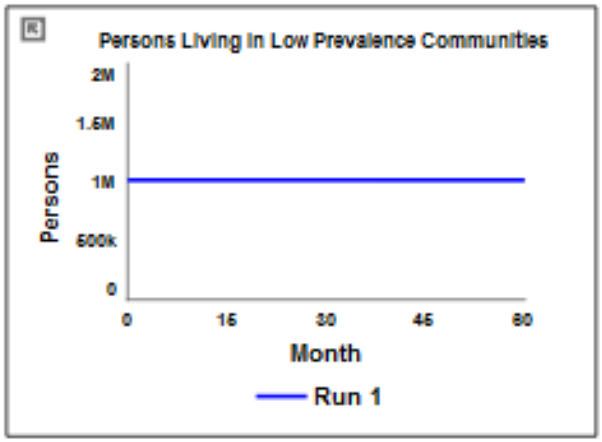
HIV AT-RISK AND PEOPLE LIVING WITH HIV (PLWH) POPULATIONS: SURVEILLANCE AND ESTIMATES	ESTIMATES USED IN THE BASE MODEL Catchment area: Hartford TGA			
YEAR USED FOR INITIAL ESTIMATES: 2017	Actual number used (units)		Equivalent to:	Code:
GENERAL POPULATION ESTIMATES IN THE CATCHMENT AREA				
Initial population in catchment area	1,210,256	(persons)	Census estimate	1
In migration rate	0.01	(1/month)		1
Out migration rate	0.01	(1/month)		1
Proportion of total population living in high prevalence communities	0.162	(proportion)	16.2% of the total area population	1
GENERAL HIV TRANSMISSION RISK ESTIMATES				
Per contact risk of HIV infection	0.0049	(persons/ contact	49 per 10,000 contacts	4
Risky contacts per month in high prevalence areas	0.0090	(contacts/ pers/mo)		4
Risky contacts per month in low prevalence areas	0.0030	(contacts/ pers/mo)		4
Time (it takes) to achieve VIRAL SUPPRESSION (after starting ART)	6	(months)	6 months	4
CURRENT HIV CASCADE NUMBERS FROM STATE SURVEILLANCE REPORTS				
State estimated proportion of UNDIAGNOSED PLWH	0.10	(proportion)	10% of Total PLWH	1
Initial documented HIV incidence (diagnosis) rate for catchment area	8.25	Persons/ month	8.25 people/mo. diagnosed	1
Initial number of DIAGNOSED PLWH	3,586	(persons)		1
Initial proportion of PLWH who are ENGAGED IN CARE	0.76	(proportion)	76% of diagnosed PLWH	1
Initial estimated proportion of Diagnosed PLWH on ART	0.76	(proportion)	76%--estimated	1
Initial proportion of DIAGNOSED PLWH who are LOST TO CARE	0.24	(proportion)	24% of diagnosed PLWH	1
Initial proportion of PLWH who are VIRALLY SUPPRESSED	0.65	(proportion)	765% of diagnosed PLWH	1
HIV TEST AND TREAT CARE CONTINUUM AND VIRAL SUPPRESSION ESTIMATES				
Estimated proportion of late HIV testers	0.27		27% of all people who test HIV+	1
Proportion HIV deaths	0.002	Persons/ persons/ month	about 3% of PLWH are dying annually	1
GOAL: Proportion on ART	1.0		100% of all PLWH	3
(Average) time (it takes) to start ART (after being linked to care)	0.25	(months)	1 week	2
Estimated proportion of Engaged in Care PLWH who are ADHERENT to ART	0.95		95% of PLWH Engaged In Care	1

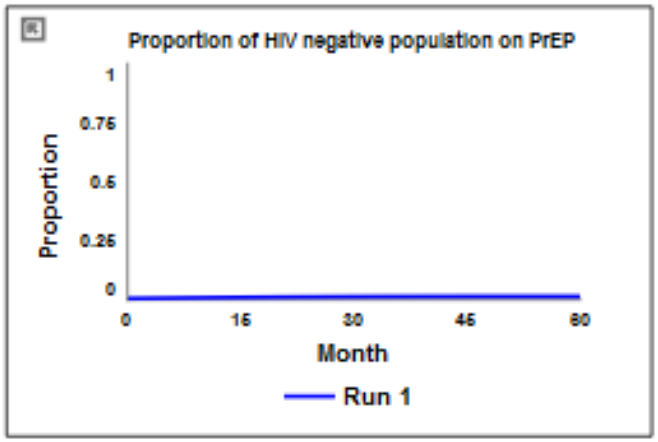
Codes:

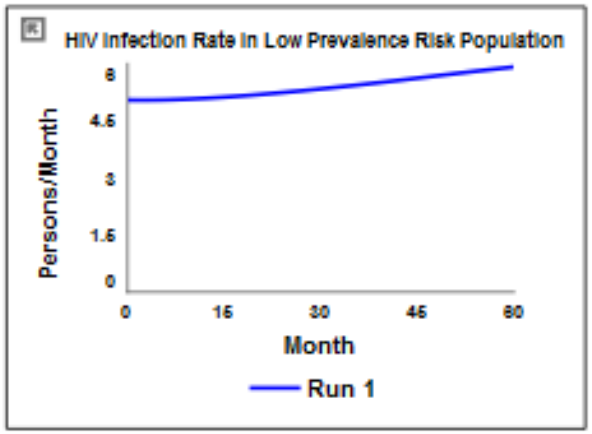
1. **Conditions of the Population and the Epidemic**
2. **Service Delivery Conditions and Protocols**
3. **Intervention Strategies to Improve the System**
4. **Mathematical Calibrations**

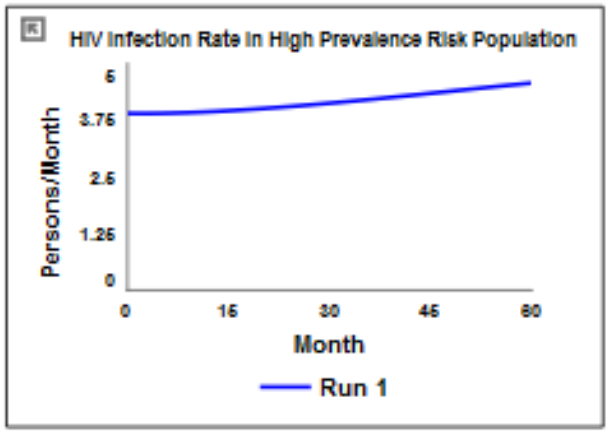
HIV Infection and Treatment as Prevention Module:
Base Case Run Output Graphs*
Part 1: HIV Infection and Effect of Viral Suppression (VS) on HIV Incidence

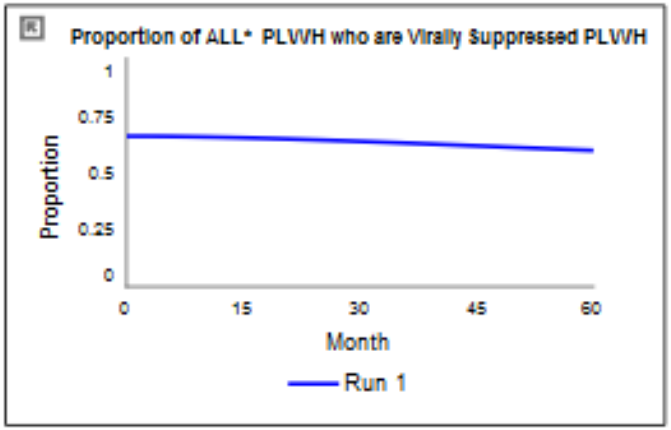






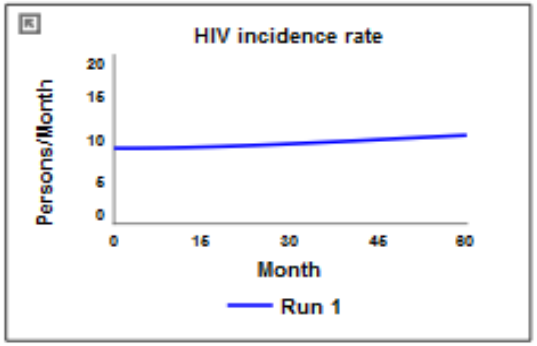


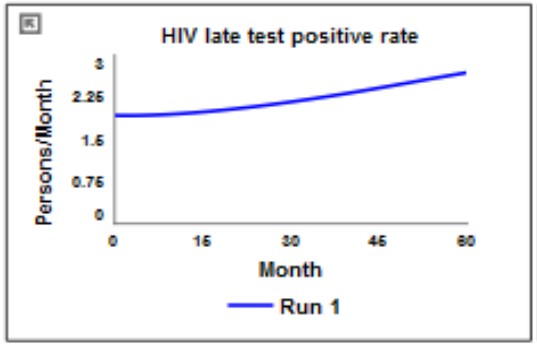


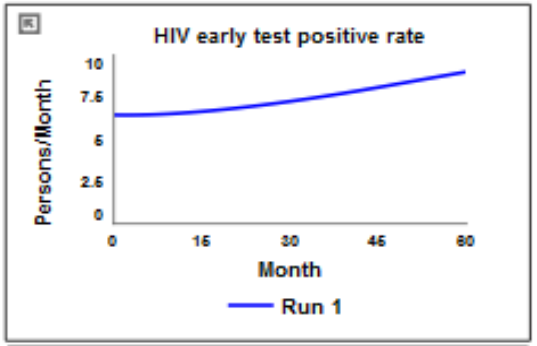


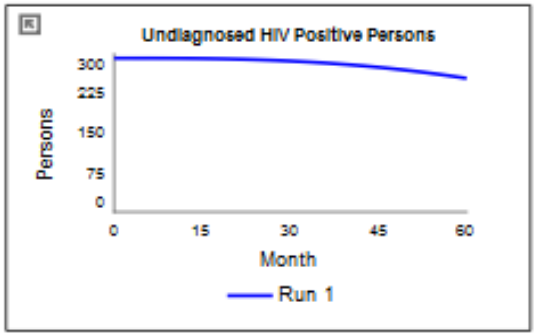
* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

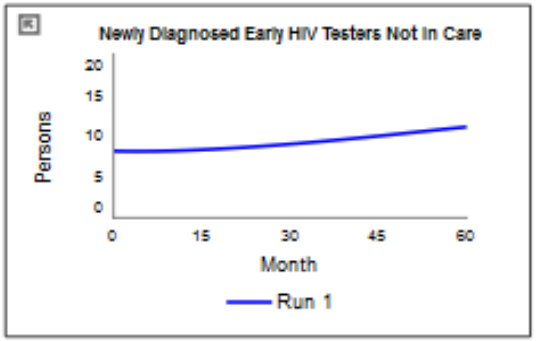
HIV Infection and Treatment as Prevention Module:
Base Case Run Output Graphs*
Part 2: HIV Treatment Cascade and Viral Suppression (VS) (Part A)

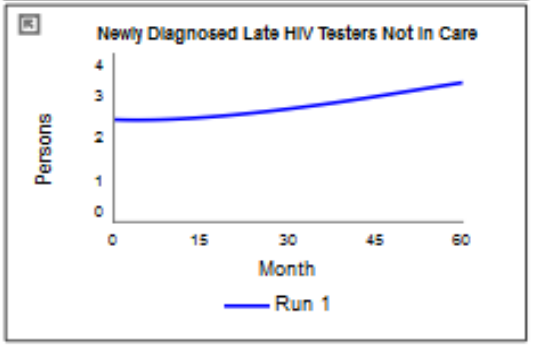


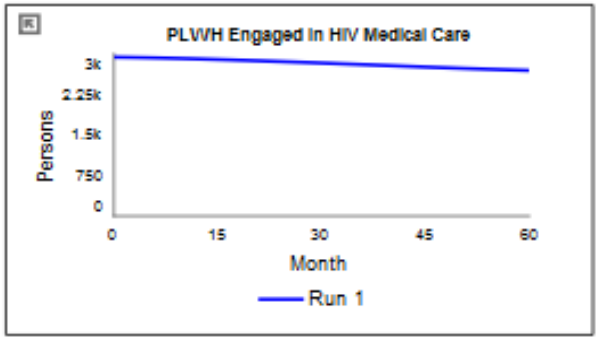


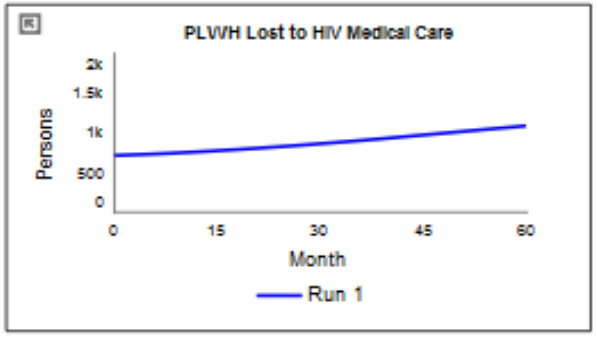






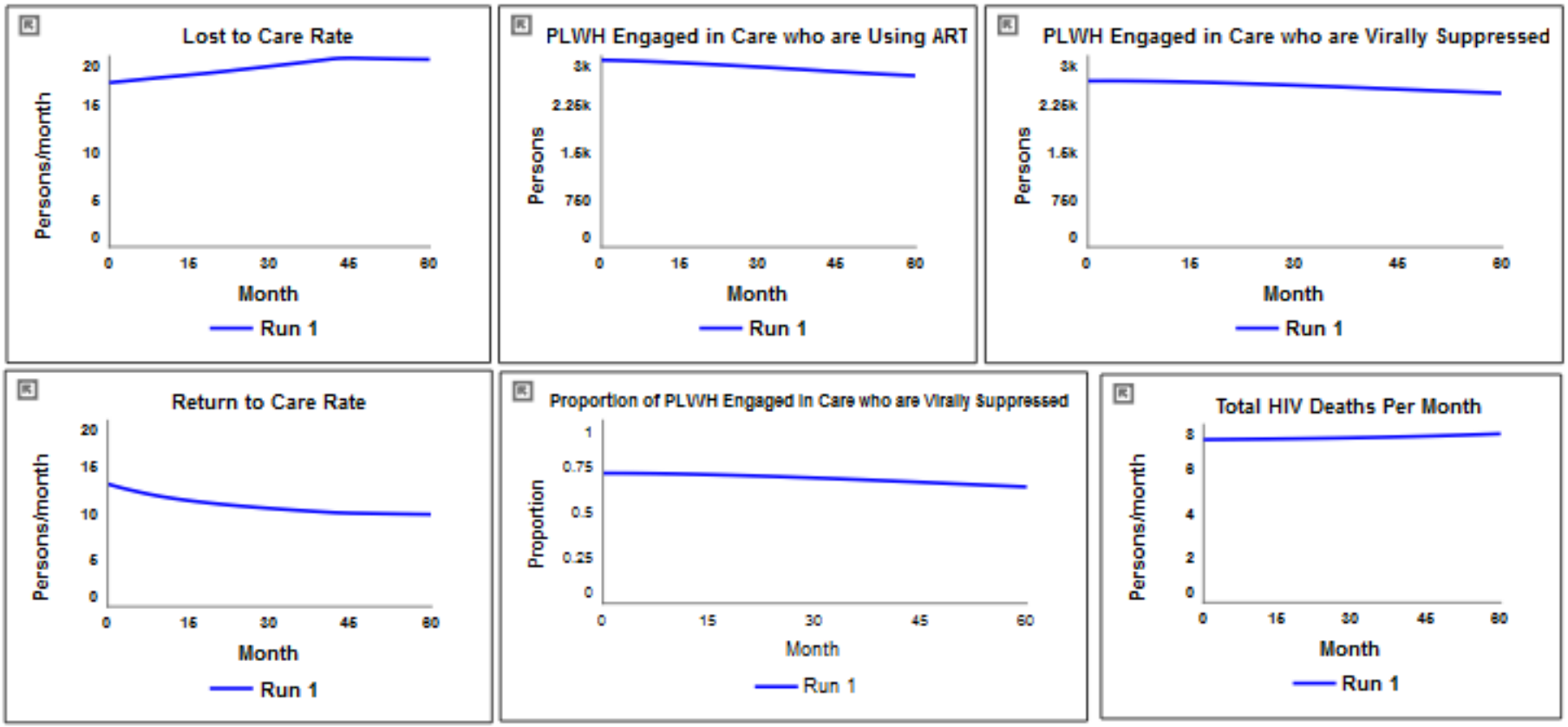






* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

HIV Infection and Treatment Cascade Module:
Base Case Run Output Graphs*
Part 2: HIV Treatment Cascade and Viral Suppression (VS) (Part B)



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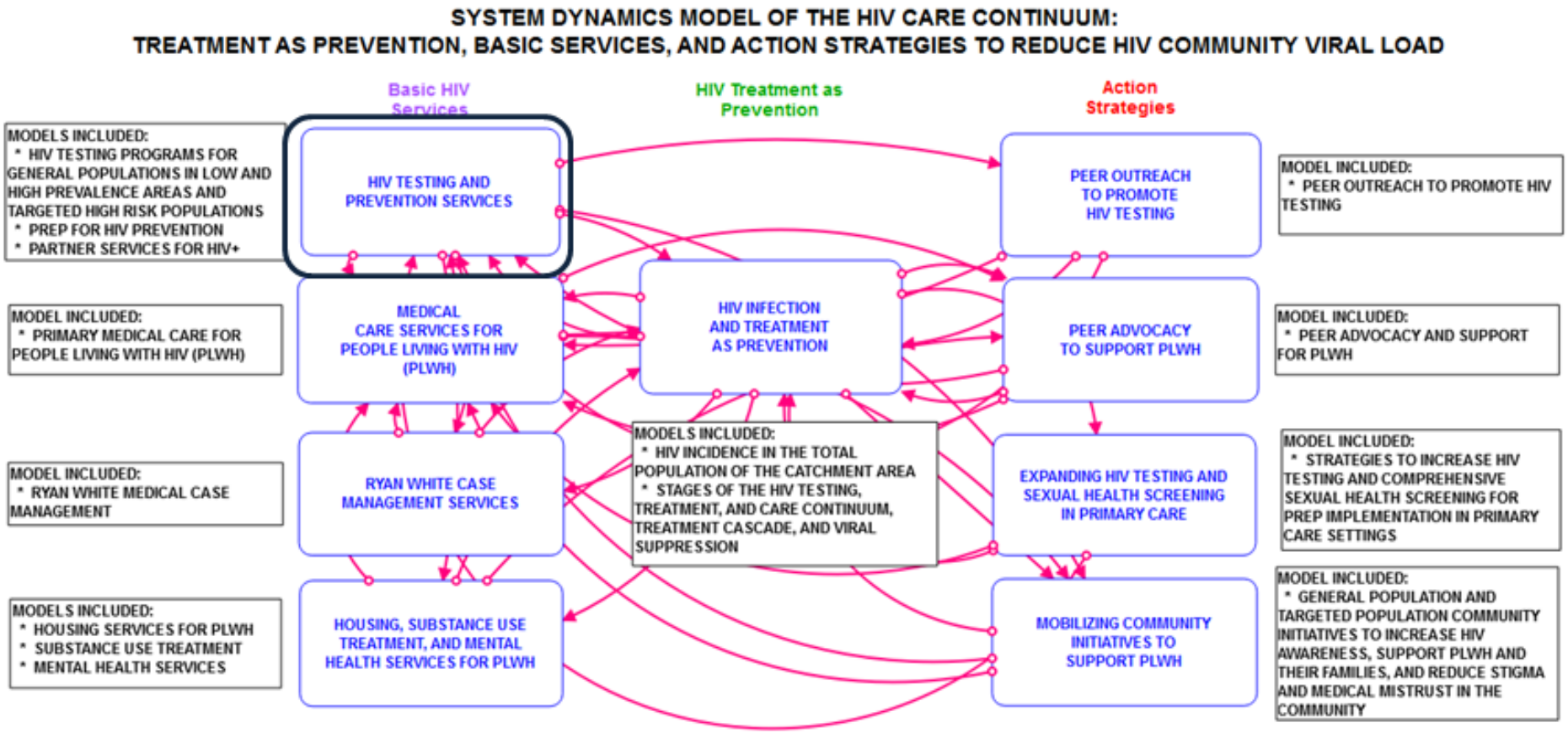
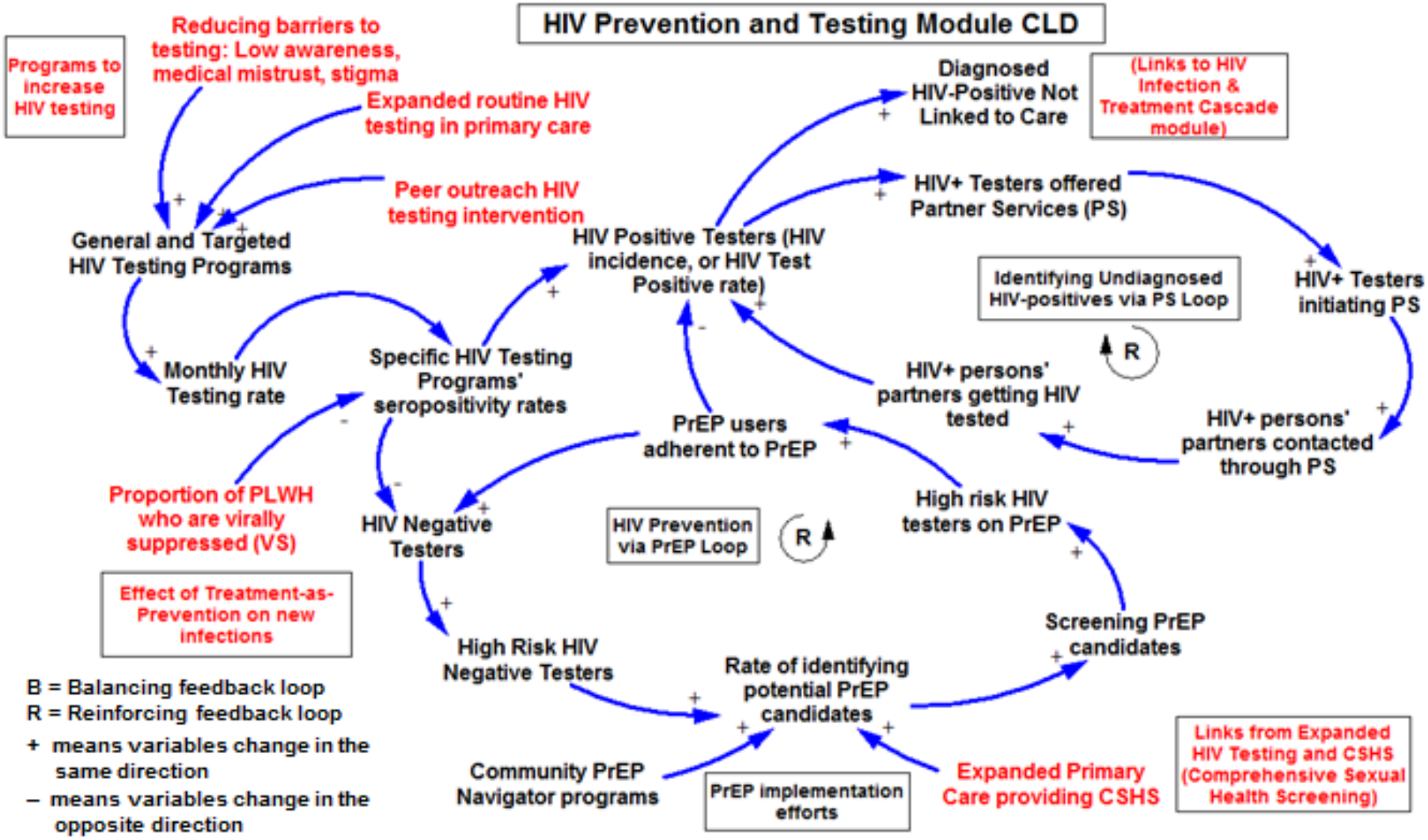
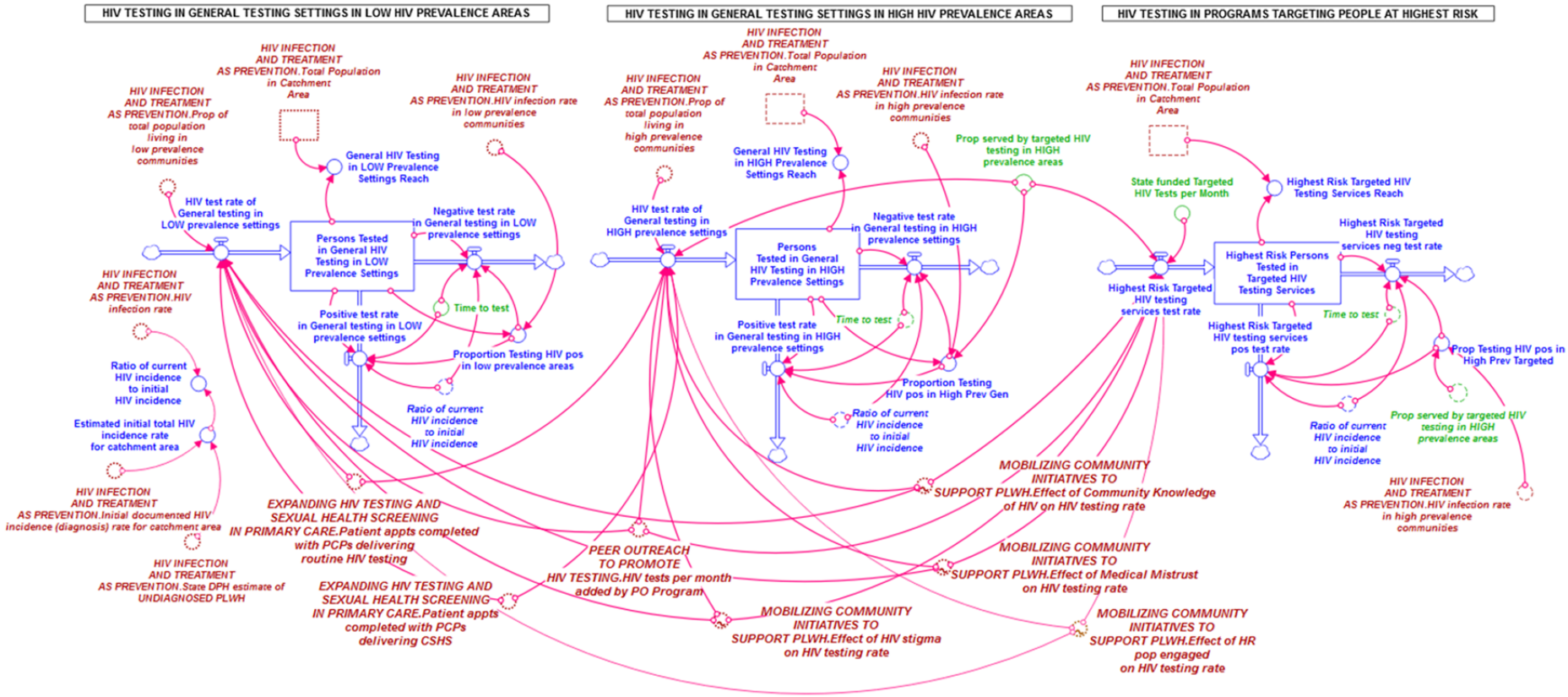
Chapter 2: HIV PREVENTION AND TESTING SERVICES MODULE



HIV Prevention and Testing Services Module: Causal Loop Diagram (CLD)



HIV Prevention and Testing Services Module: Stock/Flow Model
Part 1: HIV Testing Services



(Details of each model of HIV testing settings start on next page)

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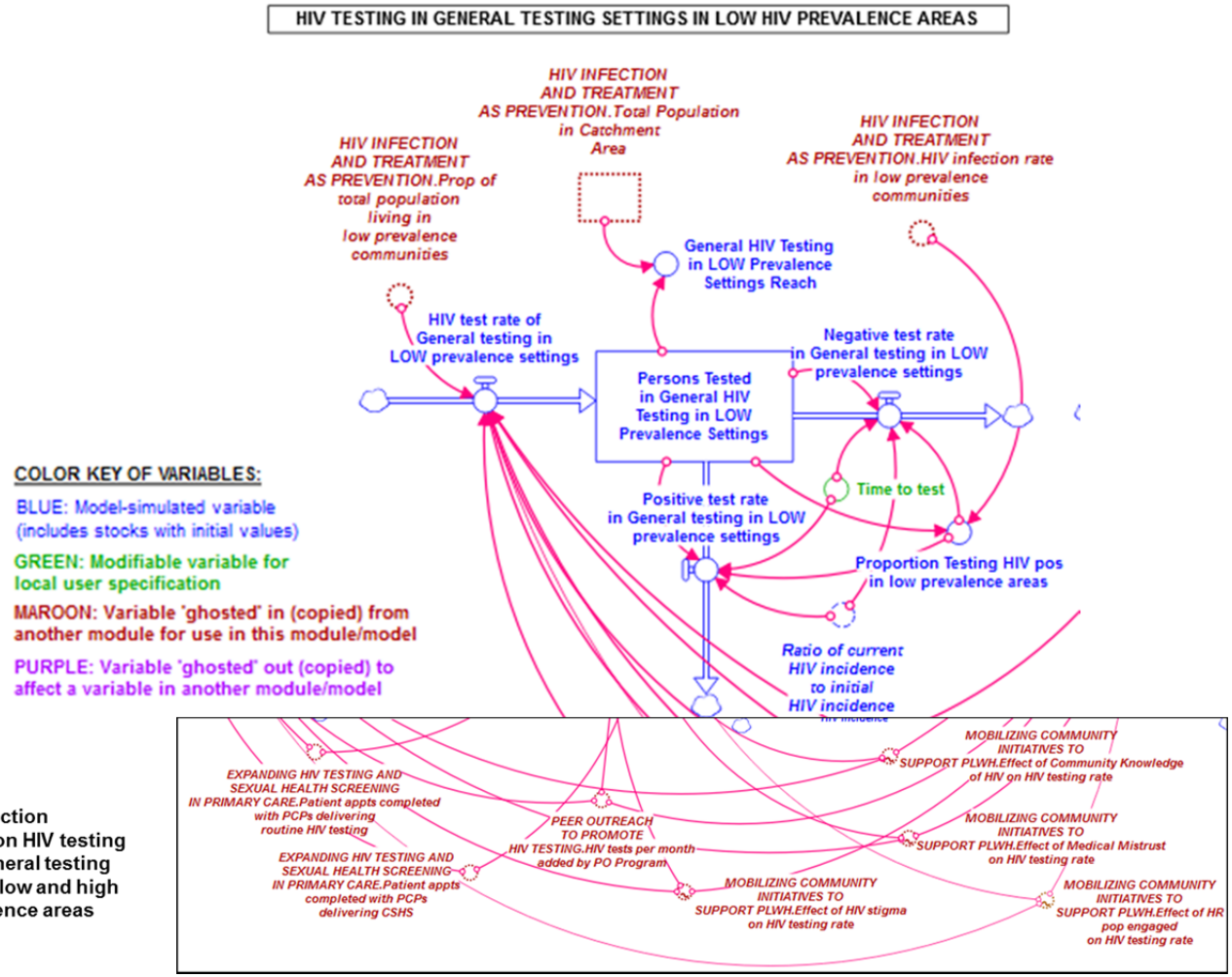
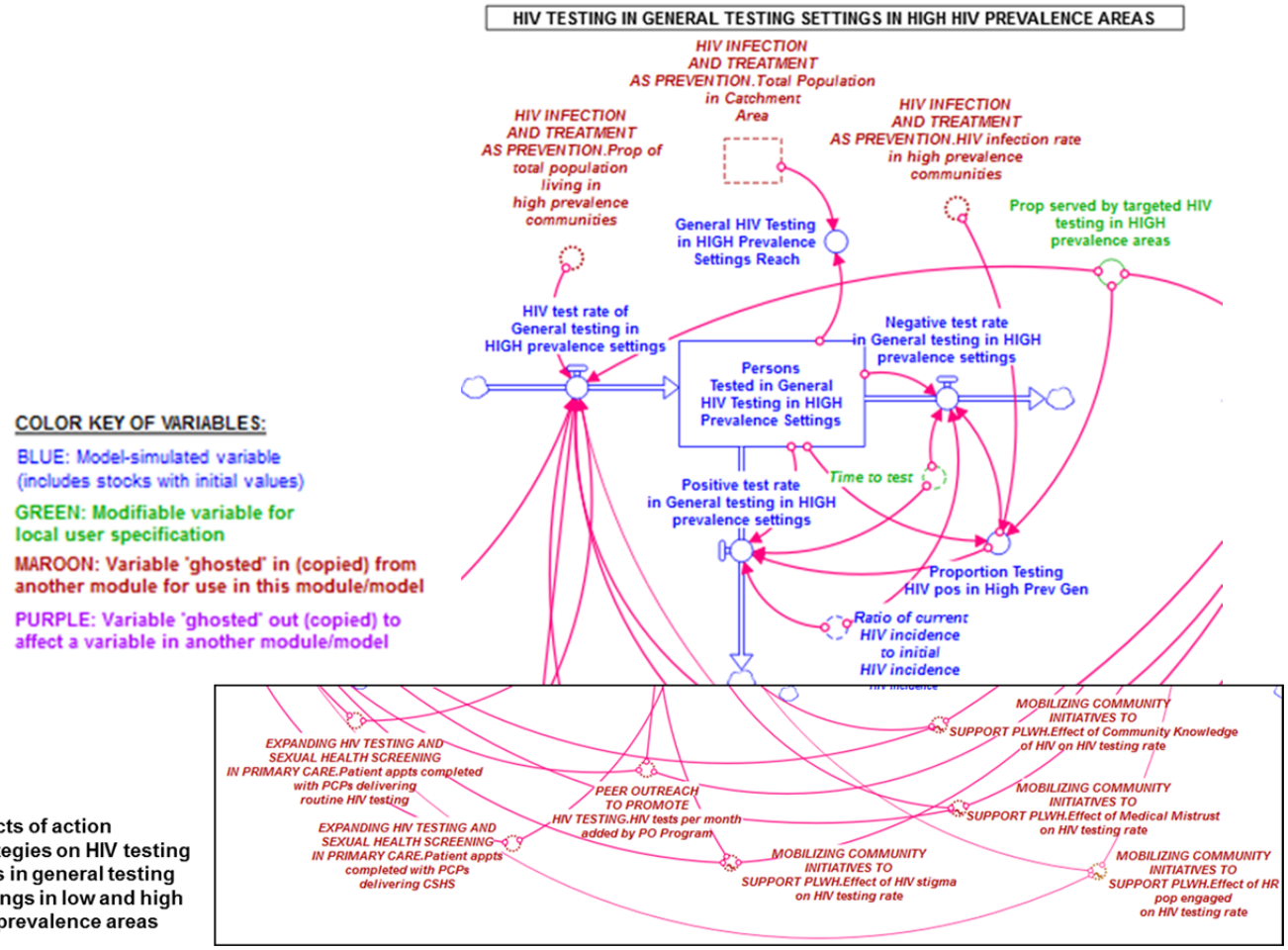
HIV Prevention and Testing Services Module:
Stock/Flow Model HIV Testing Services:
Part A: HIV Testing in General Testing Sites* in LOW HIV Prevalence Communities



Effects of action strategies on HIV testing rates in general testing settings in low and high HIV prevalence areas

*** Includes testing in hospitals, community and private clinics and other health centers in low prevalence communities.**

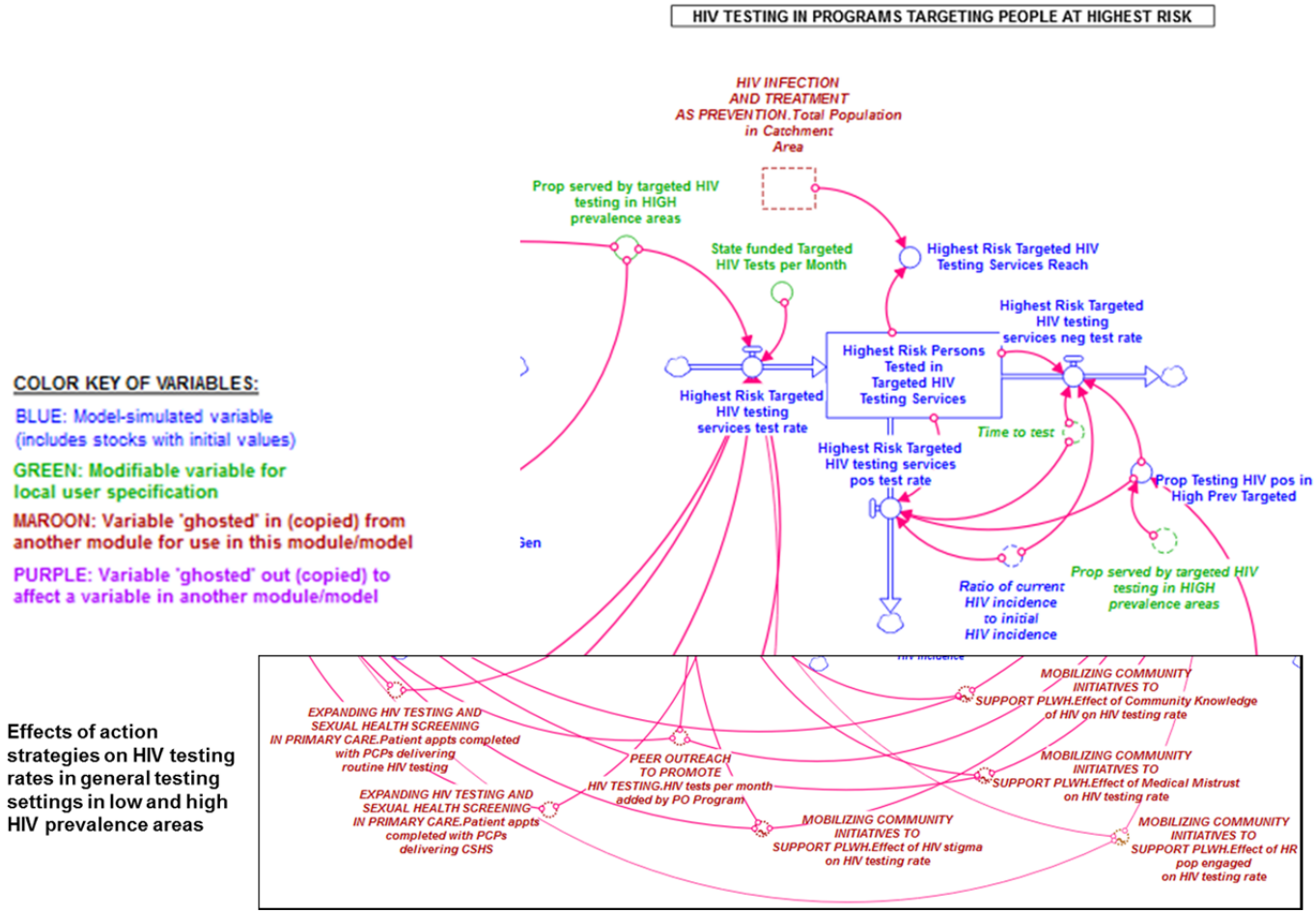
HIV Prevention and Testing Services Module:
Stock/Flow Model HIV Testing Services:
Part B: HIV Testing in General Testing Sites* in HIGH HIV Prevalence Communities



Effects of action strategies on HIV testing rates in general testing settings in low and high HIV prevalence areas

* **Includes HIV testing in hospitals, community and private clinics and other health centers in high prevalence communities. Also includes HIV testing programs to expand HIV testing on the general population, such as Expanded Testing Intervention (ETI).**

HIV Prevention and Testing Services Module:
Stock/Flow Model HIV Testing Services:
Part C: HIV Testing in Targeted Testing Sites in HIGH HIV Prevalence Communities



* **Includes HIV testing focused on reaching special populations at highest risk in high prevalence communities. This includes Early Intervention Services (ETS), Outreach, Treatment and Linkage to Care (OTL) programs, Syringe Services Programs, Partner Services, and other specially focused HIV testing programs.**

HIV Prevention and Testing Services Module:
Key Modifiable Variables:
HIV Testing Services

HIV PREVENTION AND TESTING SERVICES MODULE CALIBRATION WORKSHEET

Note: HIV seropositivity rate for each testing setting is determined by HIV Transmission Risk Estimates & Contacts per month in high and low prevalence areas in the HIV T&T & VS Module

	ESTIMATES USED IN THE BASE MODEL			
CATCHMENT AREA	Hartford TGA			
HIV TESTING SERVICES MODULE CALIBRATION WORKSHEET	Actual number used (units)		Equivalent to:	
HIV TESTING ESTIMATES				Codes:
Time to test (for HIV after exposure)	1.1	Month	about 1 month	1
Proportion (of the total population) served by targeted HIV testing in HIGH prevalence areas	0.20		20% of people living in high prevalence areas	2
State funded Targeted HIV Test per Month	400	Persons/ Month	400 tested/month through special programs	2
Time to be scheduled for initial clinic visit	0.25	Month	1 week	2

Codes:		
	1	Conditions of the Population and the Epidemic
	2	Service Delivery Conditions and Protocols
	3	Intervention Strategies to Improve the System
	4	Mathematical Calibrations

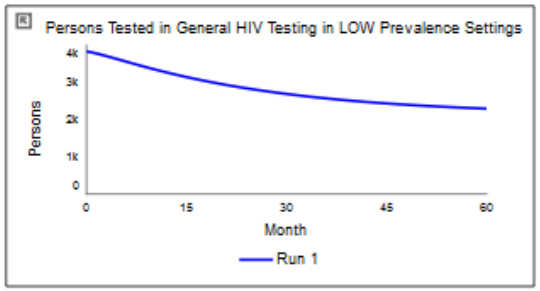
Sample Targeted HIV Testing Programs for Model Calibrations

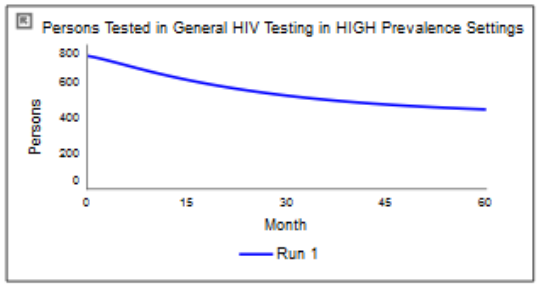
HIV PREVENTION AND TESTING SERVICES MODULE CALIBRATION WORKSHEET

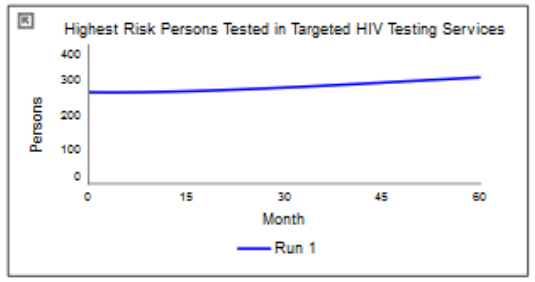
Note: HIV seropositivity rate for each testing setting is determined by HIV Transmission Risk Estimates & Contacts per month in high and low prevalence areas in the HIV T&T & VS Module

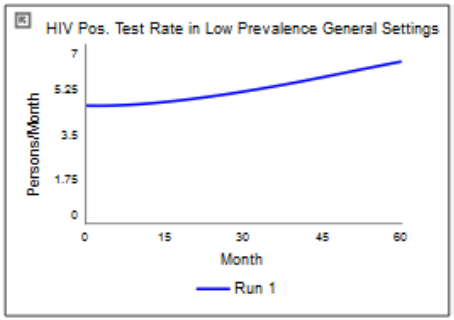
	ESTIMATES USED IN THE BASE MODEL							
CATCHMENT AREA	Hartford County and Hartford TGA							
CALCULATIONS TO ESTIMATE NUMBER OF HIV TESTS CONDUCTED ANNUALLY AND SERO-POSITIVITY RATE OF HIV TESTS CONDUCTED PER PROGRAM:	(2 years provided for comparative purposes; 2015 numbers used)							
	Total Annual Tests		Positives		Sero pos rate		Reach (% of total HIV tests given)	
HIV TESTING PROGRAMS	YR 2015	YR 2016	YR 2015	YR 2016	YR 2015	YR 2016	YR 2015	YR 2016
OTL: Outreach, Treatment and Linkage to Care	4,247	4,570	7	5	0.0016	0.001094	10.1%	5.4%
ETI: Expanded Testing Intervention	12,337	12,675	10	18	0.0008	0.00142	29.4%	15.0%
EIS: Early Intervention Specialist	336	219	2	1	0.0060	0.004566	0.8%	0.3%
SSP: Syringe Services Program	0	0	0	0	#DIV/0!	#DIV/0!	0.0%	0.0%
OTHER: Testing in primary care and other settings not including programs listed above	25000	67000	80	75	0.0032	0.00112	59.6%	79.3%
							0.0%	0.0%
TOTAL ANNUAL TESTS FOR CATCHMENT AREA	**41920**	**84464**	**99**	**99**	**0.0024**	**0.001172**	100.0%	100.0%

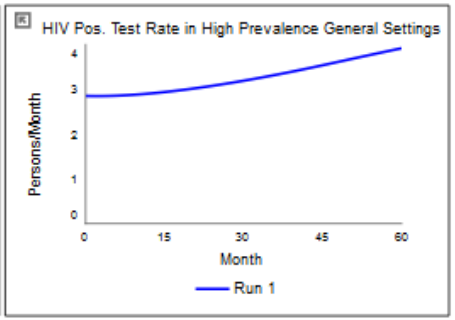
HIV Testing and Prevention Services Module:
Base Case Run Output Graphs*
HIV Testing Services

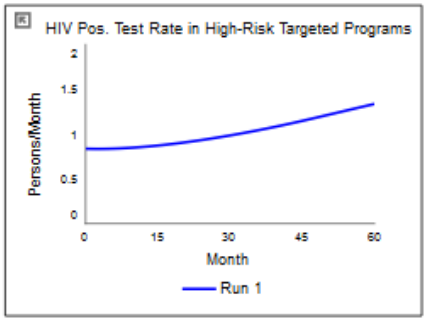


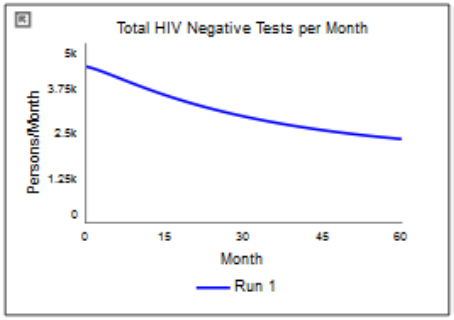


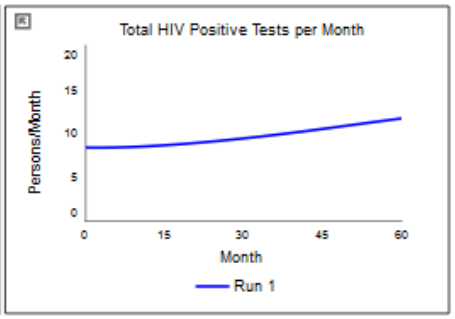


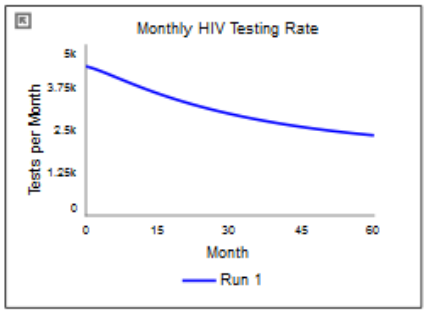






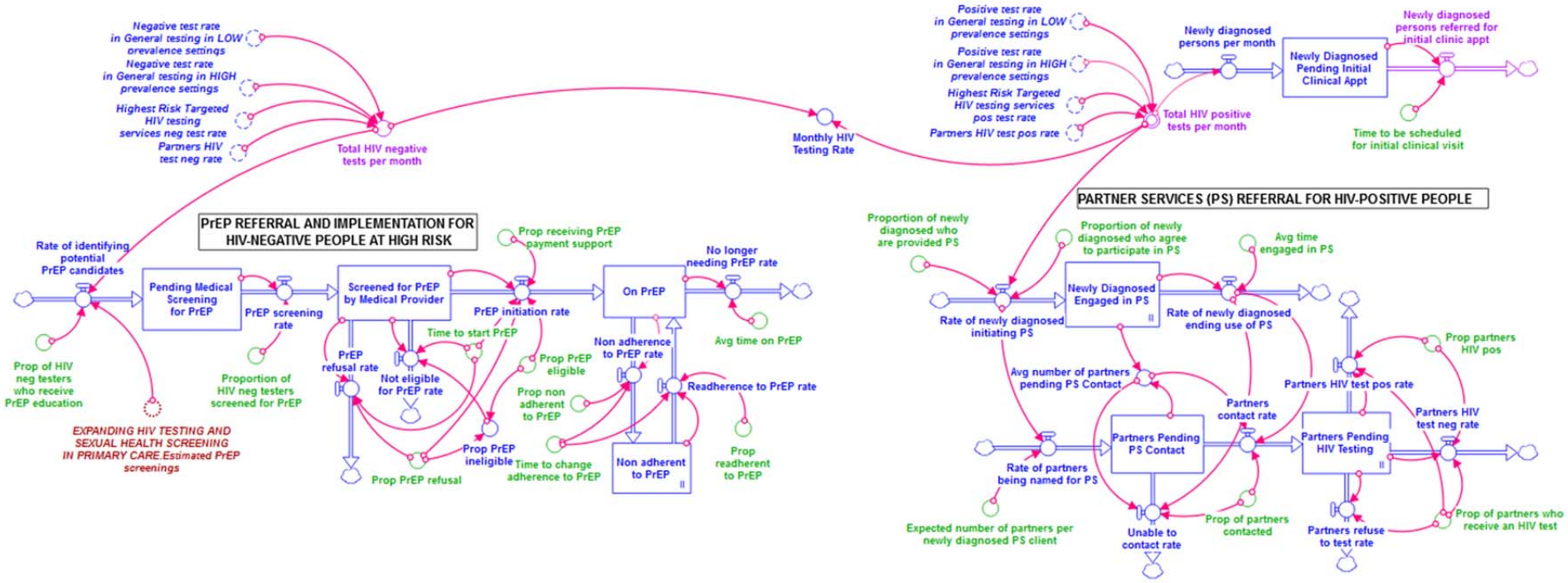






*** Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

HIV Prevention and Testing Services Module:
PrEP Implementation and Partner Services Stock/Flow Model



COLOR KEY OF VARIABLES:

BLUE: Model-simulated variable (includes stocks with initial values)

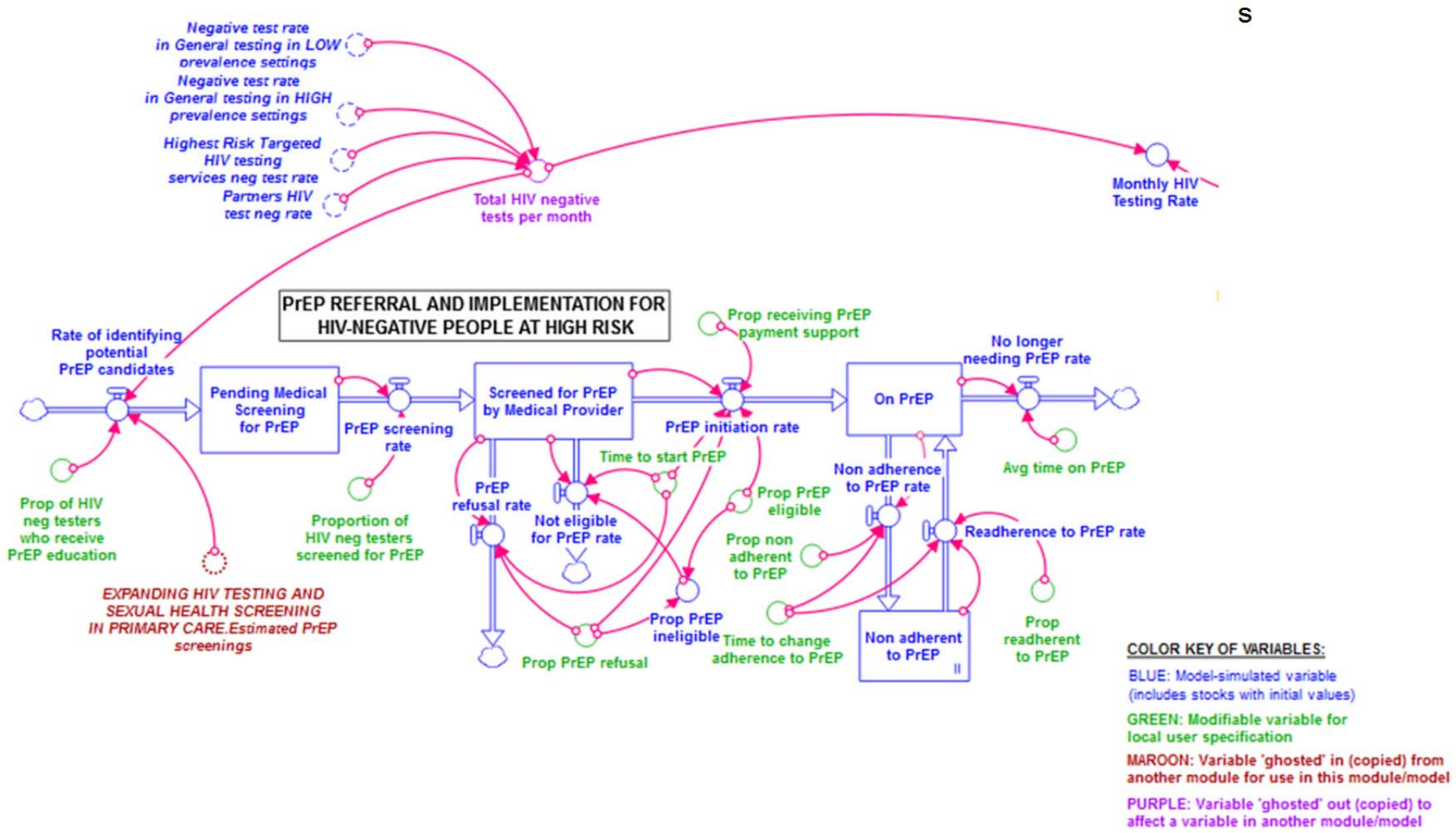
GREEN: Modifiable variable for local user specification

MAROON: Variable 'ghosted' in (copied) from another module for use in this module/model

PURPLE: Variable 'ghosted' out (copied) to affect a variable in another module/model

(Details of each model are on the pages below)

HIV Prevention and Testing Services Module
PrEP Implementation Stock/Flow Model Detail



HIV Prevention and Testing Services Module: PrEP Implementation Key Modifiable Variables

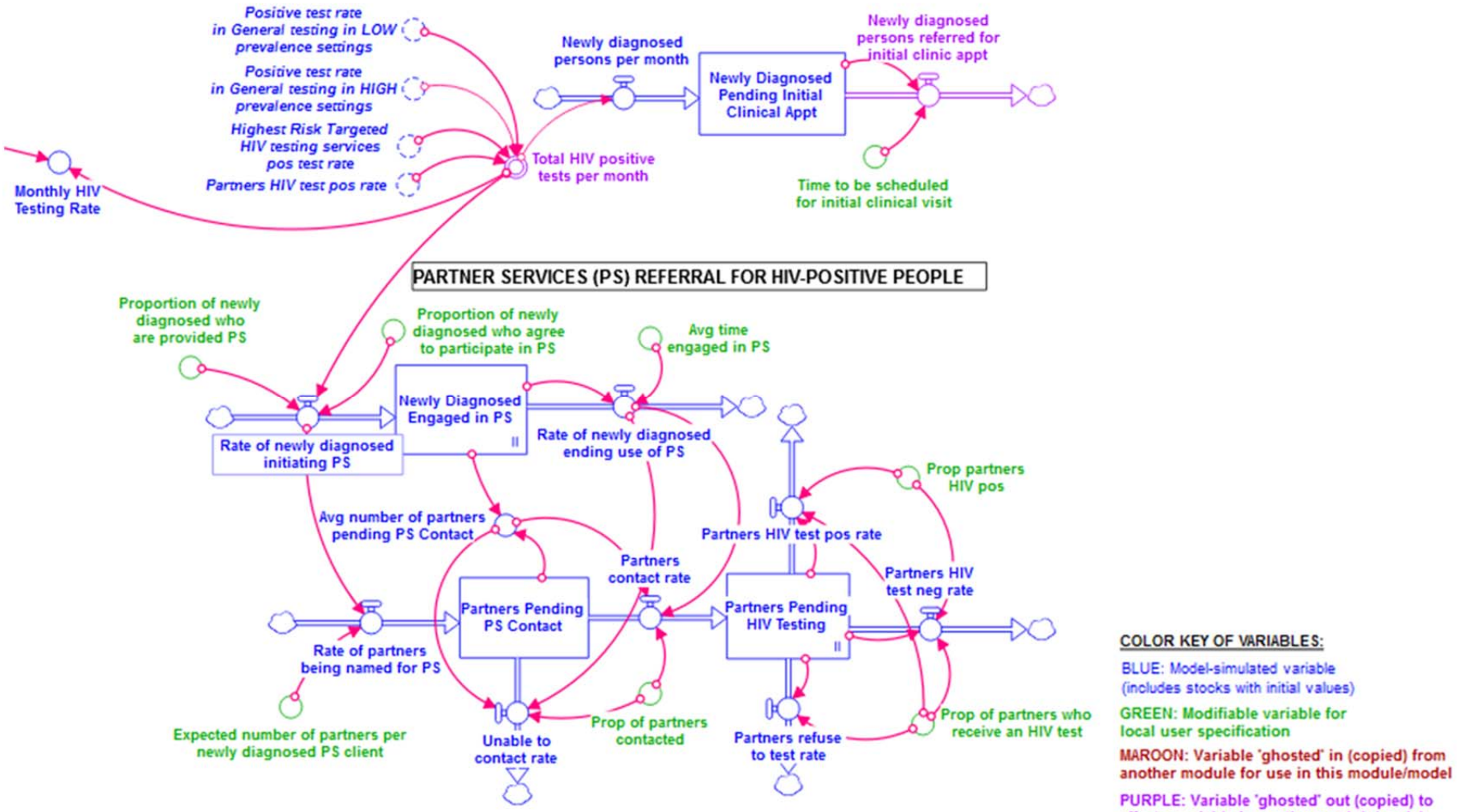
HIV PREVENTION AND TESTING SERVICES MODULE CALIBRATION WORKSHEET

Note: HIV seropositivity rate for each testing setting is determined by HIV Transmission Risk Estimates & Contacts per month in high and low prevalence areas in the HIV T&T & VS Module

			ESTIMATES USED IN THE BASE MODEL	
CATCHMENT AREA		Hartford TGA		
HIV PREVENTION SERVICES MODULE CALIBRATION WORKSHEET: PREP	Actual number used (units)		Equivalent to:	
PRE-EXPOSURE PROPHYLAXIS (PrEP)	ESTIMATES USED IN THE BASE MODEL			
Proportion of HIV negative testers who receive PrEP education	0.15		15% of HIV negative testers	2
Proportion of HIV negative testers who are screened for PrEP	0.1		10% of HIV-neg testers	2
Proportion PrEP refusal	0.60		60% of those screened for PrEP	1
Proportion PrEP eligible	0.70		70% of those screened for PrEP	1
Proportion receiving PrEP payment support	0.90		90% of screened PrEP eligible	3
Time (it takes) to start PrEP (after being determined eligible)	0.25	(months)	1 week	2
Proportion non-adherent to PrEP	0.20		20%	1
Time (it takes) to change adherence to PrEP (after starting it)	1	(month)	1 month	1
Proportion re-adherent to PrEP (after stopping it for a while)	0.50		50%	1
Average time on PrEP	24	(months)	2 years	1

Codes:		
	1	Conditions of the Population and the Epidemic
	2	Service Delivery Conditions and Protocols
	3	Intervention Strategies to Improve the System
	4	Mathematical Calibrations

HIV Prevention and Testing Services Module
Partner Services Stock/Flow Model Detail



HIV Prevention and Testing Services Module: Partner Services
Key Modifiable Variables

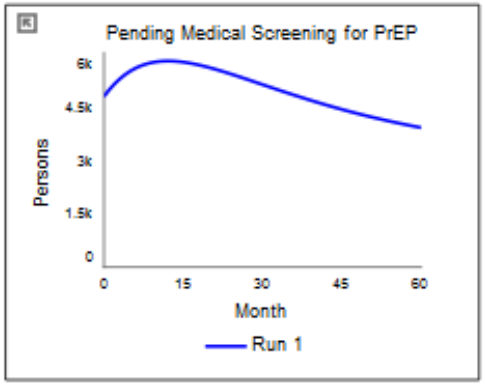
HIV PREVENTION AND TESTING SERVICES MODULE CALIBRATION WORKSHEET

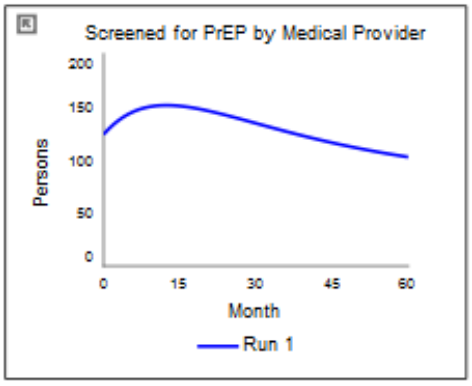
Note: HIV seropositivity rate for each testing setting is determined by HIV Transmission Risk Estimates & Contacts per month in high and low prevalence areas in the HIV T&T & VS Module

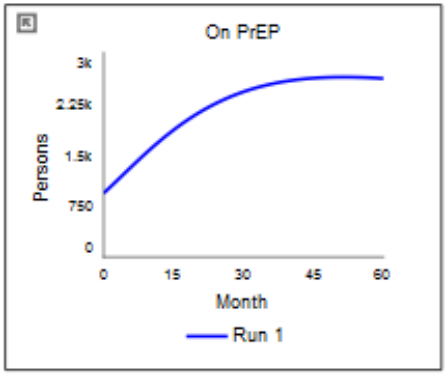
			ESTIMATES USED IN THE BASE MODEL	
CATCHMENT AREA	Hartford TGA			
HIV PREVENTION SERVICES MODULE CALIBRATION: PARTNER SERVICES	Actual number used (units)		Equivalent to:	
PARTNER SERVICES (PS)	ESTIMATES USED IN THE BASE MODEL			
Proportion of newly diagnosed PLWH who are provided Partner Services (PS)	0.50		30% of newly diagnosed PLWH	2
Proportion of newly diagnosed who agree to participate in PS	0.95		50% of newly diagnosed PLWH	1
Average time engaged in PS	3	(months)	3 months	2
Expected number of partners (named) per newly diagnosed PS client	0.4	(persons)	4 partners	1
Proportion of partners contacted	0.90		20%	2
Proportion of partners who receive an HIV test	0.50		50%	2
Proportion of partners who are HIV-positive	0.07		15% of partners who test	1

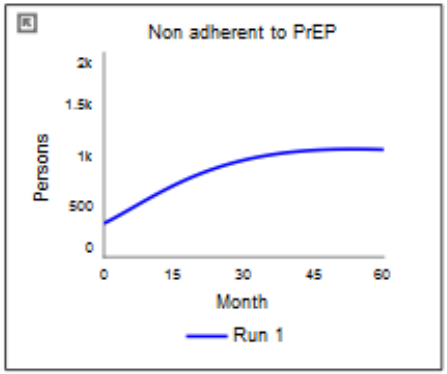
Codes:	**1**	**Conditions of the Population and the Epidemic**
	2	**Service Delivery Conditions and Protocols**
	3	**Intervention Strategies to Improve the System**
	4	**Mathematical Calibrations**

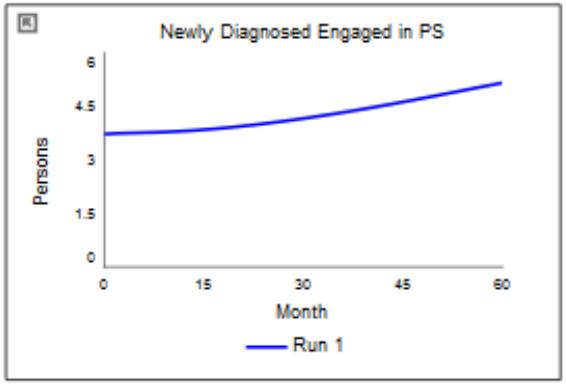
HIV Testing and Prevention Services Module:
PrEP Implementation and Partner Services
Base Case Run Output Graphs*

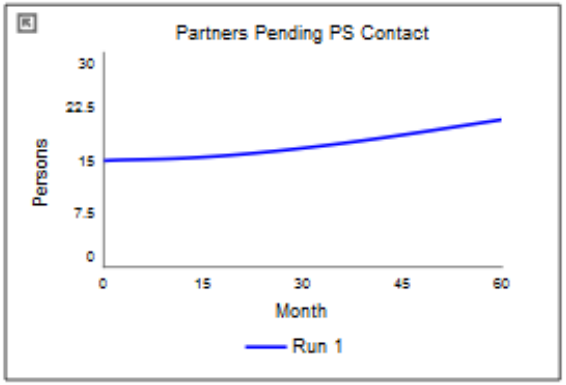


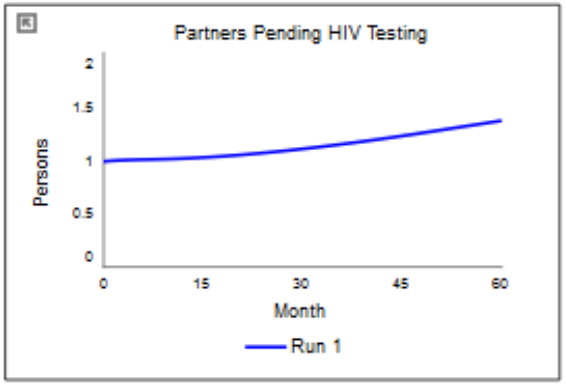






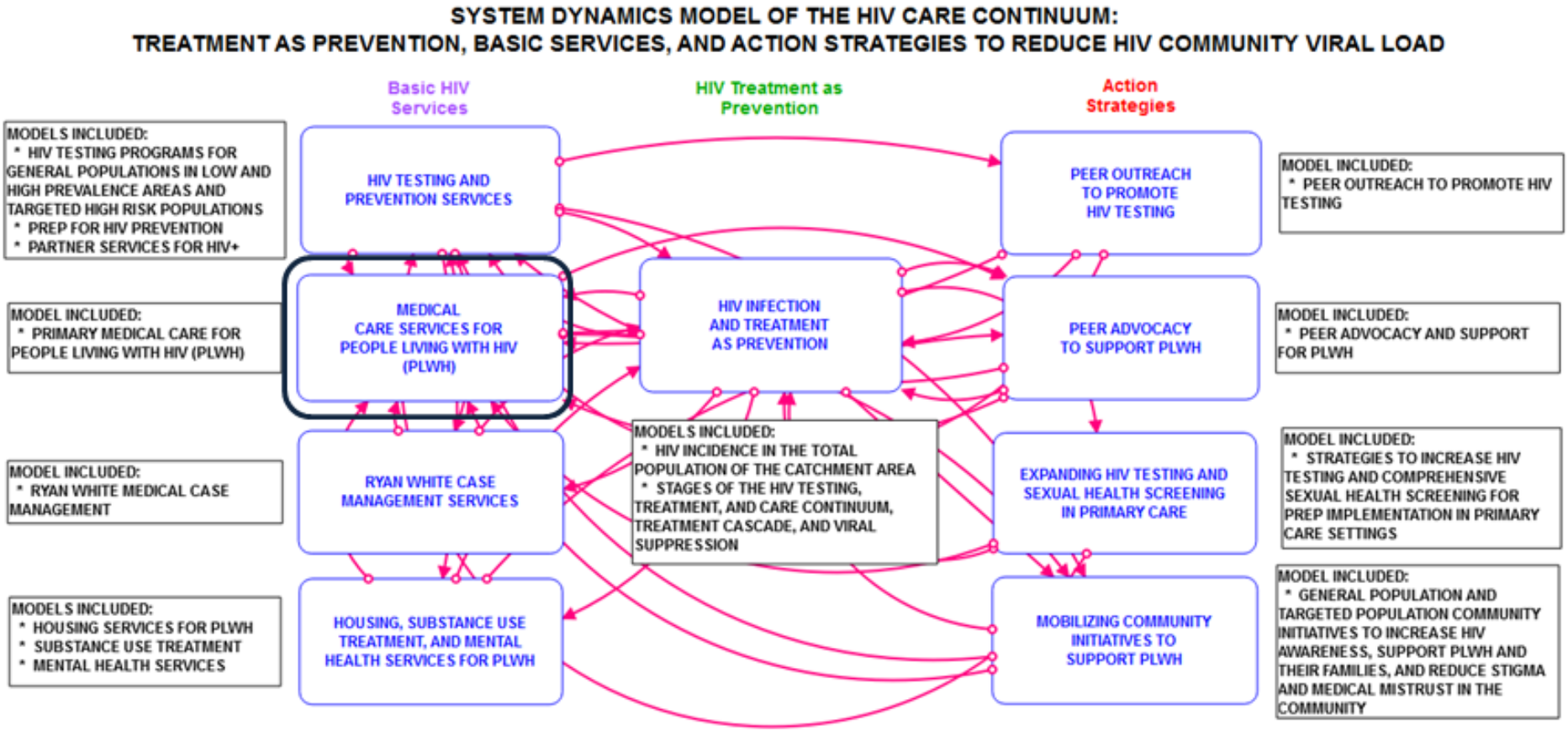




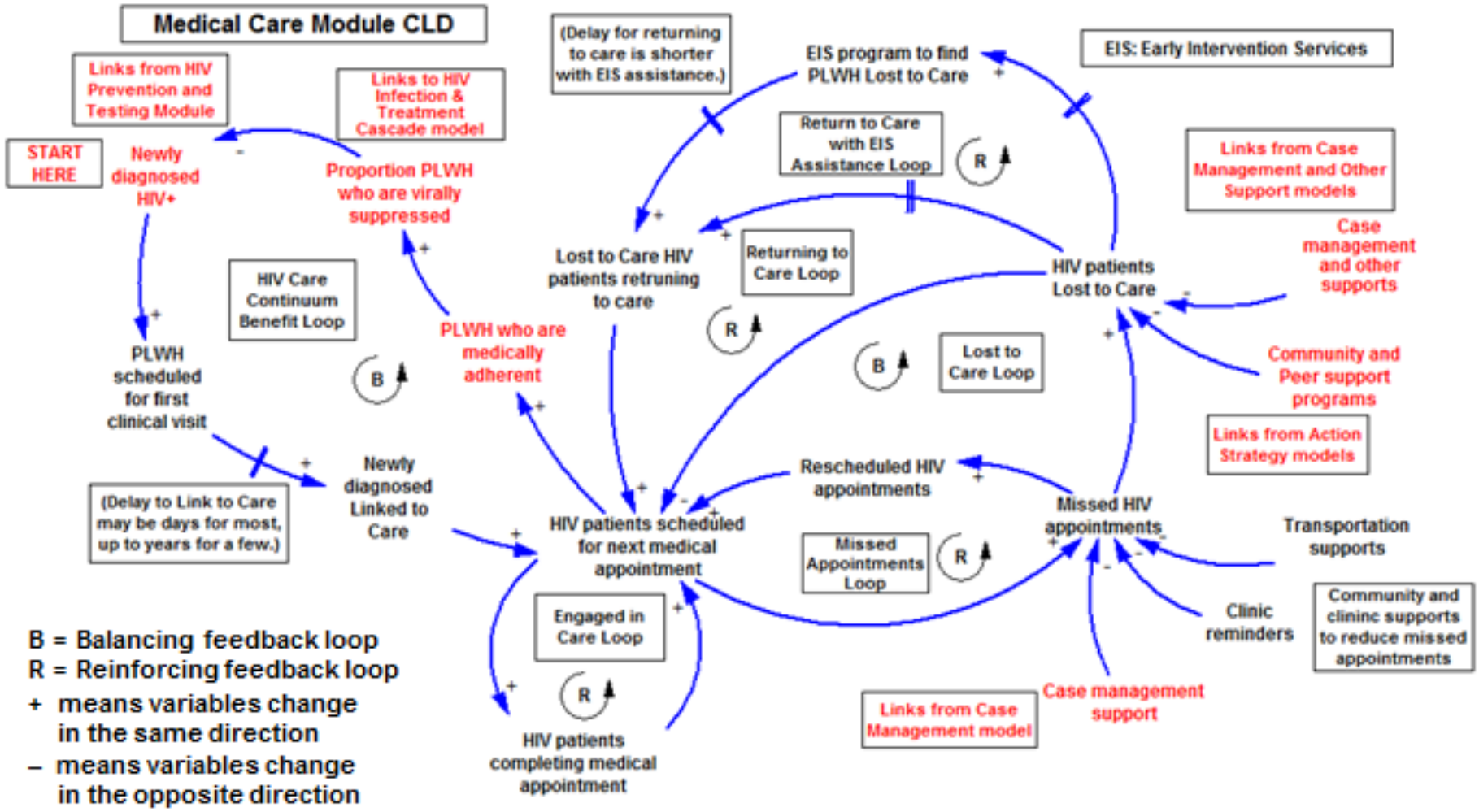


*** Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

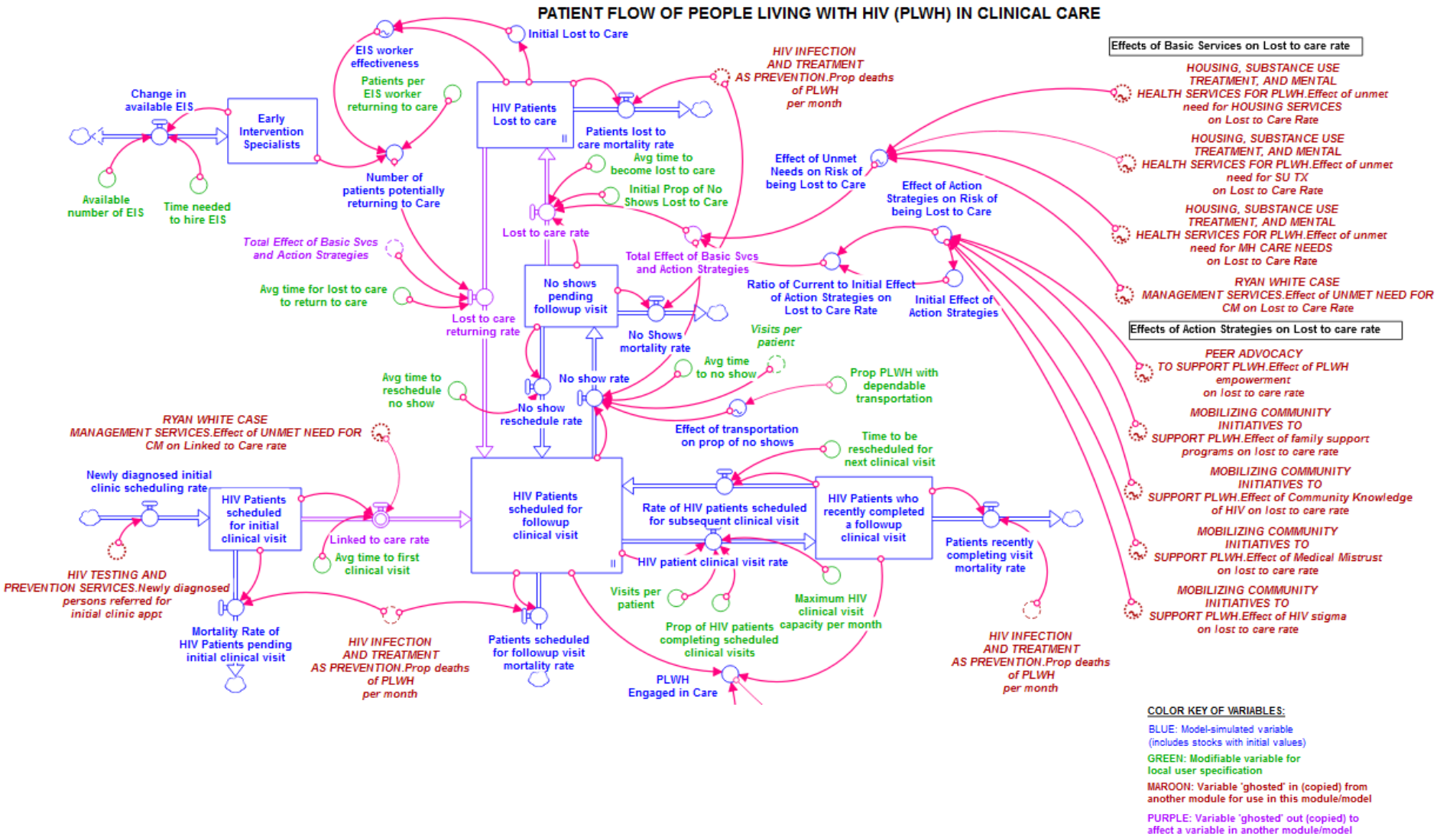
Chapter 3: MEDICAL CARE SERVICES MODULE



Medical Care Services for People Living with HIV (PLWH) Module: Causal Loop Diagram (CLD)



Medical Care Services for People Living with HIV (PLWH) Module: Stock/Flow Model



Medical Care Services for People Living with HIV (PLWH) Module: Key Modifiable Variables

MEDICAL CARE SERVICES MODULE CALIBRATION WORKSHEET

ESTIMATES USED IN THE BASE MODEL

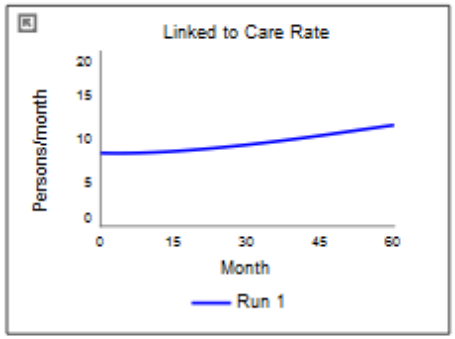
Catchment area: Hartford TGA

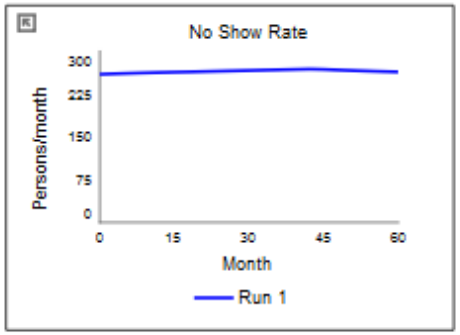
YEAR USED FOR INITIAL ESTIMATES: 2017	Actual number used (units)		Equivalent to:	Codes:
PATIENT FLOW OF PEOPLE LIVING WITH HIV (PLWH) IN CLINCIAL CARE				
Initial values imported from HIV Treatment as Prevention Module				
Initial (number) Diagnosed PLWH	3,652		3,328 PLWH	1
Initial proportion of DIAGNOSED PLWH Engaged in Care	0.80		80% of PLWH	1
Initial proportion of HIV Patients Lost to Care	0.20		20% of PLWH	1
Linkage to Care & Clinic Capacity				
Average time to first clinical visit after HIV diagnosis (time to be linked to care)	2	(months)	2 months	2
Maximum HIV clinical visit capacity per month in the catchment area	1,000	(visits / month)	1,000 appointment slots available	2
Proportion of HIV patients completing scheduled clinical visits	0.75		75% of patients	1
Time to be rescheduled for next clinical visit after completing a visit	0.25	(months)	1 week	2
Challenges to Staying in Care				
Proportion of PLWH with dependable transportation	0.60		60% of PLWH patients	1
New value proportion PLWH with dependable transportation (comparisons)	0.60		(same as initial unless revised)	1
Average time to no-show (for a medical appointment)	6	(months)	6 months	2
Average time to reschedule no-show clinical appointment	1	(months)	1 month	2
Initial proportion of no-shows (who become) Lost to Care	0.60		60% of no-shows	1
Average time to become lost to care	12	(months)	12 months	2
Average time for lost to care to return to care	1	(month)	1 month	2
Program to Reduce Lost to Care				
Available number of Early Intervention Specialists (EIS) to find lost to care	2	(persons)	2 EIS	2
Additional or Fewer EIS (to allow comparison simulations)	0	(persons)	(change as desired)	2
Time needed to hire (and train new) EIS	12	(months)	1 year	3
Patients per EIS worker returning to care	8	patients/ month/ EIS	8 patients/ month per EIS	3
Mathematical calibrations				
Visits per patient	1	(1/month)		4

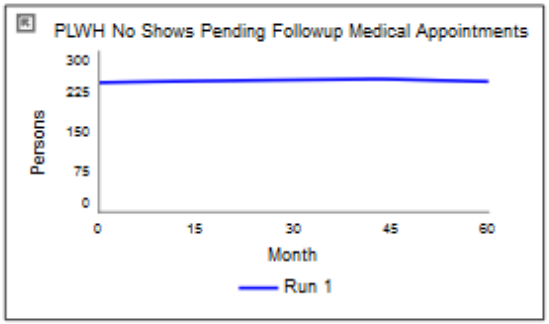
Codes:

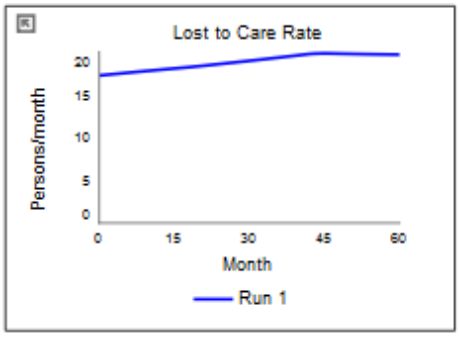
1. **Conditions of the Population and the Epidemic**
2. **Service Delivery Conditions and Protocols**
3. **Intervention Strategies to Improve the System**
4. **Mathematical Calibrations**

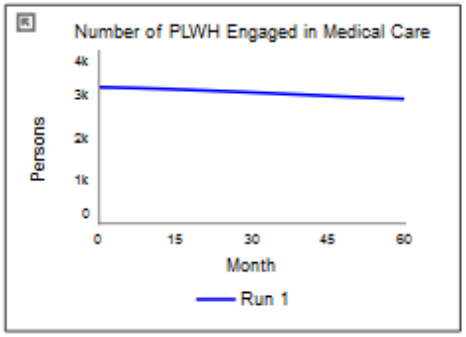
Medical Care Services for People Living with HIV (PLWH) Module:
Base Case Run Output Graphs*
Status of Engagement in Care

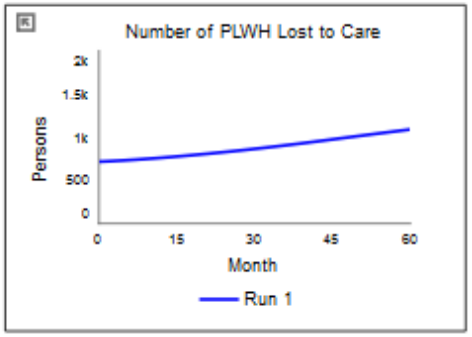






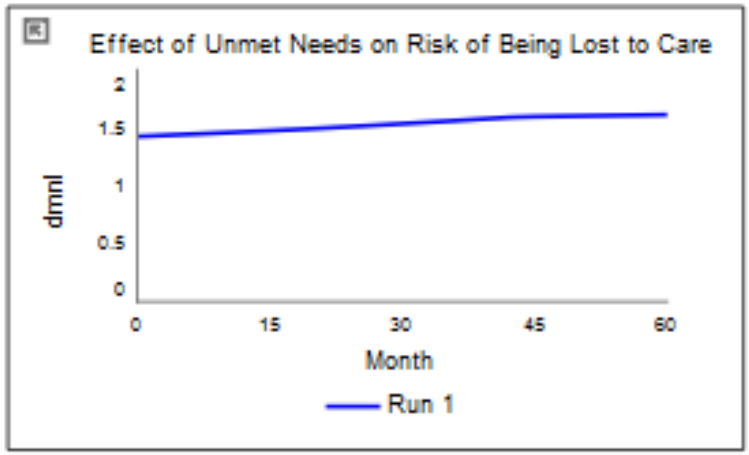


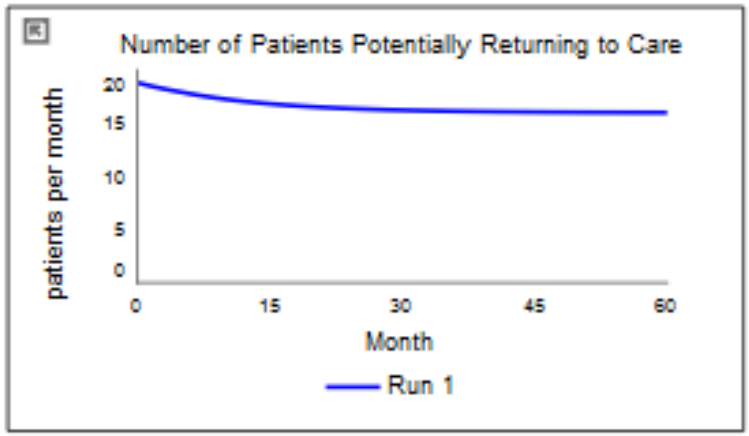


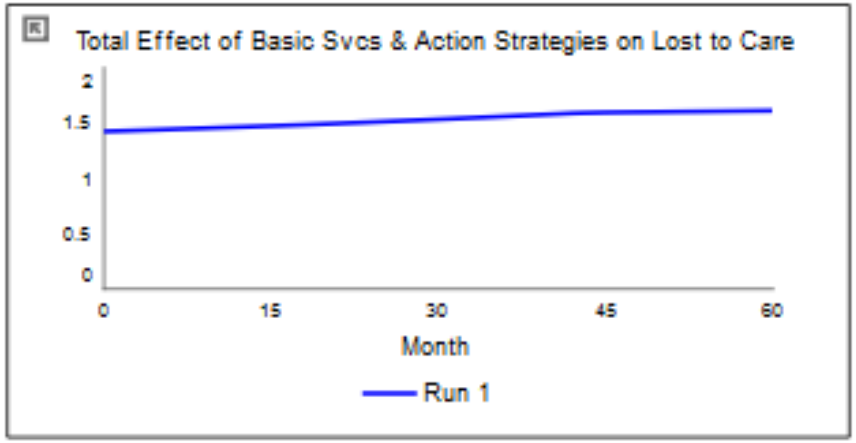


* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

Medical Care Services for People Living with HIV (PLWH) Module:
Base Case Run Output Graphs*
Effects on Lost to Care and Returning to Care Rates

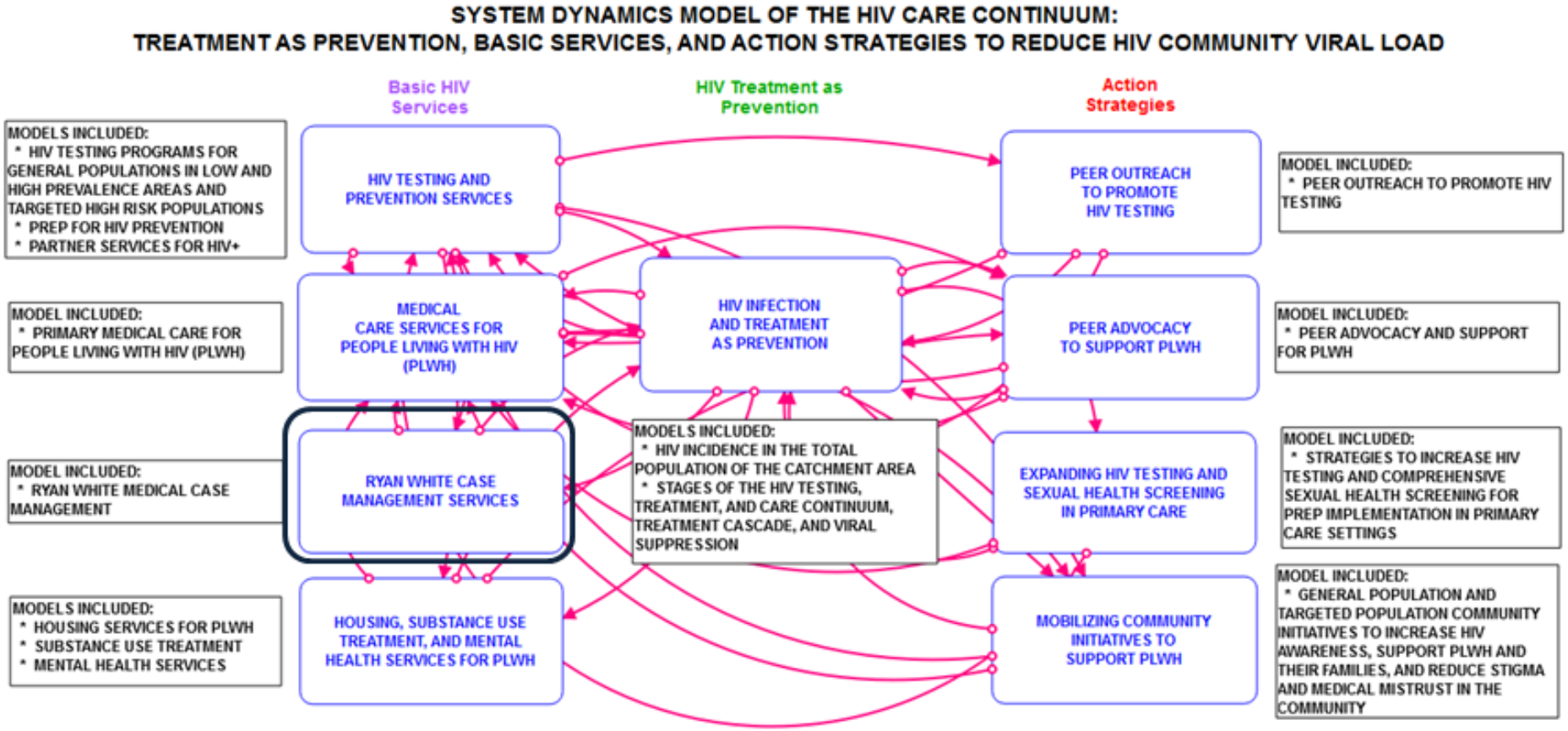




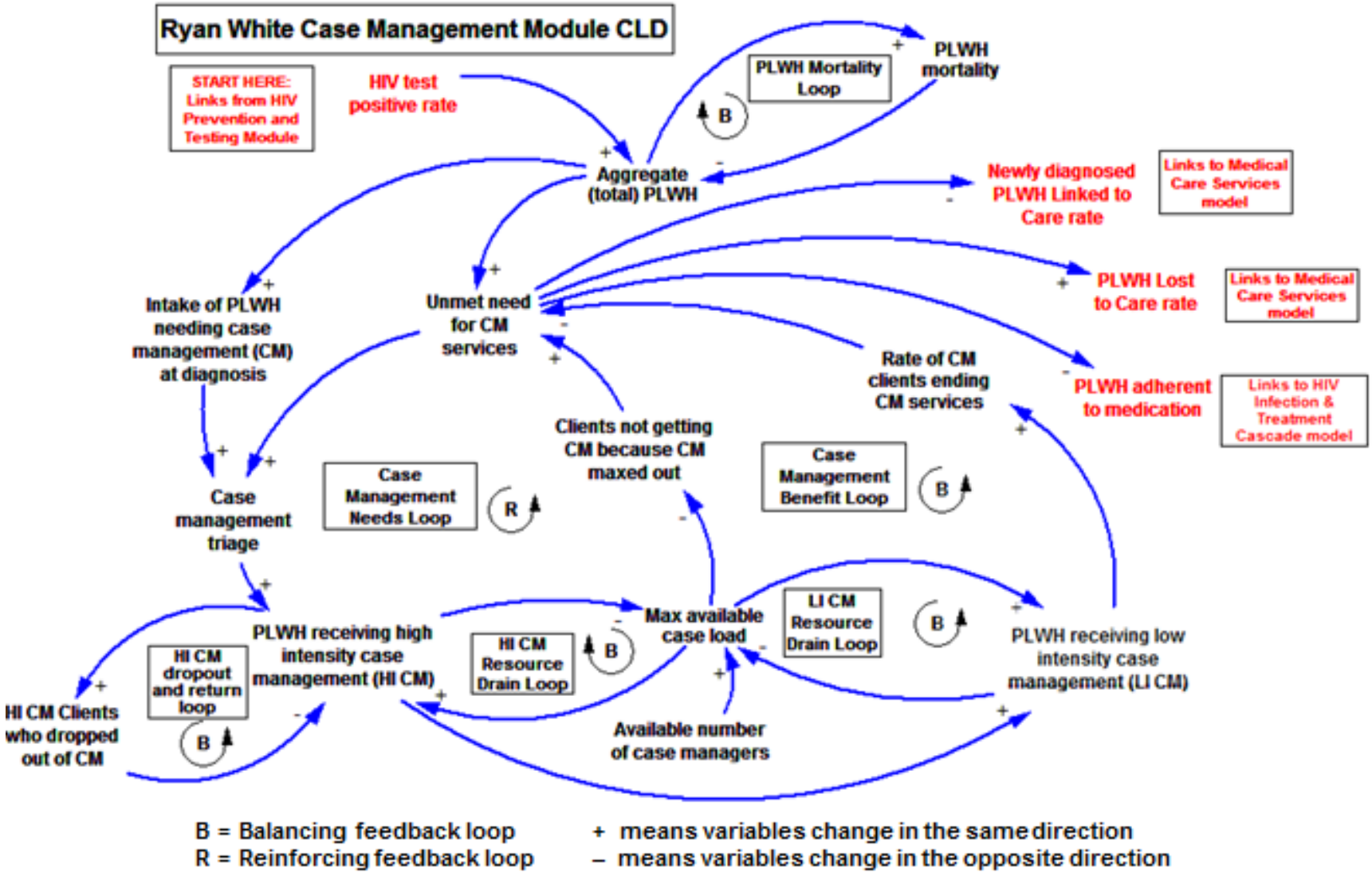


*** Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

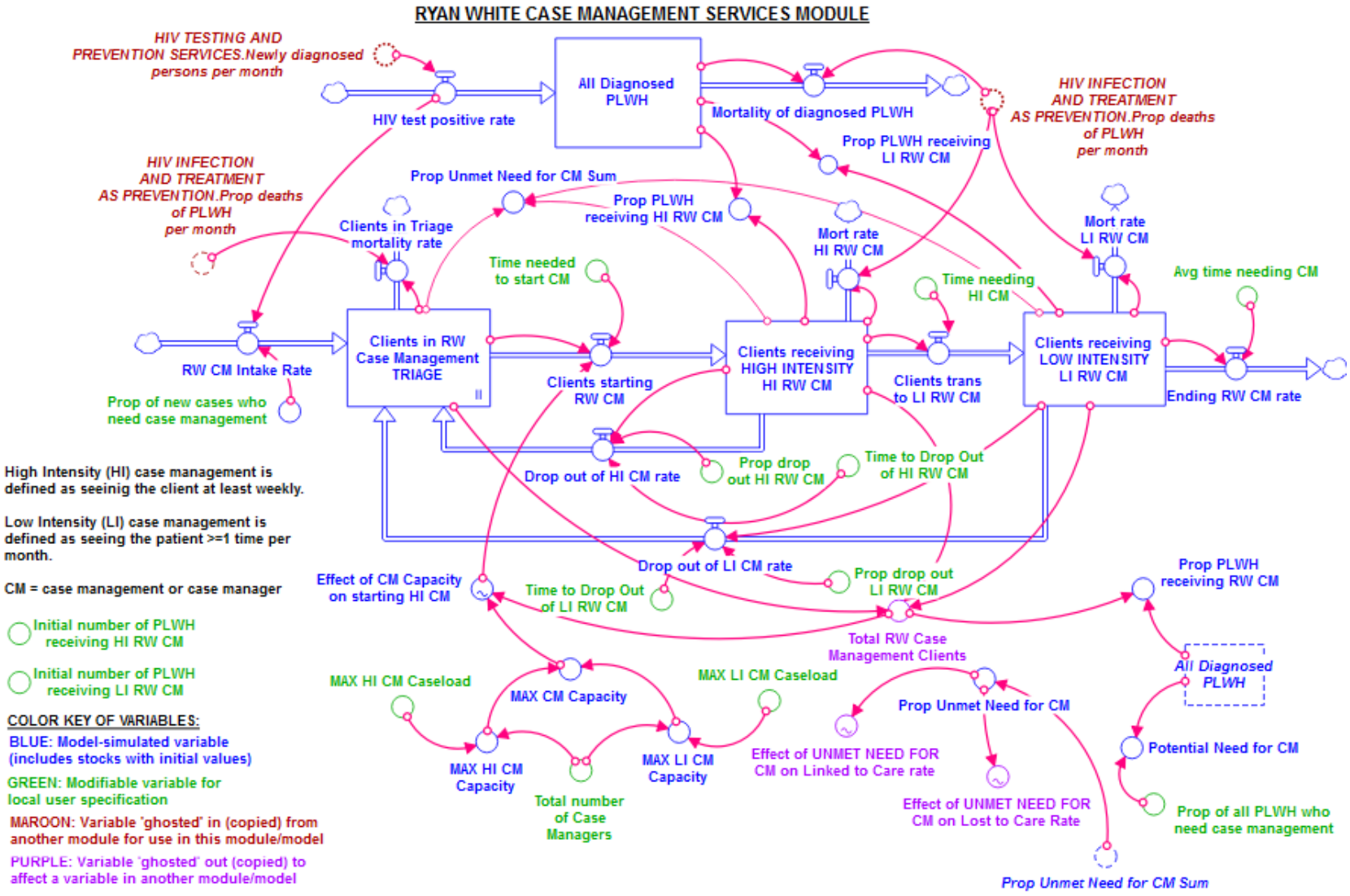
Chapter 4: RYAN WHITE CASE MANAGEMENT SERVICES MODULE



Ryan White Case Management Services Module: Causal Loop Diagram (CLD)



Ryan White Case Management Services Module: Stock/Flow Model



Ryan White Case Management Services Module: Key Modifiable Variables

RYAN WHITE CASE MANAGEMENT SERVICES MODULE CALIBRATION WORKSHEET

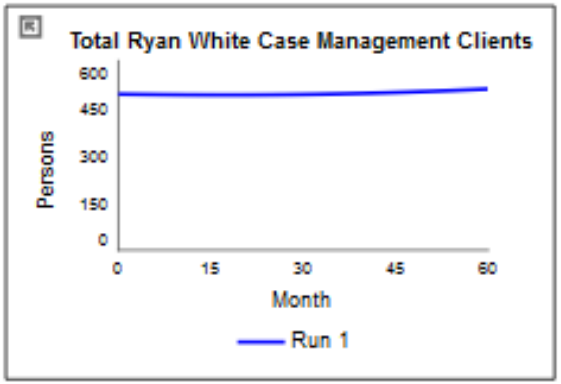
ESTIMATES USED IN THE BASE MODEL

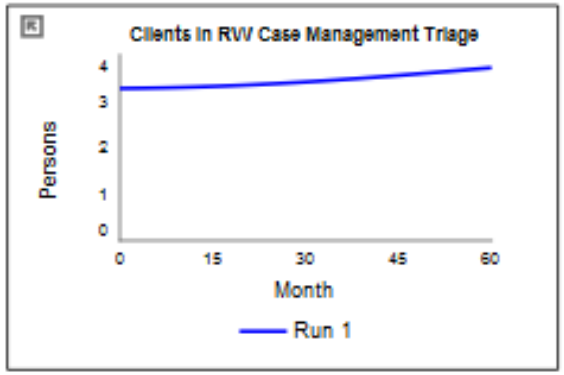
Catchment area: Hartford TGA

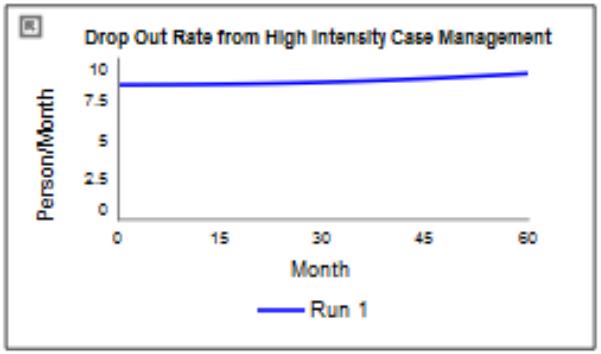
YEAR USED FOR INITIAL ESTIMATES:	2016	Actual number used (units)		Equivalent to:	Codes:
Case Management Needs					
Imported from Treatment as Prevention Module: Initial number of diangnosed PLWH		3586	(persons)	3,628 PLWH in catchment area	1
Initial number of PLWH receiving high intensity (HI) Ryan White case management		250	(persons)	250 PLWH	1
Initial number of PLWH receiving low intensity (LI) Ryan White case management		250	(persons)	250 PLWH	1
Proportion of new HIV cases who need case management		0.33		33% of all PLWH	1
Proportion of all PLWH who need case management (CM)		0.13		13% of all PLWH	1
Proportion of high intensity Ryan White CM clients who drop our of HI RW CM		0.20		20% of HI case management clients	1
Time (it takes) for HI CM clients to drop out of HI RW CM		6	(months)	6 months	1
Proportion of low intensity Ryan White CM clients who drop our of LI RW CM		0.10		10% of LI case management clients	1
Time (it takes) for LI CM clients to drop out of LI RW CM		12	(months)	1 year	1
Ryan White Case Management Delivery					
Time needed to start case management		0.25	(months)	1 week	2
(Expected) time needing high intensity (HI) case management (CM) services		60	(months)	5 years	1
Average time needing (LI) case management services		120	(months)	10 years	1
Ryan White Case Management Capacity					
Total number of Ryan White case managers (full time equivalent [FTE]) in catchment area		18	(persons)	Total of 18 FTE (full-time + part-time)	2
Additional or fewer RW case managers (for use in simulating comparison runs)		0		(set to 0 until changed)	2
Maximum high intensity (HI) case management caseload		20		20 clients/ case manager	2
Maximum low intensity (LI) case management caseload		25		25 clients/ case manager	2

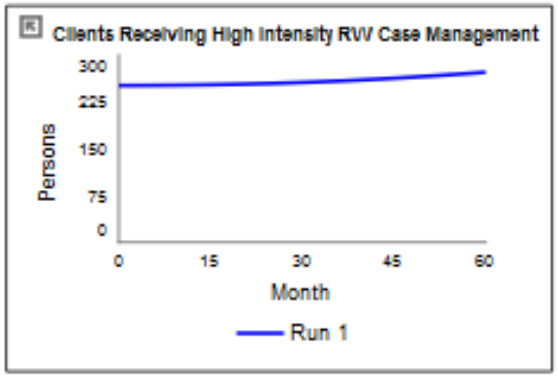
Codes:		
	1	**Conditions of the Population and the Epidemic**
	2	**Service Delivery Conditions and Protocols**
	3	**Intervention Strategies to Improve the System**
	4	**Mathematical Calibrations**

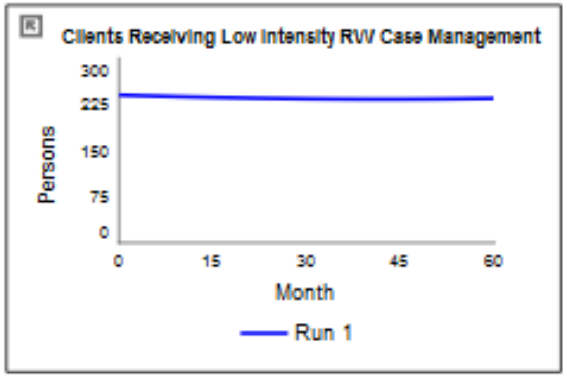
Ryan White Case Management Services Module:
Base Case Run Output Graphs*

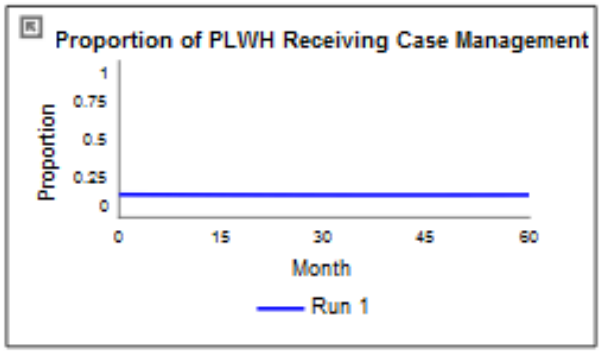


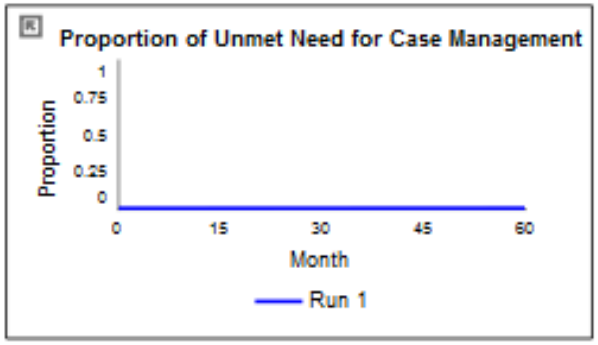






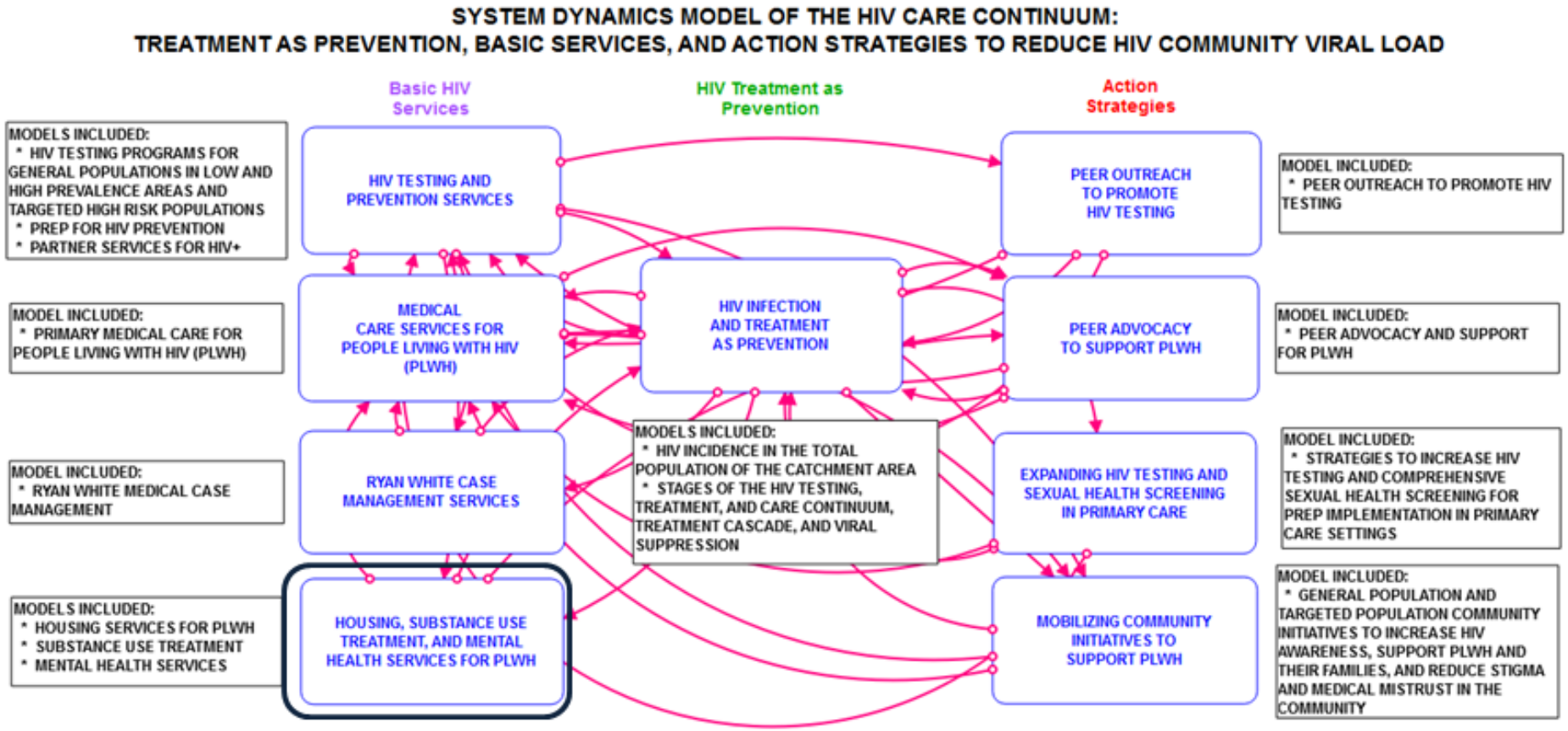




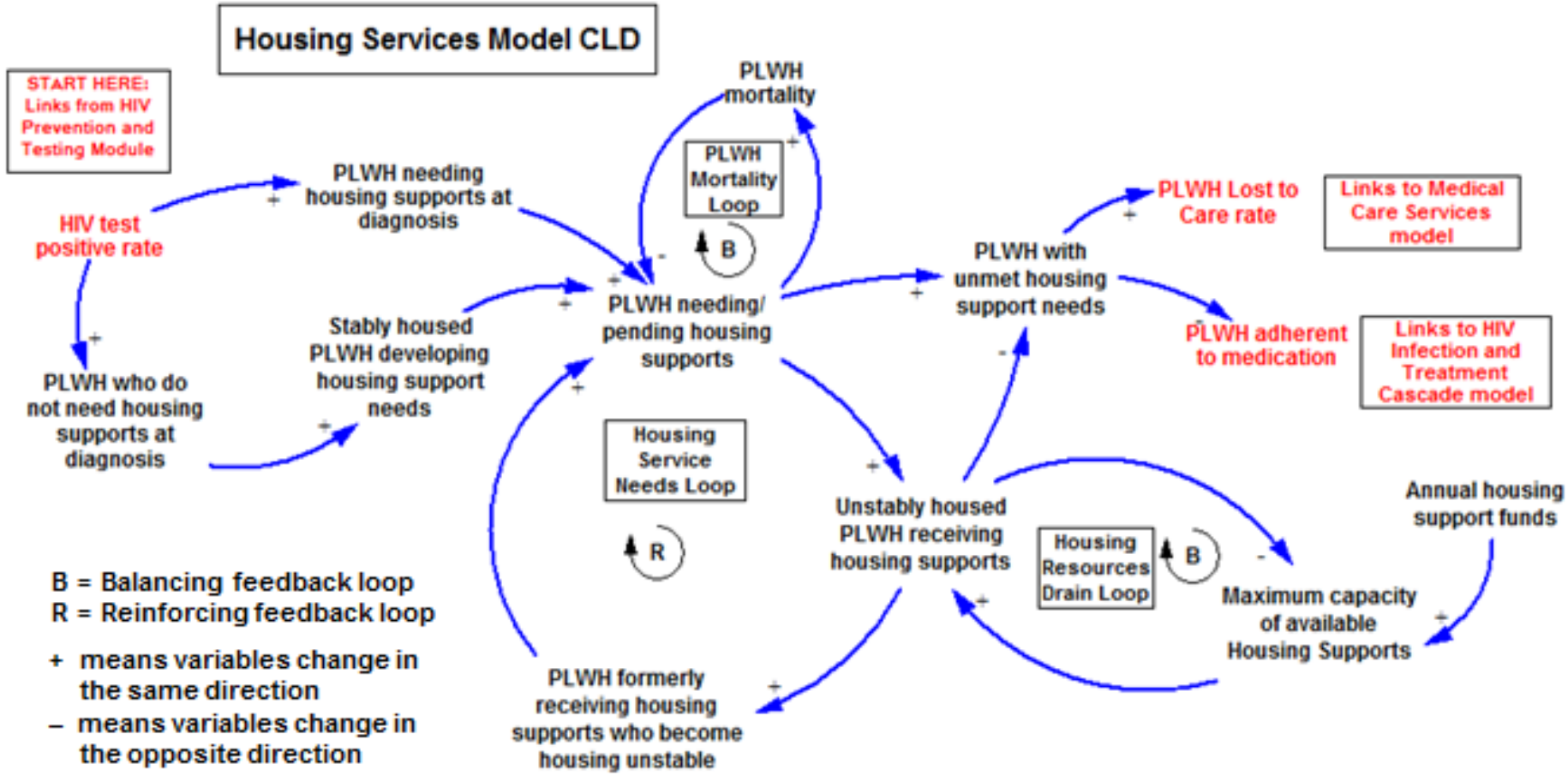


* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

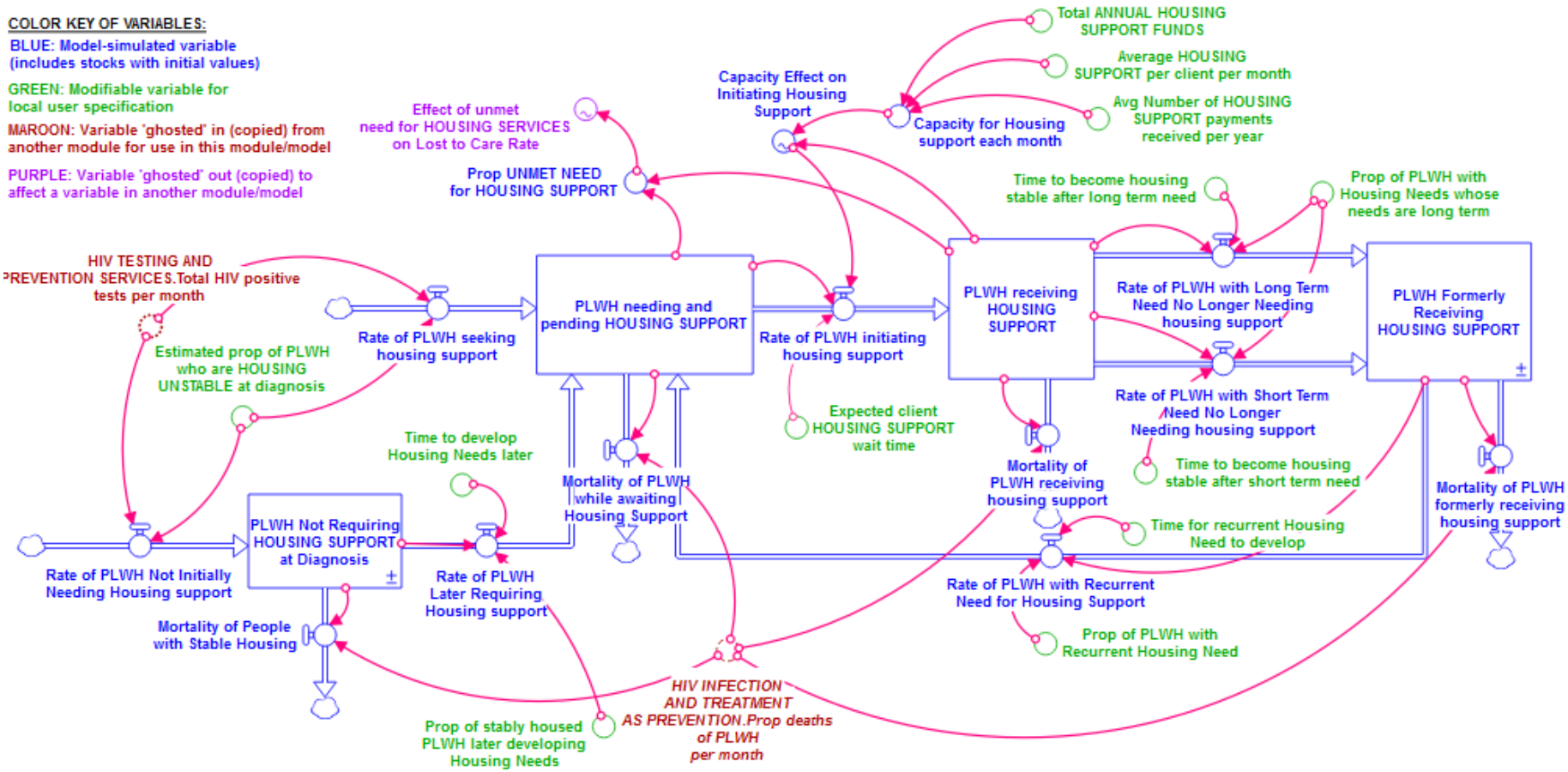
Chapter 5: HOUSING, SUBSTANCE USE TREATMENT, AND MENTAL HEALTH SERVICES FOR PLWH MODULE: Housing Services Model



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module:
<u>Housing Services Model</u>:
Causal Loop Diagram (CLD)



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: Housing Services Stock/Flow Model



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: Housing Services Model: Key Modifiable Variables

SUPPORT SERVICES FOR PLWH AND FOR PERSONS AT RISK MODULE CALIBRATION WORKSHE

			ESTIMATES USED IN THE BASE MODEL		
CATCHMENT AREA			Hartford TGA		
HOUSING SERVICES		ESTIMATES USED IN THE BASE MODEL			
YEAR USED FOR INITIAL ESTIMATES:	2016	Actual number used (units)		Equivalent to:	Codes:
Housing Conditions of the Population					
Estimated proportion of PLWH who are HOUSING UNSTABLE at diagnosis		0.30		30% of all PLWH	1
Proportion of stably housed PLWH (at diagnosis) later developing housing needs		0.05		5% of PLWH stably housed at diagnosis	1
(Expected) time to develop housing needs later (after not needing them at HIV diagnosis)		48	(months)	4 years	1
Proportion of PLWH with housing needs whose needs are long-term		0.60		60% of PLWH with housing needs	1
Time to become Housing Stable after long-term need (with housing services)		120	(months)	10 years	1
Time to become Housing Stable after short-term need (with housing services)		12	(months)	1 year	1
Proportion of PLWH with recurrent housing needs		0.20		20% of PLWH stably housed after services	1
(Expected) time for recurrent housing needs to develop		36	(months)	3 years	1
Housing Support Resources					
Total ANNUAL HOUSING SUPPORT FUNDS		$2,100,000		$2,100,000 annually	2
Additional or Fewer Housing Support funds (for modeling to simulate different scenarios)		$0		(0 until changed during modeling)	2
Average HOUSING SUPPORT per client		$750		$750/payment per month	2
Average number of HOUSING SUPPORT payments received per year		12		12 payments per year	2
Housing Support Service Delivery					
Expected client housing support wait time		2	(months)	2 months wait time	2
New higher or lower housing support wait time (for model simulation variations)		2	(months)	(same as expected until changed)	2

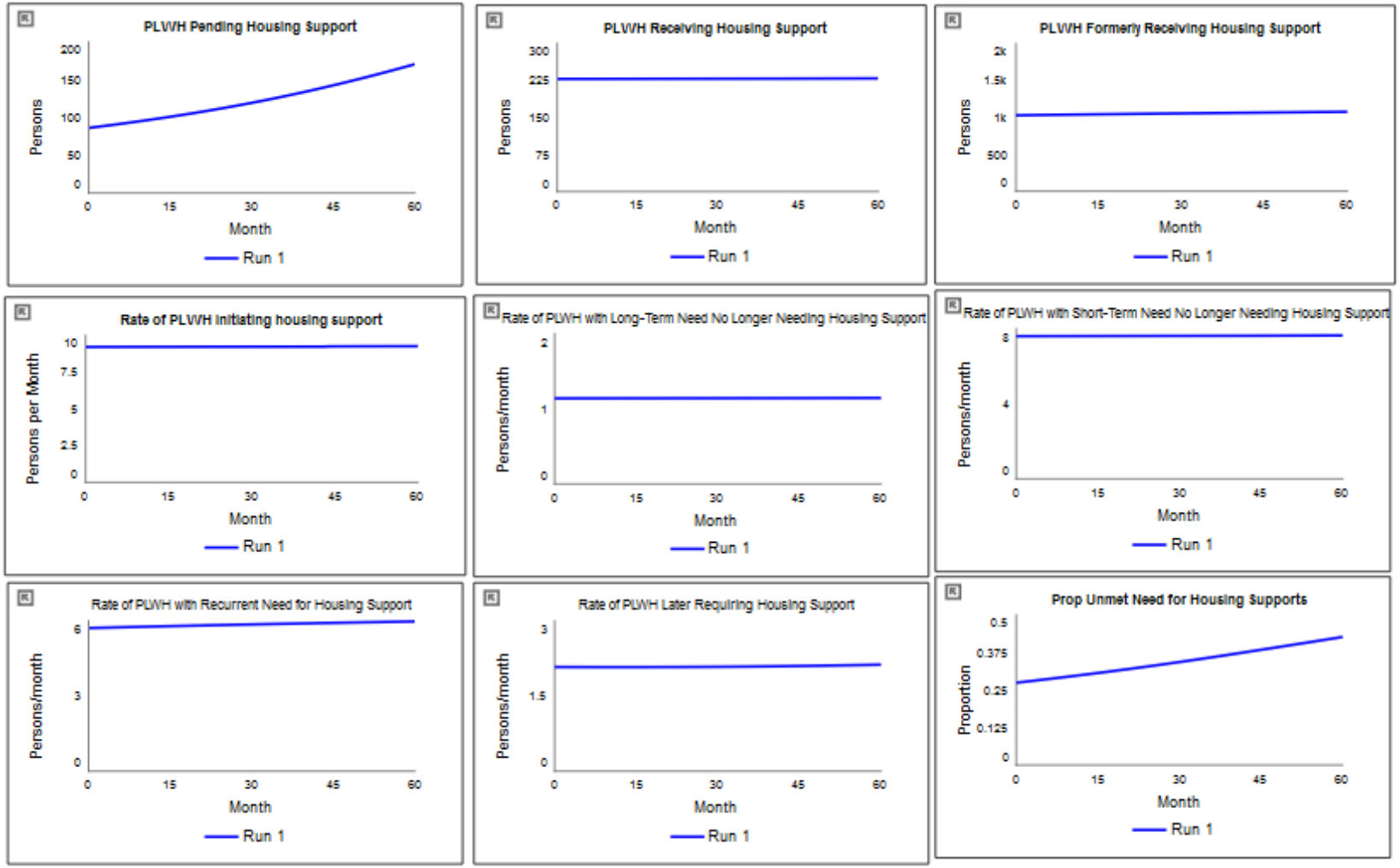
Codes:	**1**	**Conditions of the Population and the Epidemic**
	2	**Service Delivery Conditions and Protocols**
	3	**Intervention Strategies to Improve the System**
	4	**Mathematical Calibrations**

Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: Housing Services Model
Sample Housing Programs for Model Calibrations

SUPPORT SERVICES FOR PLWH AND FOR PERSONS AT RISK MODULE CALIBRATION WORKSHEET

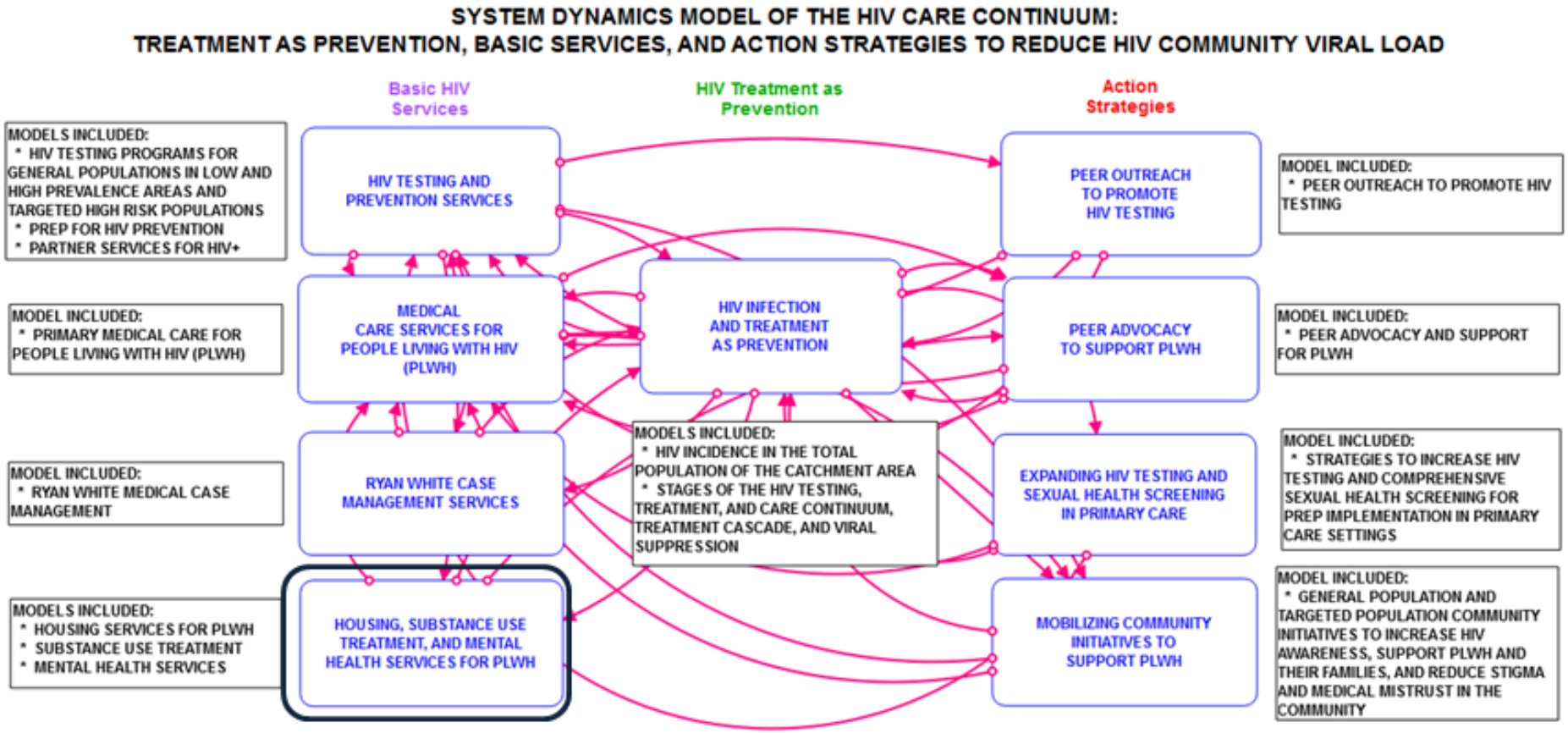
	ESTIMATES USED IN THE BASE MODEL							
CATCHMENT AREA	**Hartford TGA**							
Initial number of diangnosed PLWH		3328	(persons)	3,637 PLWH in catchment area				
HOUSING SERVICES AVAILABLE IN THE CATCHMENT AREA	**(2 years provided for comparative purposes; 2015 numbers used)**							
	Total housing clients served		Dollars spent		Cost per person		Reach (% of total clients served)	
HOUSING SERVICE PROGRAMS	YR 2015	YR 2016	YR 2015	YR 2016	YR 2015	YR 2016	YR 2015	YR 2016
Permanent housing units for People Living with HIV (PLWH) **[est rent/mo $1,000/unit]**	47	47	$564,000	$564,000	$12,000	$12,000	15.6%	17.2%
Scattered site units dedicated for PLWH **[est rent/mo $1,000 for each unit]**	111	111	$1,332,000	$1,332,000			36.8%	
Housing support coordination	49	26	$88,388	$80,567	$1,804	$3,099	16.2%	9.5%
Step down housing support	8	6	$43,405	$42,102	$5,426	$7,017	2.6%	2.2%
Transitional housing units	20	16	$117,741	$101,208	$5,887	$6,326	6.6%	5.8%
One-time housing assistance	16	0	$19,308	$0	$1,207	#DIV/0!	5.3%	0.0%
Rental Subsidies	51	68	$69,885	$69,120	$1,370	$1,016	16.9%	24.8%
TOTAL HOUSING CLIENTS SERVED IN CATCHMENT AREA, TOTAL HOUSING FUNDS, AND COST PER CLIENT SERVED	**302**	**274**	**$2,234,727**	**$2,188,997**	**$7,400**	**$7,989**	**100.0%**	**100.0%**

Housing, Substance Use Treatment, and Mental Health Services for PLWH Module:
Housing Services Model
Base Case Run Output Graphs*

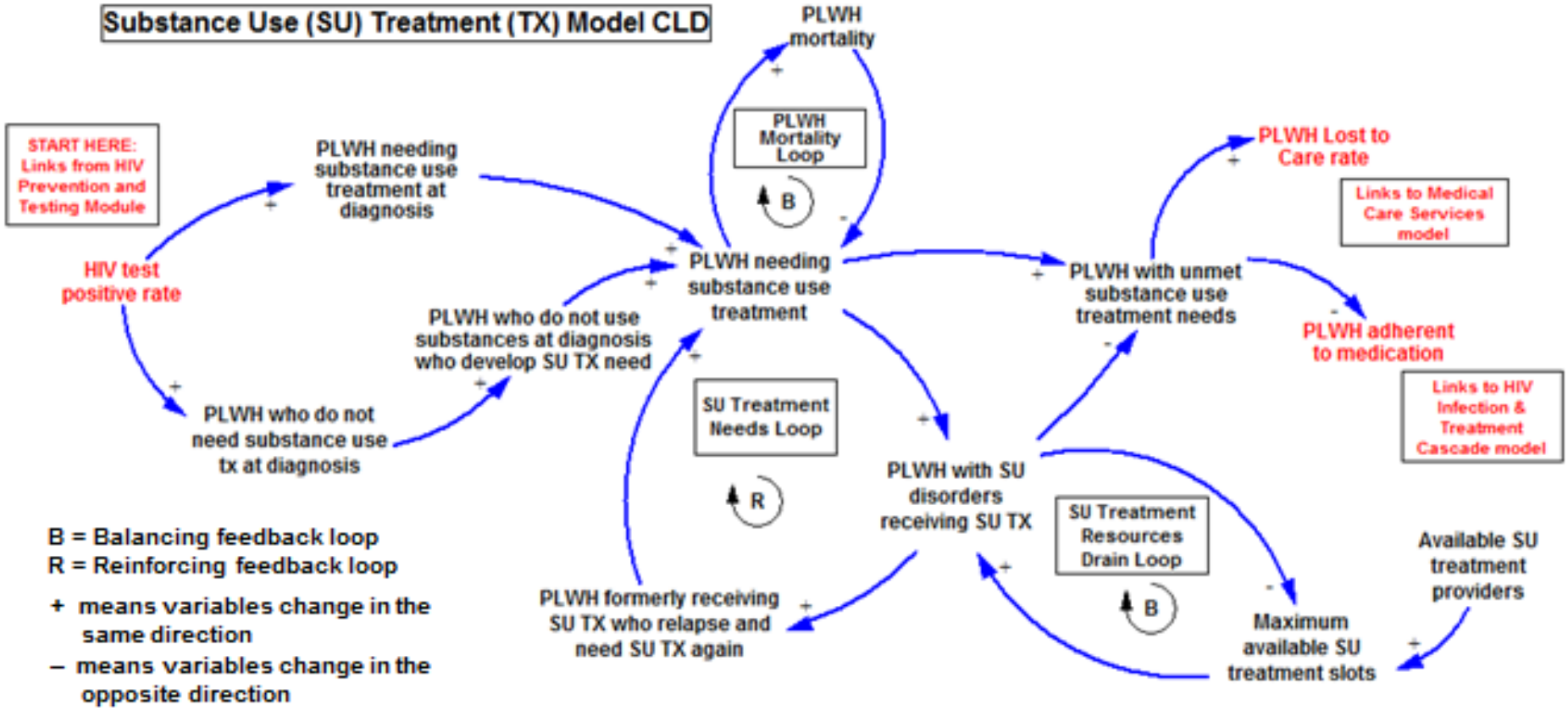


* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

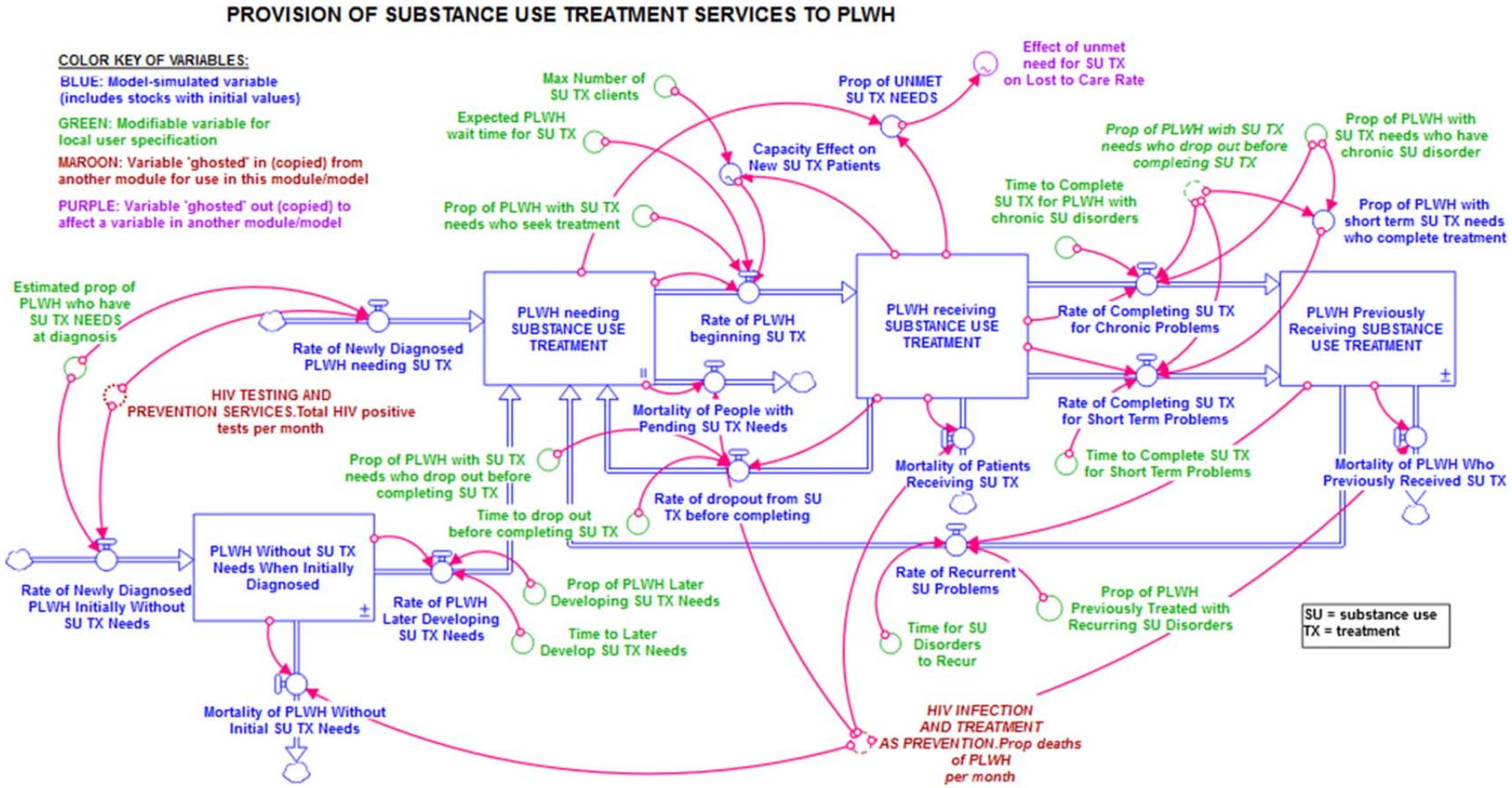
Chapter 6: HOUSING, SUBSTANCE USE TREATMENT, AND MENTAL HEALTH SERVICES FOR PLWH MODULE: Substance Use Treatment Model



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module:
Substance Use Treatment Services Model: Causal Loop Diagram (CLD)



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: <u>Substance Use Treatment Services</u> Stock/Flow Model



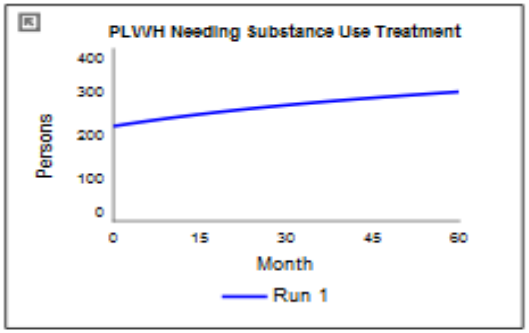
Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: Substance Use Treatment Services Model: Key Modifiable Variables

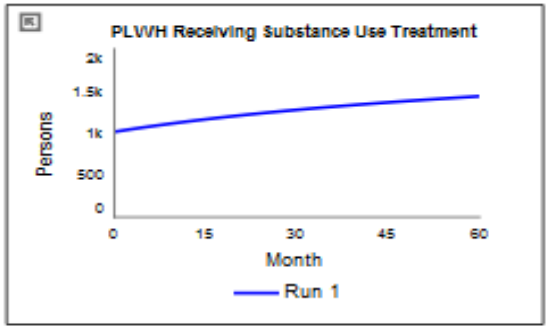
SUPPORT SERVICES FOR PLWH AND FOR PERSONS AT RISK MODULE CALIBRATION WORKSHE

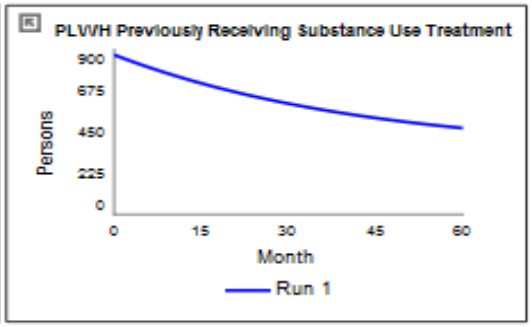
		ESTIMATES USED IN THE BASE MODEL			
CATCHMENT AREA		Hartford TGA			
SUBSTANCE USE TREATMENT SERVICES		ESTIMATES USED IN THE BASE MODEL			
YEAR USED FOR INITIAL ESTIMATES:	2016	Actual number used (units)		Equivalent to:	Codes:
Substance Use Conditions of the Population					
Estimated proportion of PLWH have substance use (SU) treatment (TX) needs at diagnosis		0.30		30% of all PLWH in the catchment area	1
Proportion of (non substance using) PLWH (at diagnosis) later developing SU TX needs		0.05		5% of non SU PLWH at diagnosis	1
(Expected) time to develop SU TX needs later (after not needing them at HIV diagnosis)		24	(months)	2 years	1
Proportion of PLWH with SU TX needs who seek treatment		0.50		50% of all PLWH with SU TX needs	1
Proportion of PLWH with SU TX needs who drop out before completing SU TX		0.60		60% of PLWH who start SU TX	1
(Expected) time to drop out (of SU TX) before completing Su TX		3	(months)	3 months	1
Proportion of PLWH with SU TX needs who have chronic SU disorder		0.20		20% of PLWH with SU TX needs	1
Time to to complete SU TX for PLWH with chronic SU disorders		120	(months)	10 years	1
Time to complete SU TX for short-term problems		24	(months)	2 years	1
Proportion of PLWH previously treated with recurring SU disorders		0.40		40% of PLWH who previously got SU TX	1
(Expected) time for SU disorders to recur (after previously receiving SU TX)		24	(months)	2 years	1
Substance Use Treatment Resources					
Maximum number of SU TX clients (in the catchment area, including PLWH and non-PLWH)		2000		2000 people (PLWH and non-PLWH)	2
Substance Use Treatment Delivery					
Expected PLWH wait time for SU TX		0.5	(months)	2 weeks wait time	2

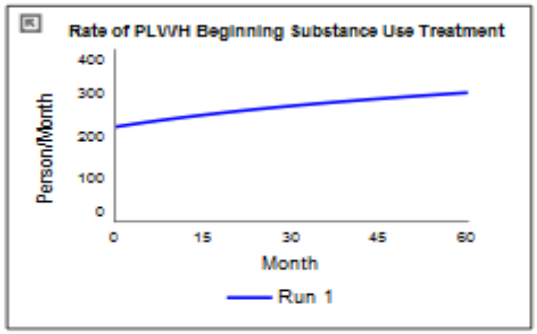
Codes:		
	1	Conditions of the Population and the Epidemic
	2	Service Delivery Conditions and Protocols
	3	Intervention Strategies to Improve the System
	4	Mathematical Calibrations

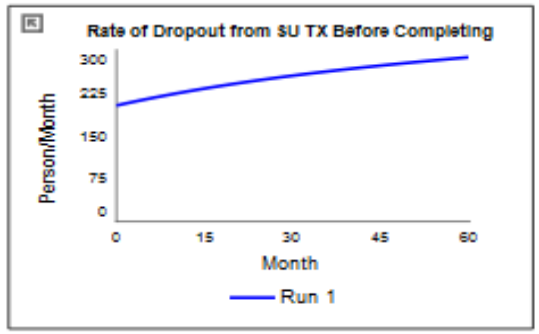
Housing, Substance Use Treatment, and Mental Health Services for PLWH Module:
<u>Substance Use Treatment Services Model</u>
Base Case Run Output Graphs*

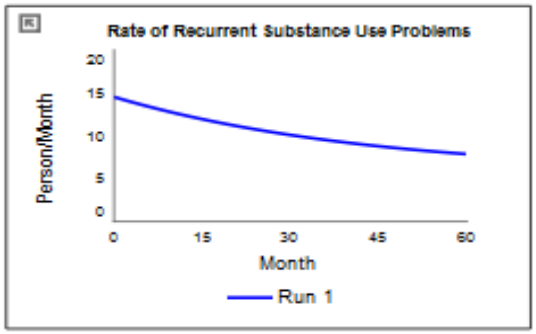


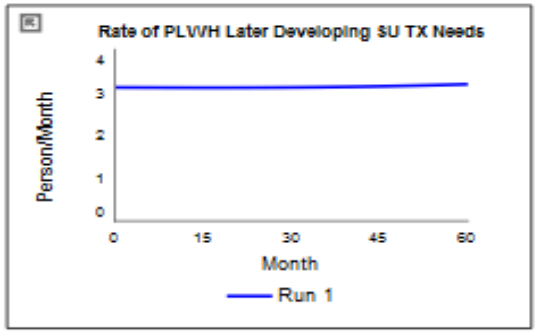


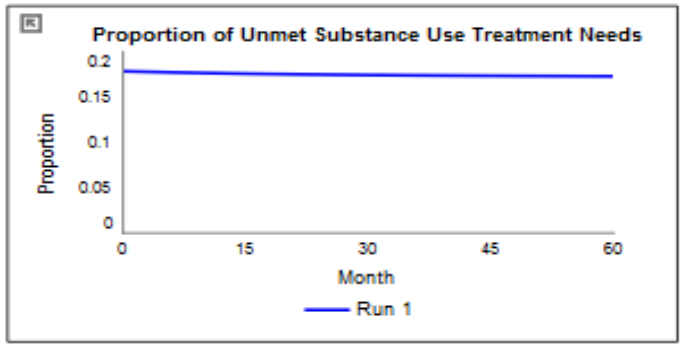






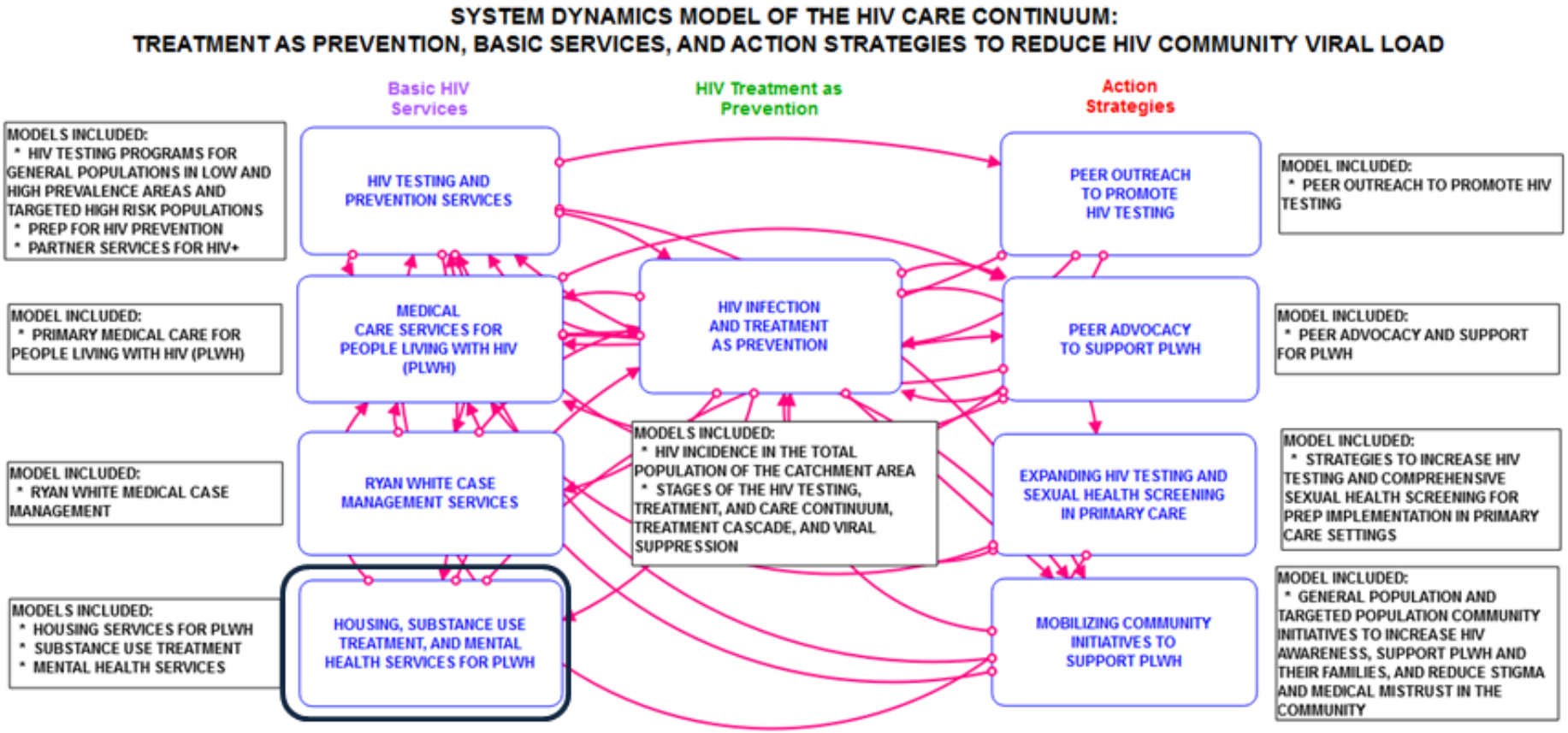




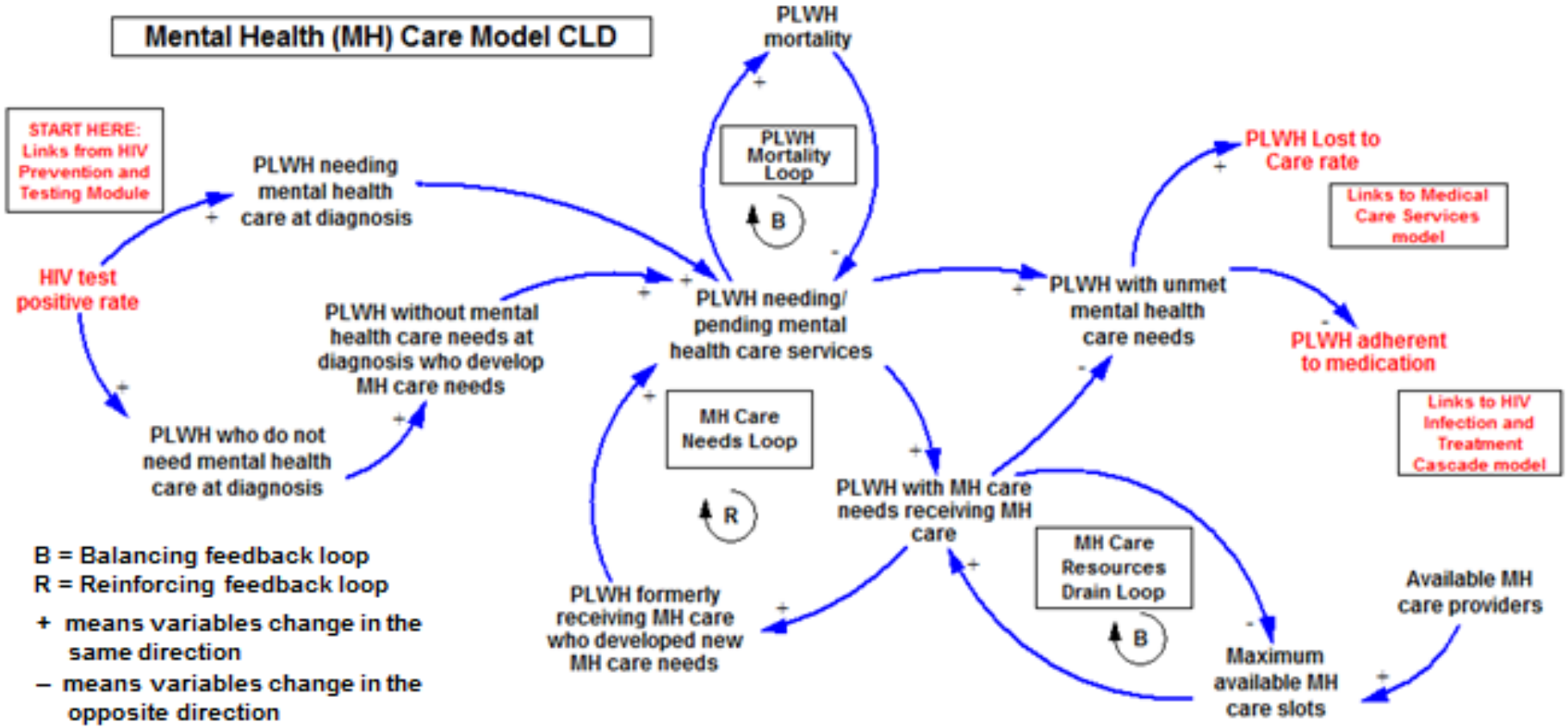


* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

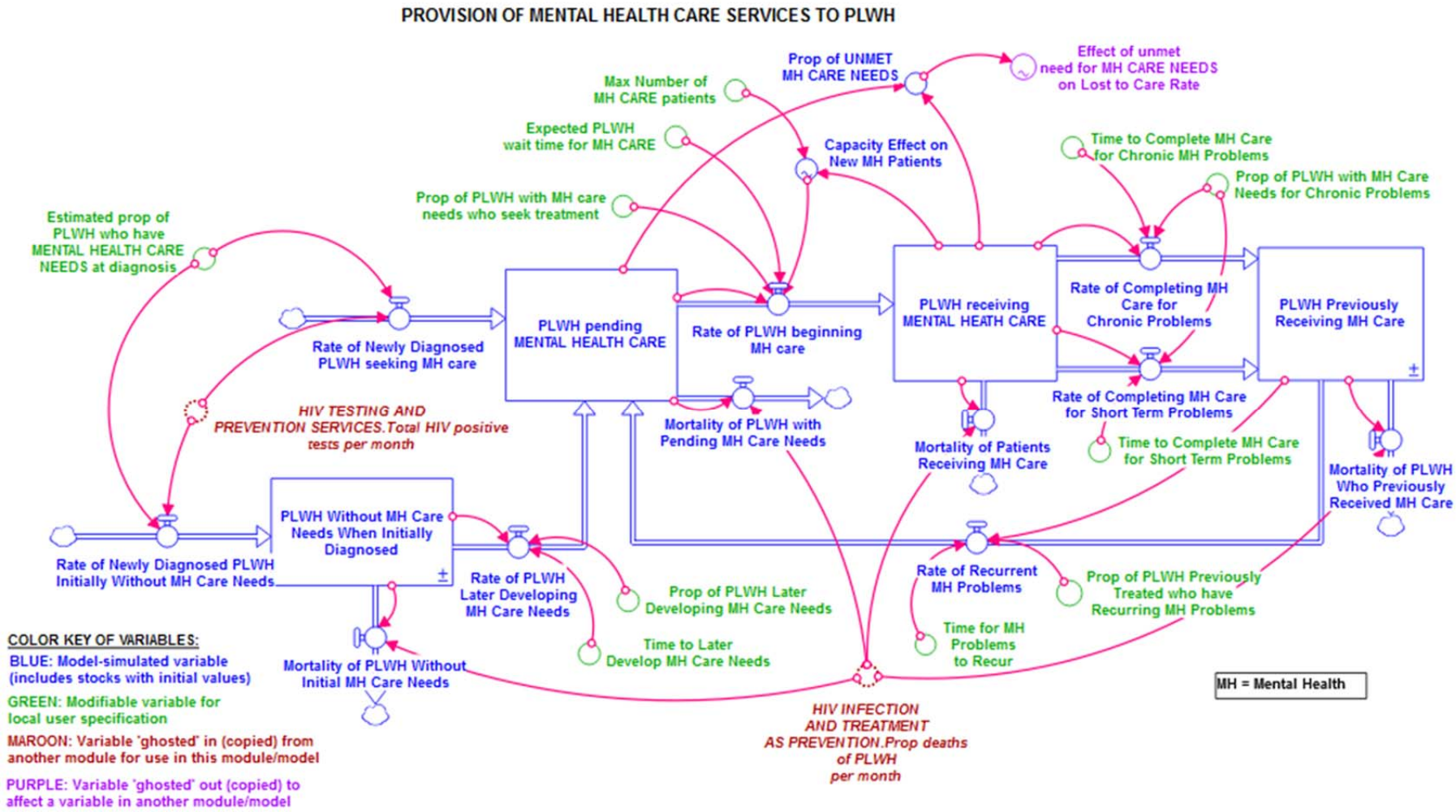
Chapter 7: HOUSING, SUBSTANCE USE TREATMENT, AND MENTAL HEALTH SERVICES FOR PLWH MODULE: Mental Health Care Model



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module:
<u>Mental Health Services Model</u>: Causal Loop Diagram (CLD)



Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: <u>Mental Health Services</u> Stock/Flow Model



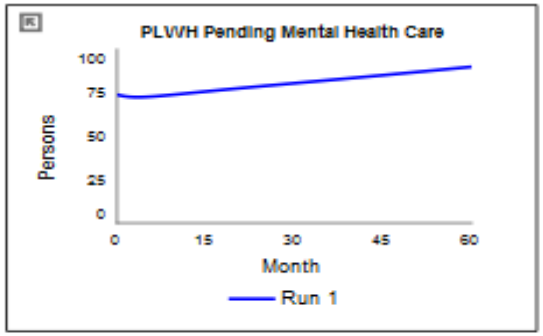
Housing, Substance Use Treatment, and Mental Health Services for PLWH Module: Mental Health Services Model: Key Modifiable Variables

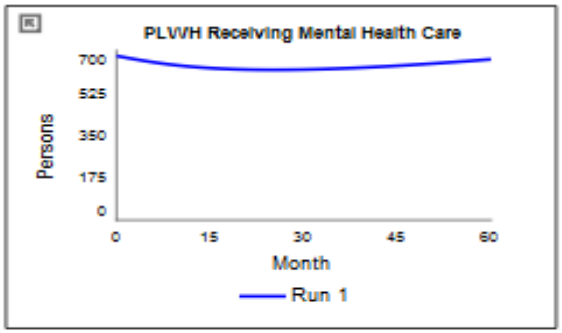
SUPPORT SERVICES FOR PLWH AND FOR PERSONS AT RISK MODULE CALIBRATION WORKSHE

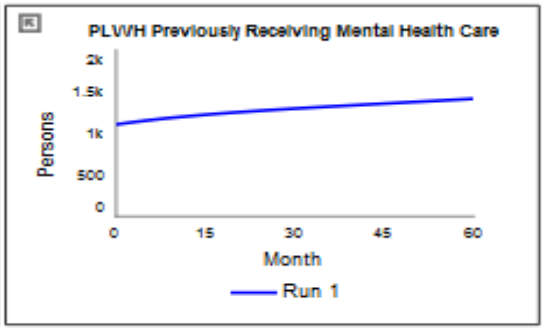
		ESTIMATES USED IN THE BASE MODEL			
CATCHMENT AREA		**Hartford TGA**			
MENTAL HEALTH SERVICES		**ESTIMATES USED IN THE BASE MODEL**			
YEAR USED FOR INITIAL ESTIMATES:	**2016**	**Actual number used (units)**		**Equivalent to:**	**Codes:**
Mental Health Conditions of the Population					
Estimated proportion of PLWH have mental health (MH) care needs at diagnosis		0.75		75% of all PLWH at diagnosis	1
Proportion of PLWH (with no MH care needs at diagnosis) later developing MH care needs		0.05		5% of non SU PLWH at diagnosis	1
(Expected) time to develop MH care needs later (after not needing them at HIV diagnosis)		36	(months)	3 years	1
Proportion of PLWH with MH care needs who seek treatment		0.75		75% of all PLWH with SU TX needs	1
Proportion of PLWH with MH care needs who have chronic MH problems		0.50		50% of PLWH with MH care needs	1
Time to to complete MH care for PLWH with chronic MH problems		120	(months)	10 years	1
Time to complete MH care for short-term problems		12	(months)	1 year	1
Proportion of PLWH previously provided MH care with recurring MH problems		0.40		40% of PLWH who previously got MHC	1
(Expected) time for MH problems to recur (after previously receiving MH care)		24	(months)	2 years	1
Mental Health Care Resources					
Maximum number of MH care patients (in the catchment area, including PLWH and non-PLWH)		750		750 people (PLWH and non-PLWH)	2
Mental Health Care Delivery					
Expected PLWH wait time for MH care		2.0	(months)	2 months wait time	2

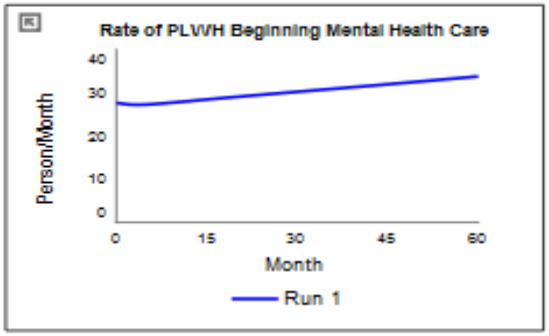
Codes:	**1**	**Conditions of the Population and the Epidemic**
	2	**Service Delivery Conditions and Protocols**
	3	**Intervention Strategies to Improve the System**
	4	**Mathematical Calibrations**

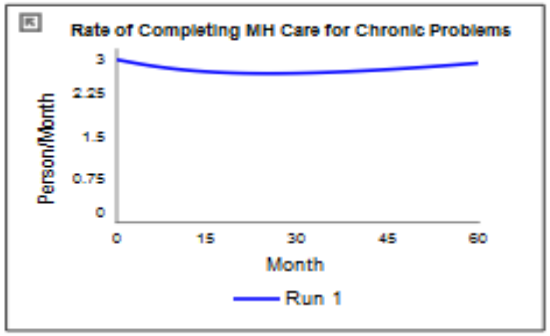
Housing, Substance Use Treatment, and Mental Health Services for PLWH Module:
Mental Health Services Model: Base Case Run Output Graphs*

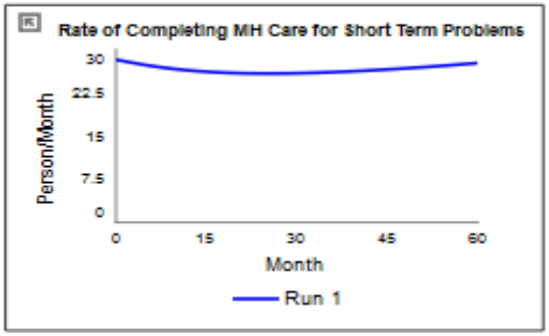


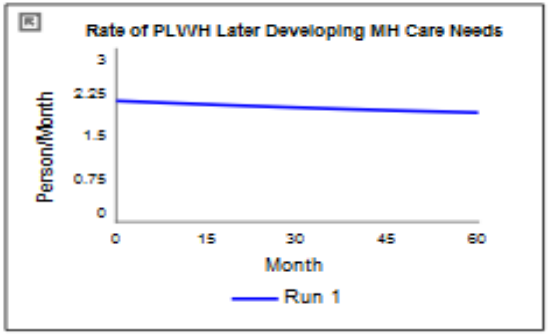


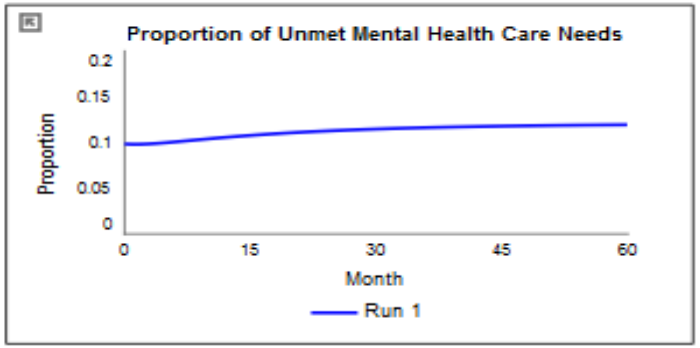












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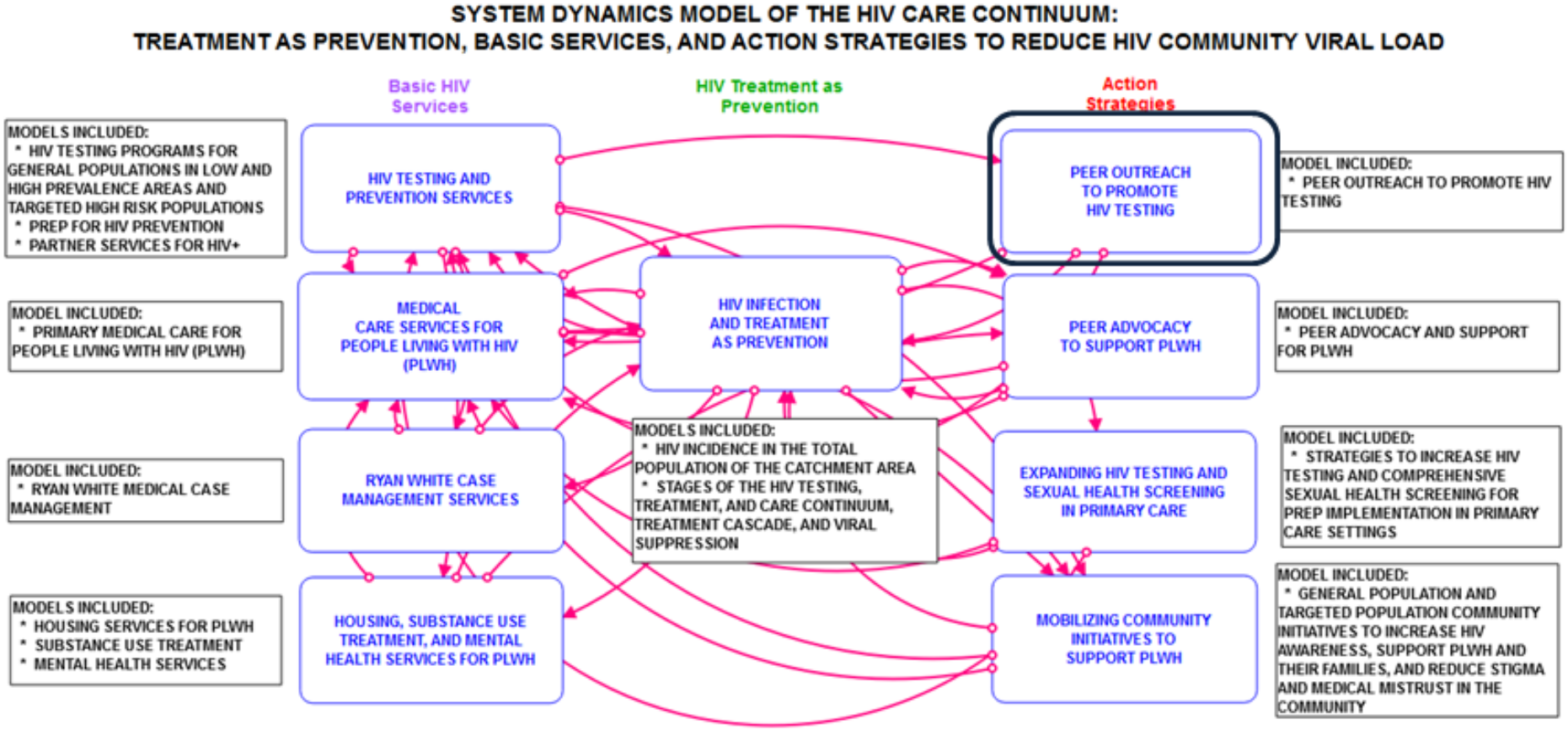
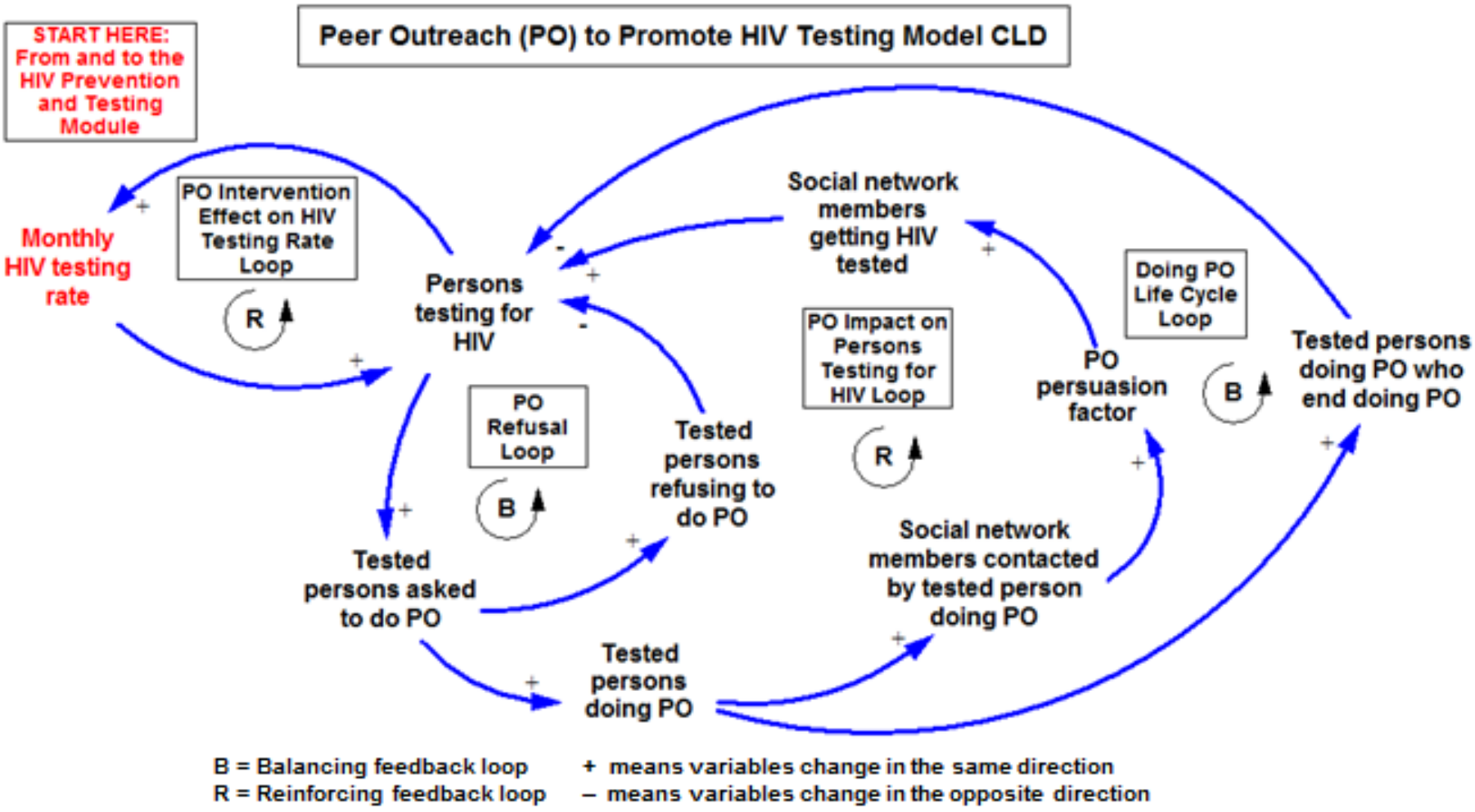
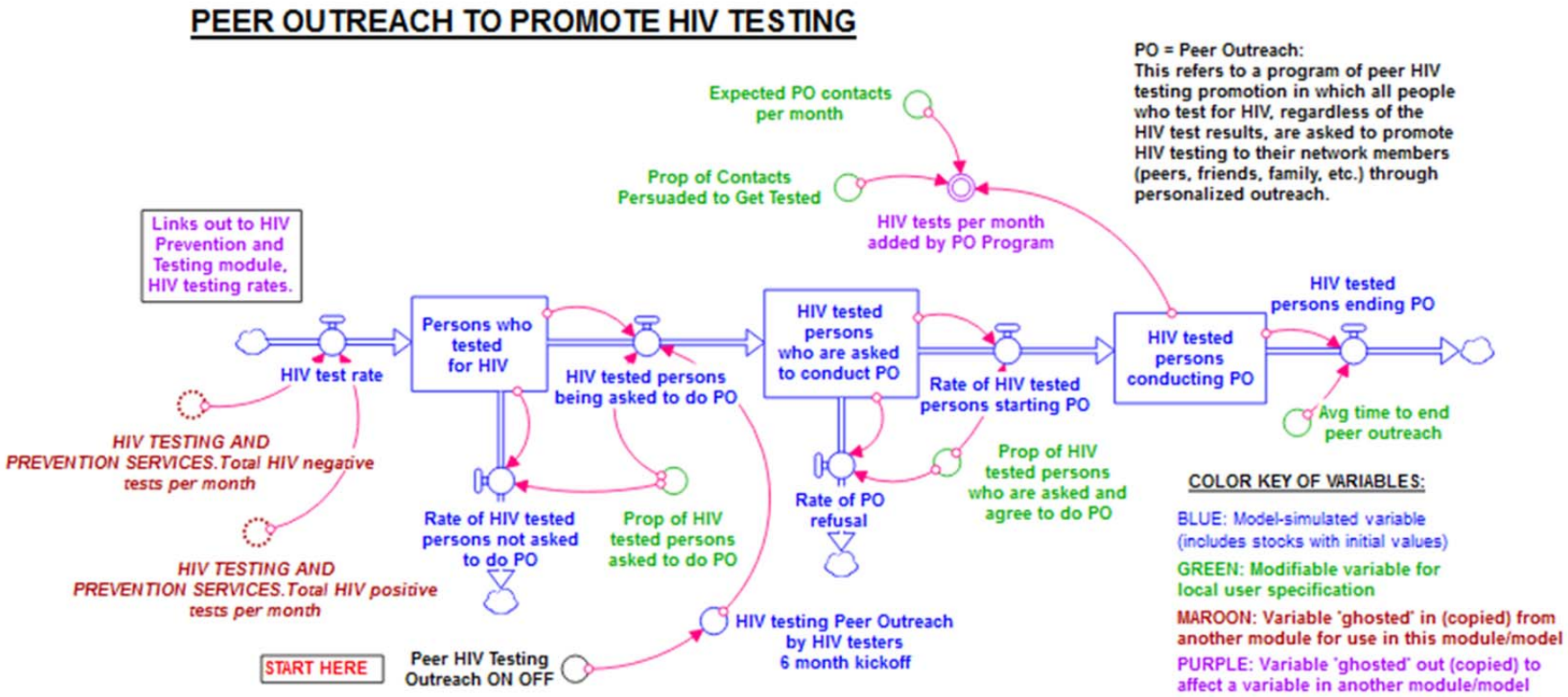
Chapter 8: PEER OUTREACH TO PROMOTE HIV TESTING MODULE



Peer Outreach to Promote HIV Testing Module: Causal Loop Diagram (CLD)



Peer Outreach to Promote HIV Testing Module: Stock/Flow Model



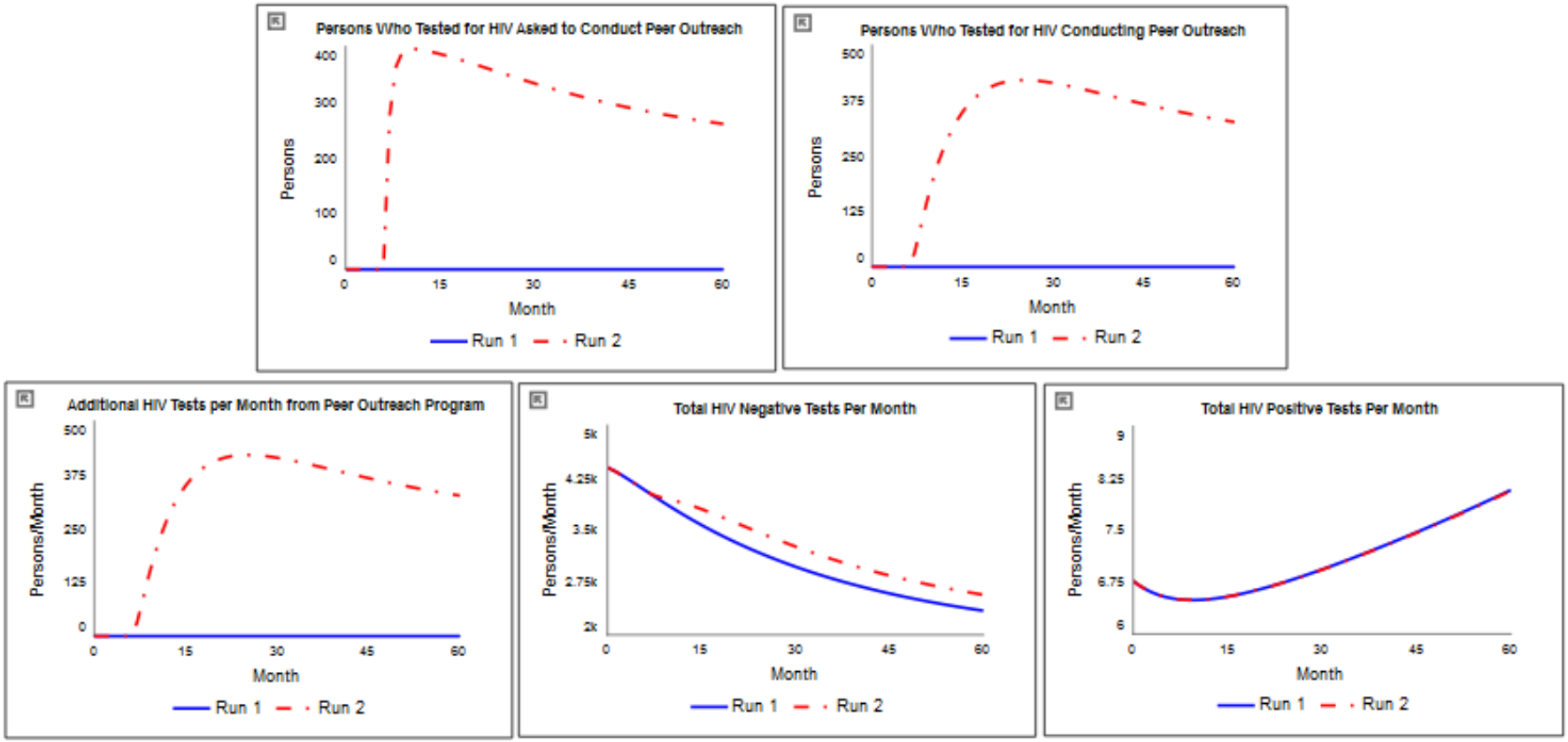
Peer Outreach to Promote HIV Testing Stock/Flow Module: Key Modifiable Variables

PEER OUTREACH TO PROMOTE HIV TESTING MODULE CALIBRATION WORKSHEET

		ESTIMATES USED IN THE BASE MODEL			
		Catchment area: Hartford TGA			
YEAR USED FOR INITIAL CALCULATIONS:	NA	Actual number used (units)		Equivalent to:	Codes:
PEER OUTREACH (PO) FOR HIV TESTING					
Proportion of tested persons asked to do PO (encourage network members to HIV test)		0.10		10% of people who get an HIV test	3
Proportion of tested persons who agree to do PO		0.20		20% of tested persons per month	3
Average time to end (stop doing) peer outreach for HIV testing		6	(months)	6 months	3
Expected "Peer Outreach" (PO) contacts (by tested person) per month		2	(persons)	2 people/month	3
Average tested person's degree of peer outreach persuasiveness (Multiplier)		1.25		25% persuasive power	3

Codes:		
	1	Conditions of the Population and the Epidemic
	2	Service Delivery Conditions and Protocols
	3	Intervention Strategies to Improve the System
	4	Mathematical Calibrations

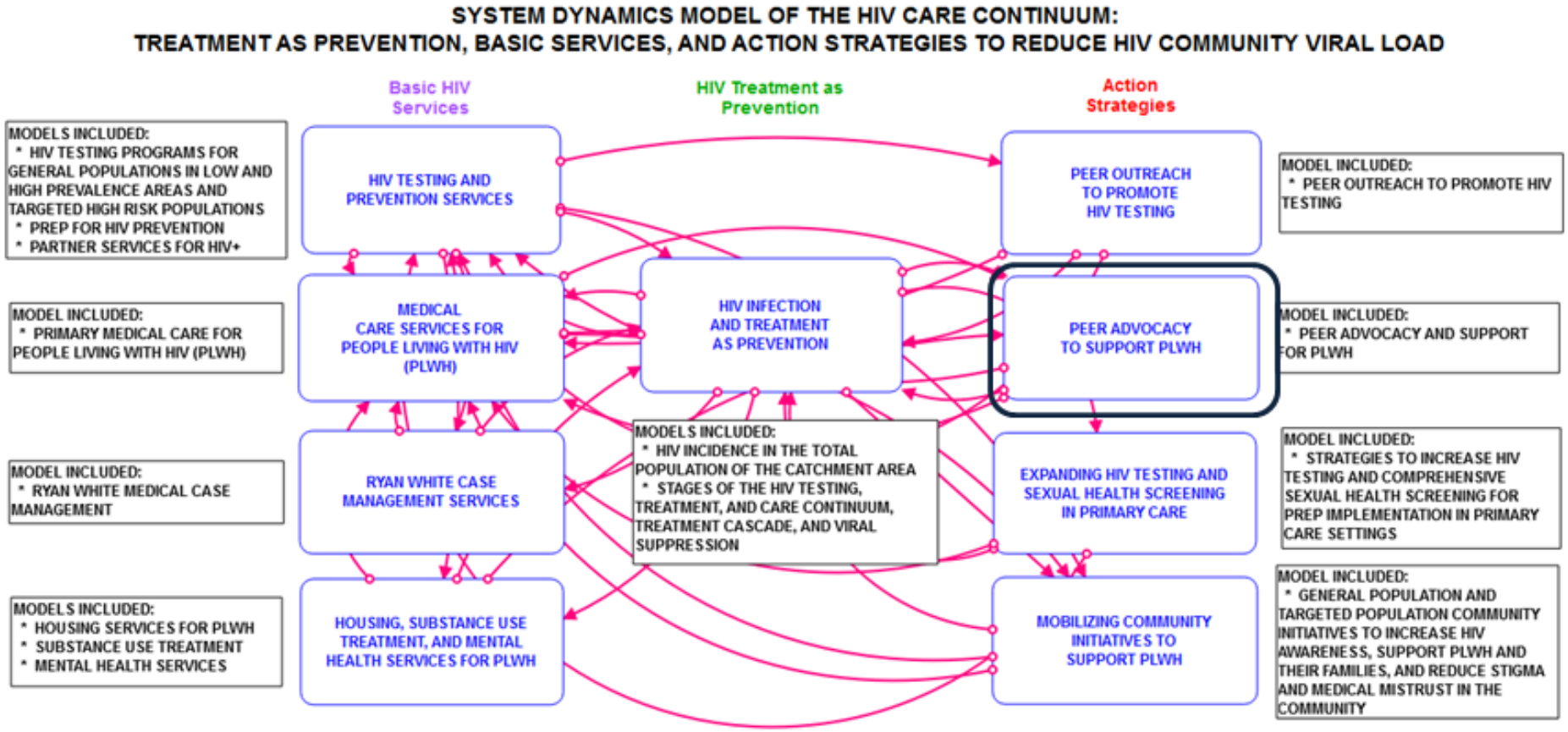
Peer Outreach to Promote HIV Testing Stock/Flow Module: Base Case Run Output Graphs*



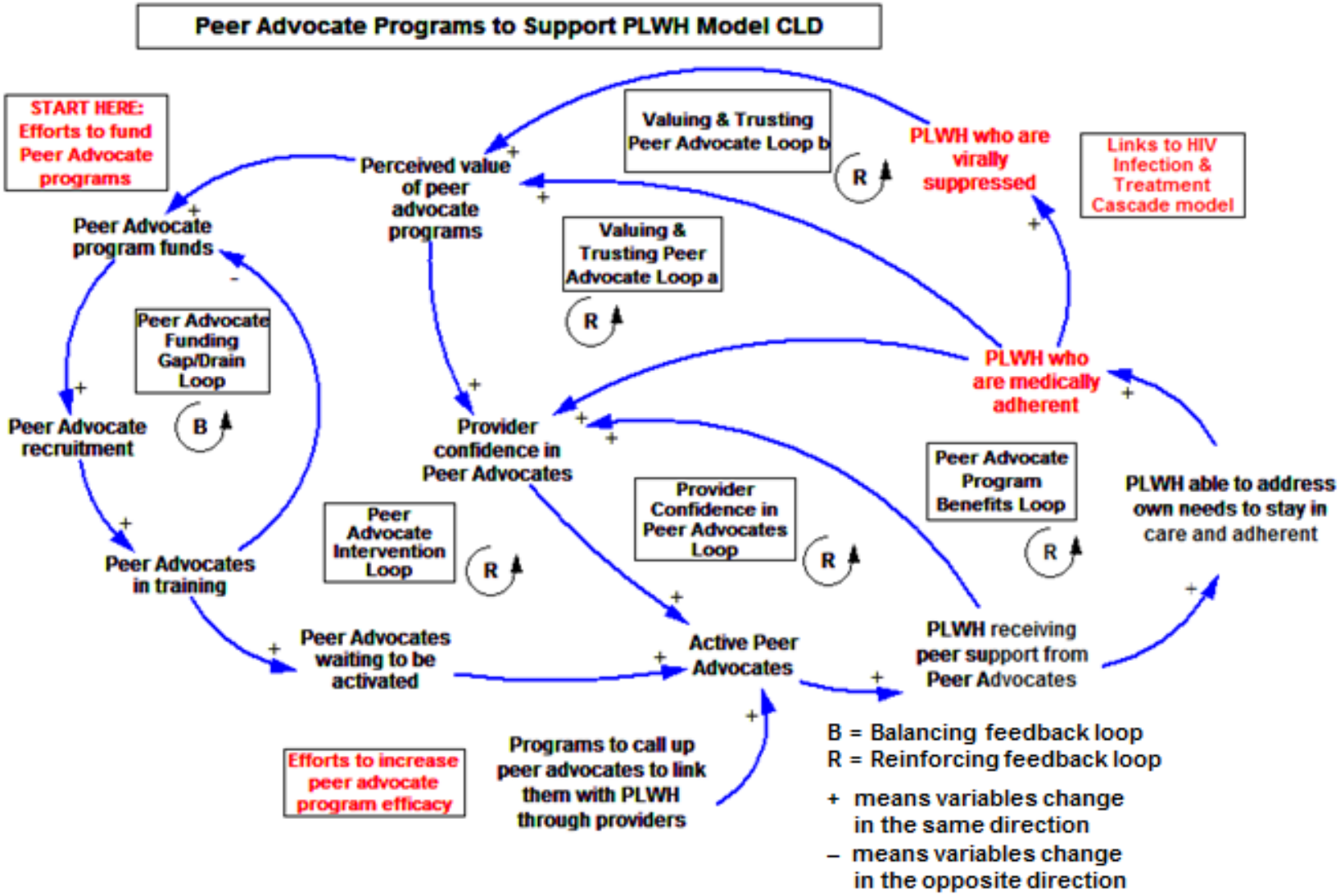
Run 1: Action strategy switch is turned off
Run 2: Action strategy switch is turned on starting at Month 6

* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

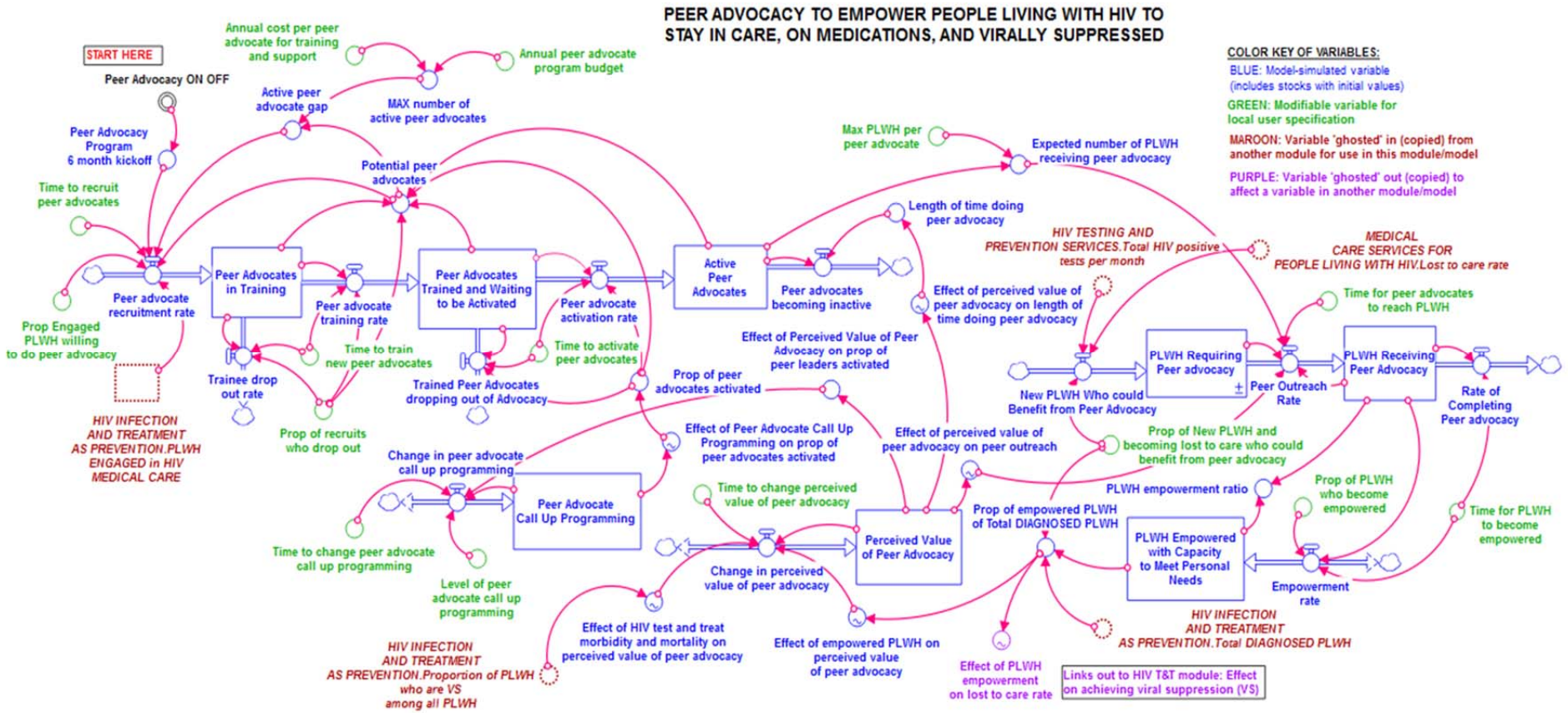
Chapter 9: PEER ADVOCACY TO SUPPORT PLWH MODULE



Peer Advocacy to Support PLWH Module: Causal Loop Diagram (CLD)



Peer Advocacy to Support PLWH Module: Stock/Flow Model



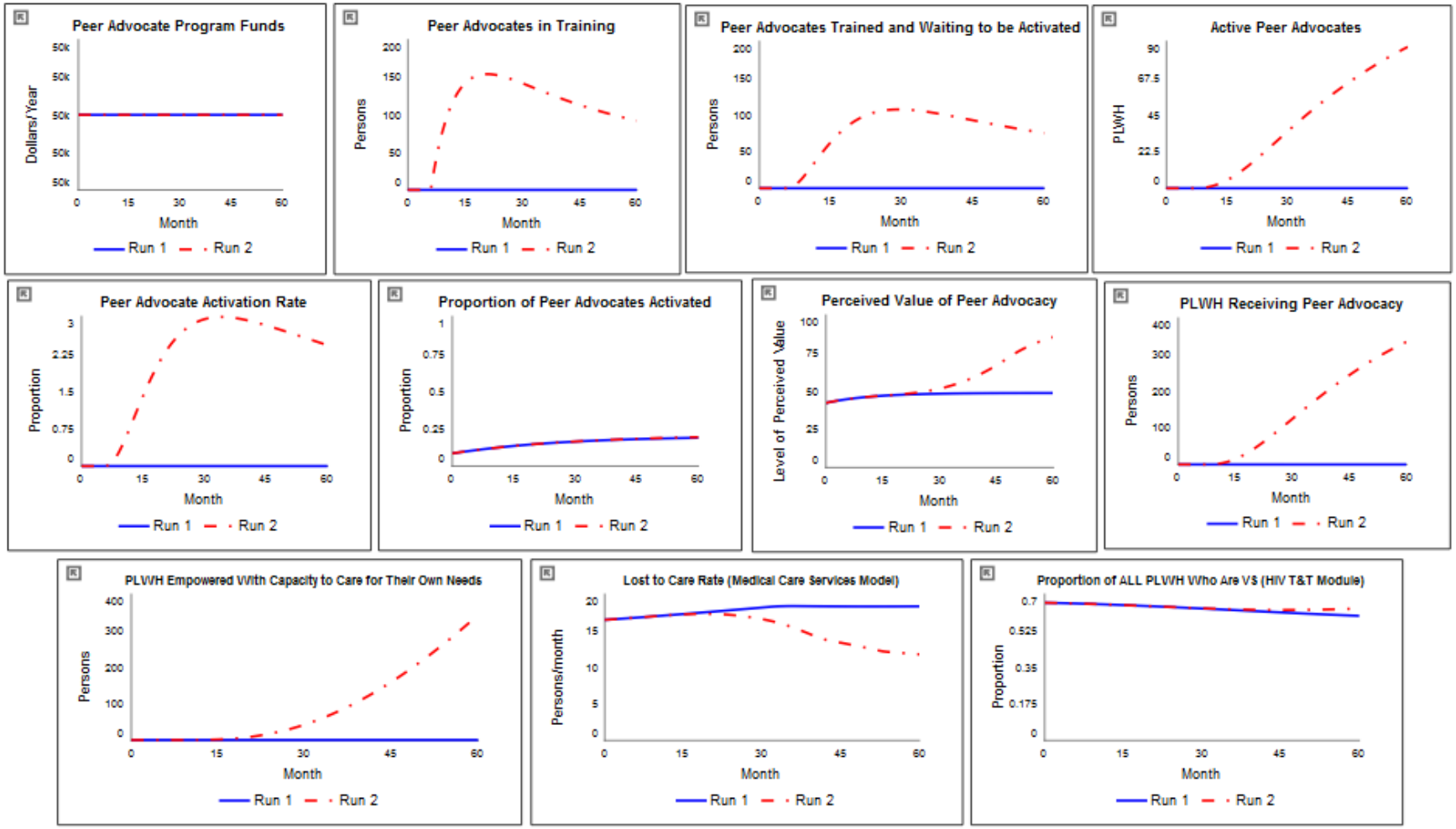
Peer Advocacy to Support PLWH Module: Key Modifiable Variables

PEER ADVOCACY TO SUPPORT PLWH MODULE CALIBRATION WORKSHEET

		ESTIMATES USED IN THE BASE MODEL			
		Catchment area: Hartford TGA			
YEAR USED FOR INITIAL CALCULATIONS:	NA	Actual number used		Equivalent to:	Codes:
PEER ADVOCACY RESOURCES					
Annual peer advocate program budget		50000	(dollars)	$50,000 per year	3
Annual cost per peer advocate for training and support		250	(dollars)	$250/year per peer advocate	3
PEER ADVOCACY PROGRAM IMPLEMENTATION					
Time (needed) to recruit peer advocates		6	(months)	6 months	3
Time needed to train new peer advocates		6	(months)	6 months	3
Proportion of recruits who drop out (of peer advocate training)		0.25		25% of peer leaders in training	3
Time (needed) to activate trained peer advocates		6	(months)	6 months	3
Time needed to change peer advocacy call-up programming		12	(months)	1 year	3
Level of peer advocate call-up programming |Range 0 - 100|		20		On a scale of 0-100: 20	3
Time (needed) to change perceived value of peer advocacy		12	(months)	1 year	3
Maximum PLWH per peer advocate (maximum capacity of peer advocate)		4	(persons)	4 PLWH per peer advocate	3
Proportion of new PLWH and those becoming lost to care who could benefit from peer advocacy support		0.50		50% of new PLWH or those becoming lost to care	1
Time needed for peer advocates to reach PLWH		3	(months)	3 months	3
Time (needed) for PLWH (who received peer advocacy) to become empowered (to care for their own health needs)		12	(months)	1 year	3
Proportion of PLWH who become empowered (after receiving peer advocacy)		0.50		50% of PLWH who receive peer advocacy	3

Codes:		
	1	**Conditions of the Population and the Epidemic**
	2	**Service Delivery Conditions and Protocols**
	3	**Intervention Strategies to Improve the System**
	4	**Mathematical Calibrations**

Peer Advocacy to Support PLWH Module: Base Case Run Output Graphs*

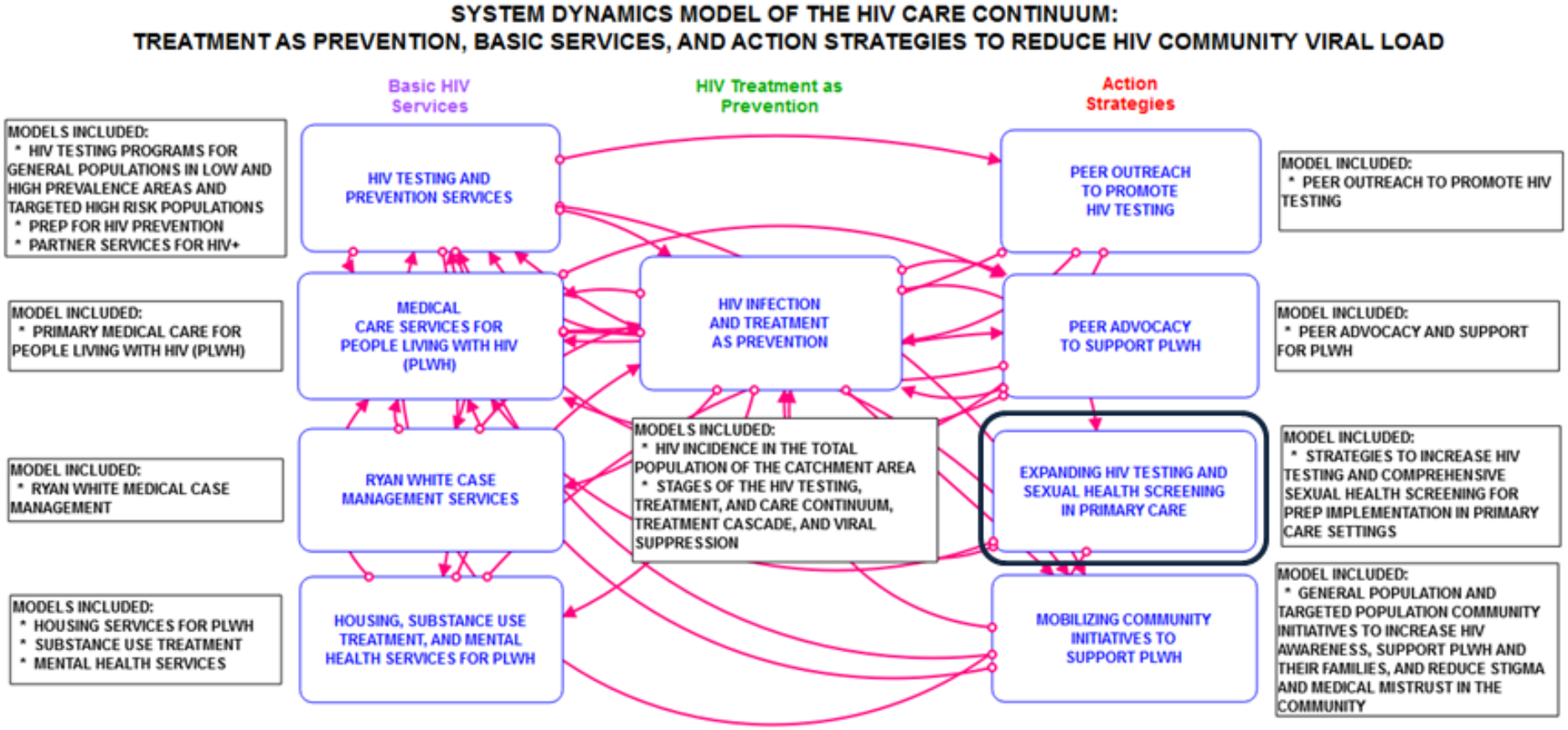


Run 1: Action strategy switch is turned off

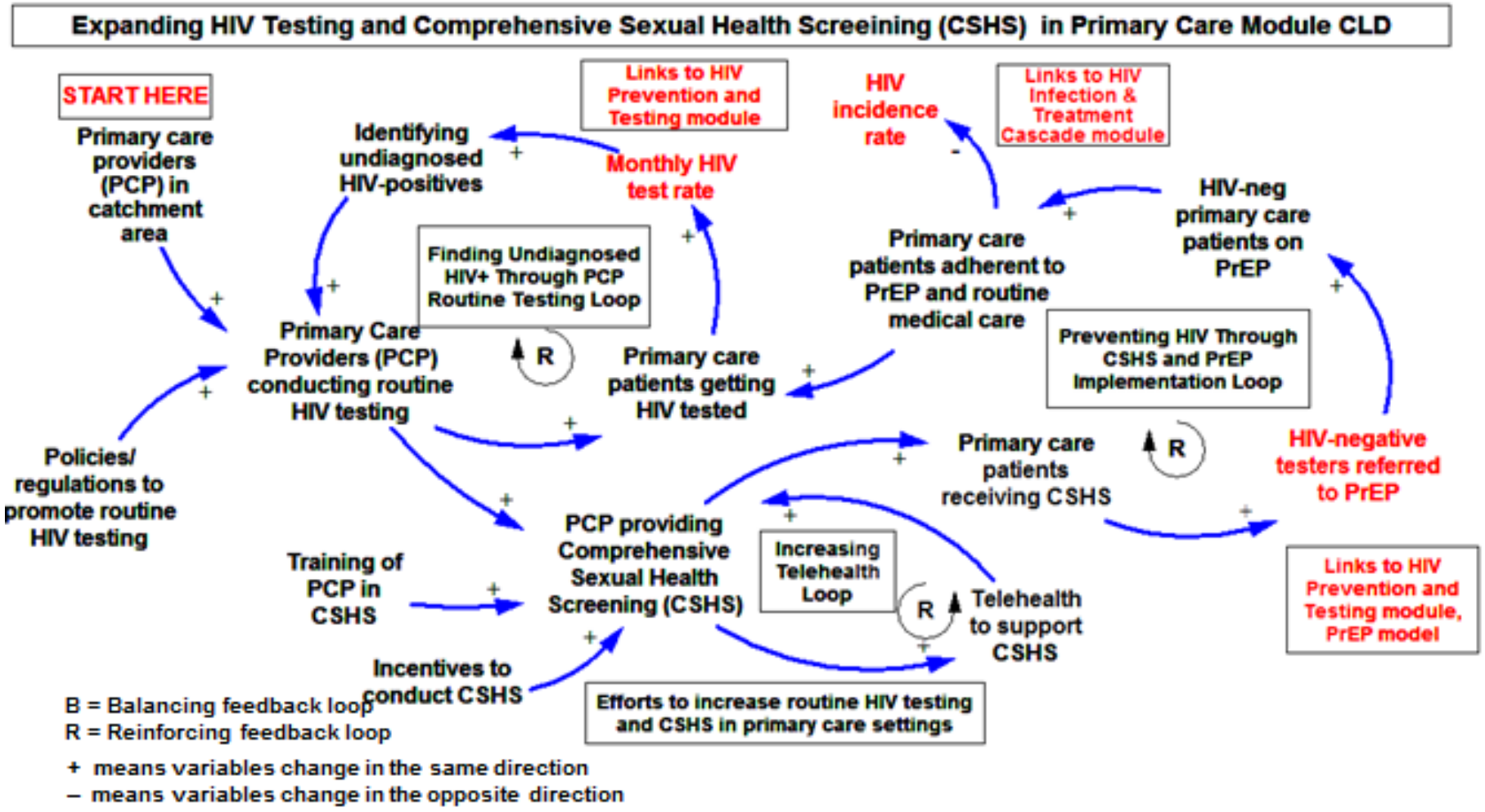
Run 2: Action strategy switch is turned on starting at Month 6

* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

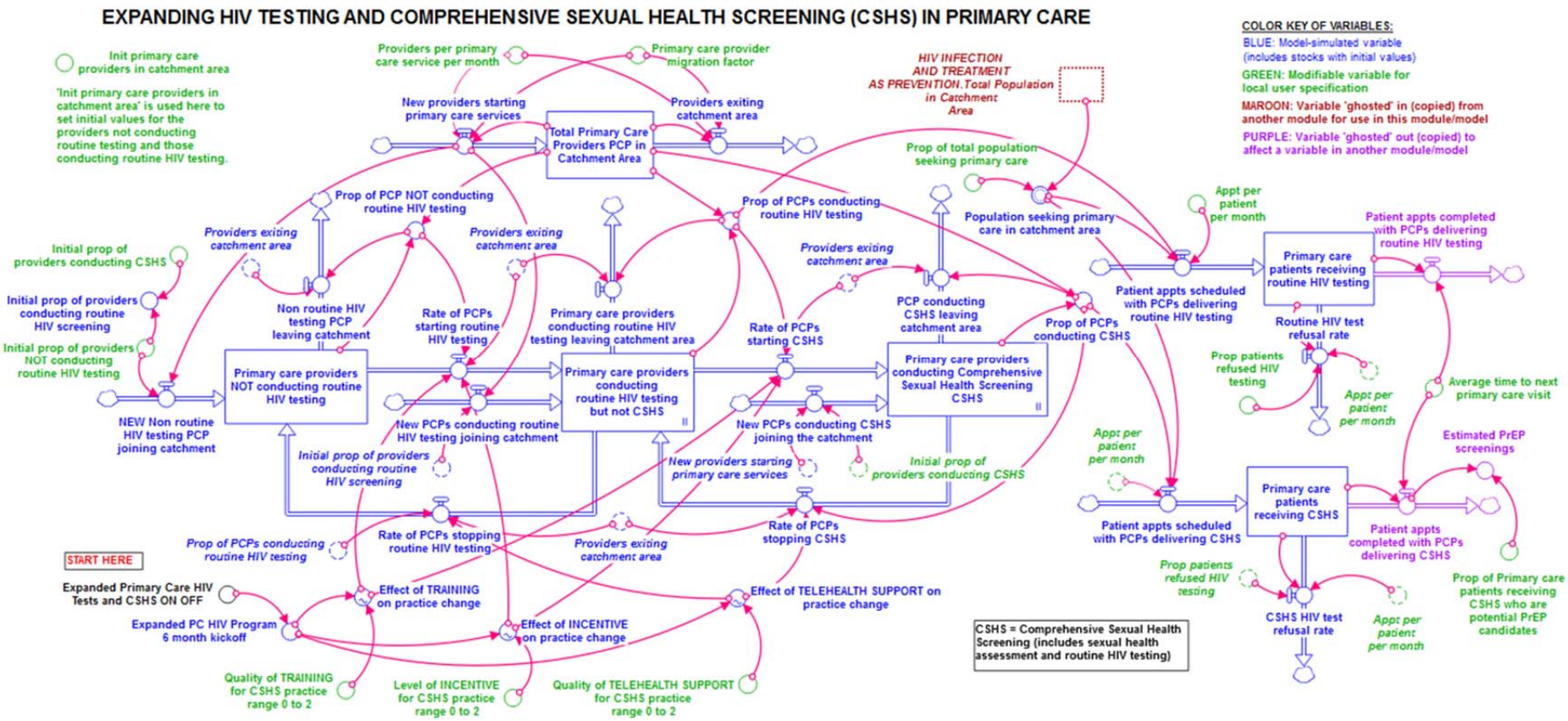
Chapter 10: EXPANDING HIV TESTING AND SEXUAL HEALTH SCREENING IN PRIMARY CARE MODULE



Expanding HIV Testing and Sexual Health Screening in Primary Care Module: Causal Loop Diagram (CLD)



Expanding HIV Testing and Sexual Health Screening in Primary Care Module: Stock/Flow Model



Expanding HIV Testing and Sexual Health Screening in Primary Care Module: Key Modifiable Variables

EXPANDING HIV TESTING IN PRIMARY CARE MODULE CALIBRATION WORKSHEET

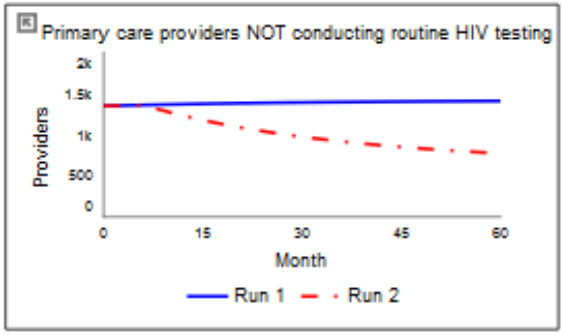
ESTIMATES USED IN THE BASE MODEL

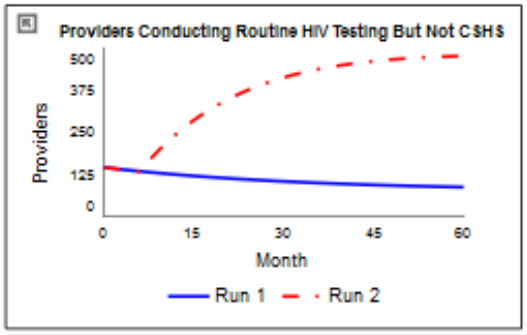
Catchment area: Hartford TGA

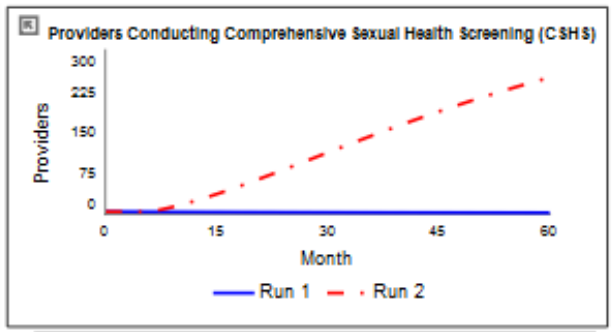
YEAR USED FOR INITIAL ESTIMATES: NA	Actual number used (units)		Equivalent to:	Codes:
PRIMARY CARE PROVIDERS IN THE AREA				
Initial # of primary care providers (PCPs) in catchment area	1500	(persons)	1,500 PCPs (MD, DO, PA, APRN)	1
Primary care provider migration factor (proportion of PCPs' in and out migration)	0.01		1% per month	1
Initial proportion of PCPs conducting comprehensive sexual health screenings (CSHS)	.005		0.5% (half of 1%)	2
Initial proportion of providers NOT conducting routine HIV testing	0.85		85%	2
Quality of training for CSHS practice (range of 0 to 2)	0		No (0), Low (1) High (2)	3
Level of incentives for CSHS practice (range of 0 to 2)	2		No (0), Low (1) High (2)	3
Quality of telehealth support for CSHS practice (range of 0 to 2)	2		No (0), Low (1) High (2)	3
PATIENTS IN THE AREA				
Proportion of TOTAL population in the catchment area seeking primary care	0.25		25% of the local population	1
Proportion of patients who refuse HIV testing	0.25		25% of patients	1
Proportion of primary care patients receiving CSHS who are potential PrEP candidates	0.10		10% of patients receiving CSHS	1
Average time to next primary care visit	18	(months)	1 and 1/2 years	2
Appointments per patient per month	1	(1/month)	one appointment per year	4

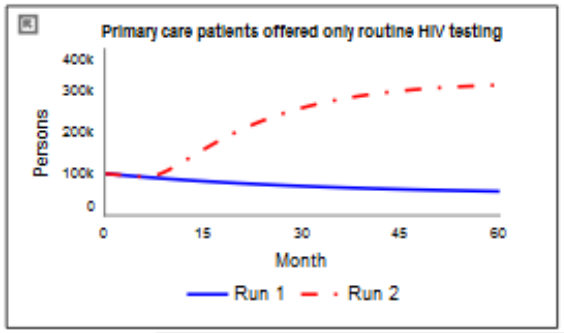
Codes:		
	1	**Conditions of the Population and the Epidemic**
	2	**Service Delivery Conditions and Protocols**
	3	**Intervention Strategies to Improve the System**
	4	**Mathematical Calibrations**

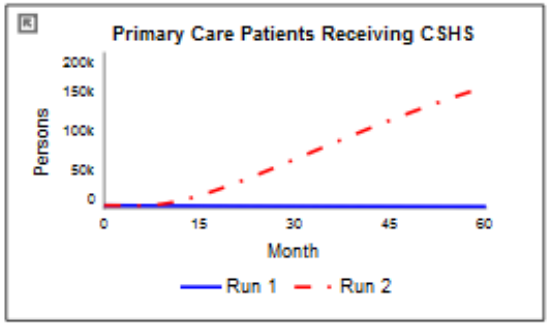
Expanding HIV Testing and Sexual Health Screening in Primary Care Module: Base Case Run Output Graphs*

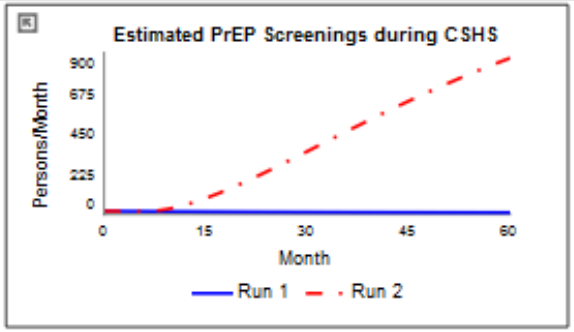


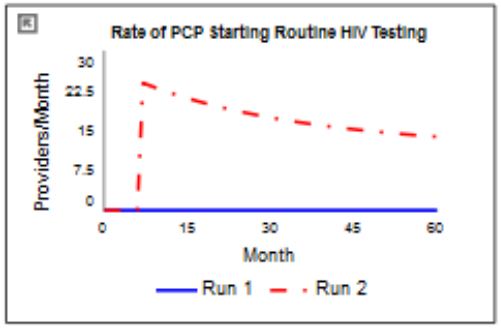


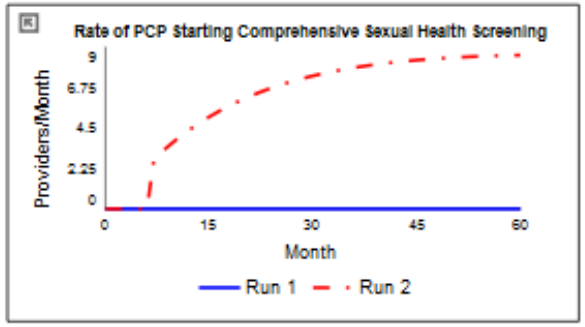












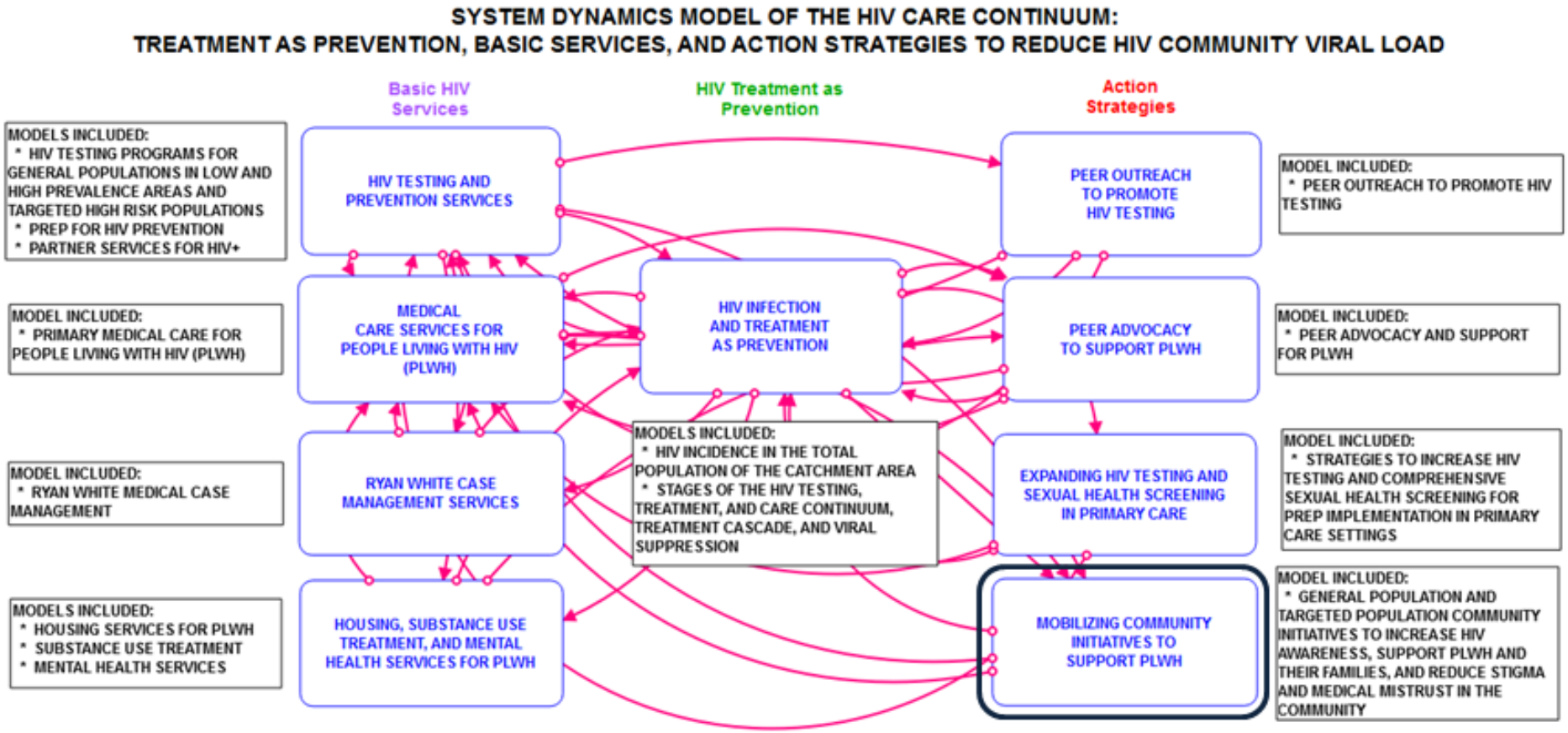
CSHS = Comprehensive Sexual Health Screening (includes sexual health assessment and routine HIV testing)

Run 1: Action strategy switch is turned off

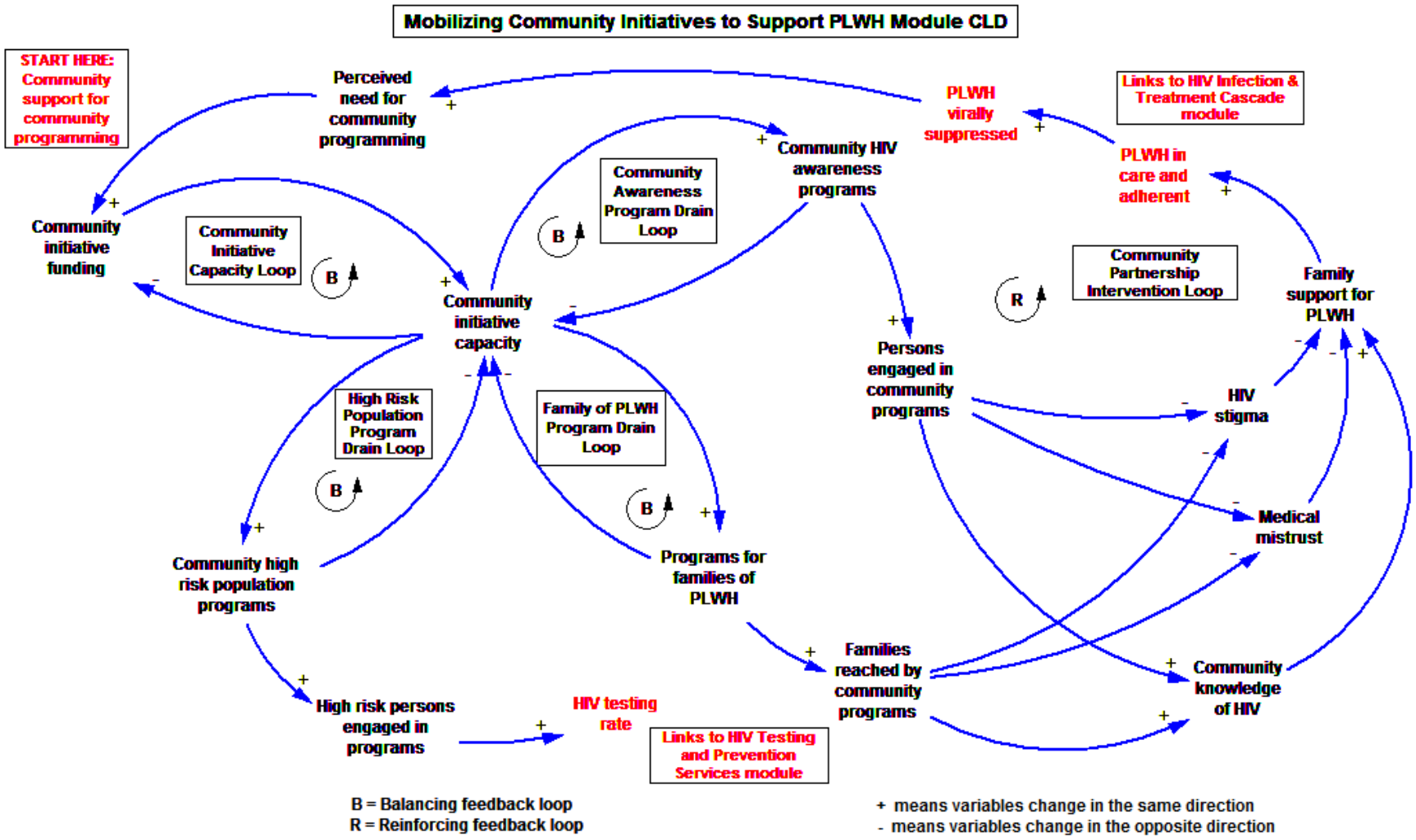
Run 2: Action strategy switch is turned on starting at Month 6

* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

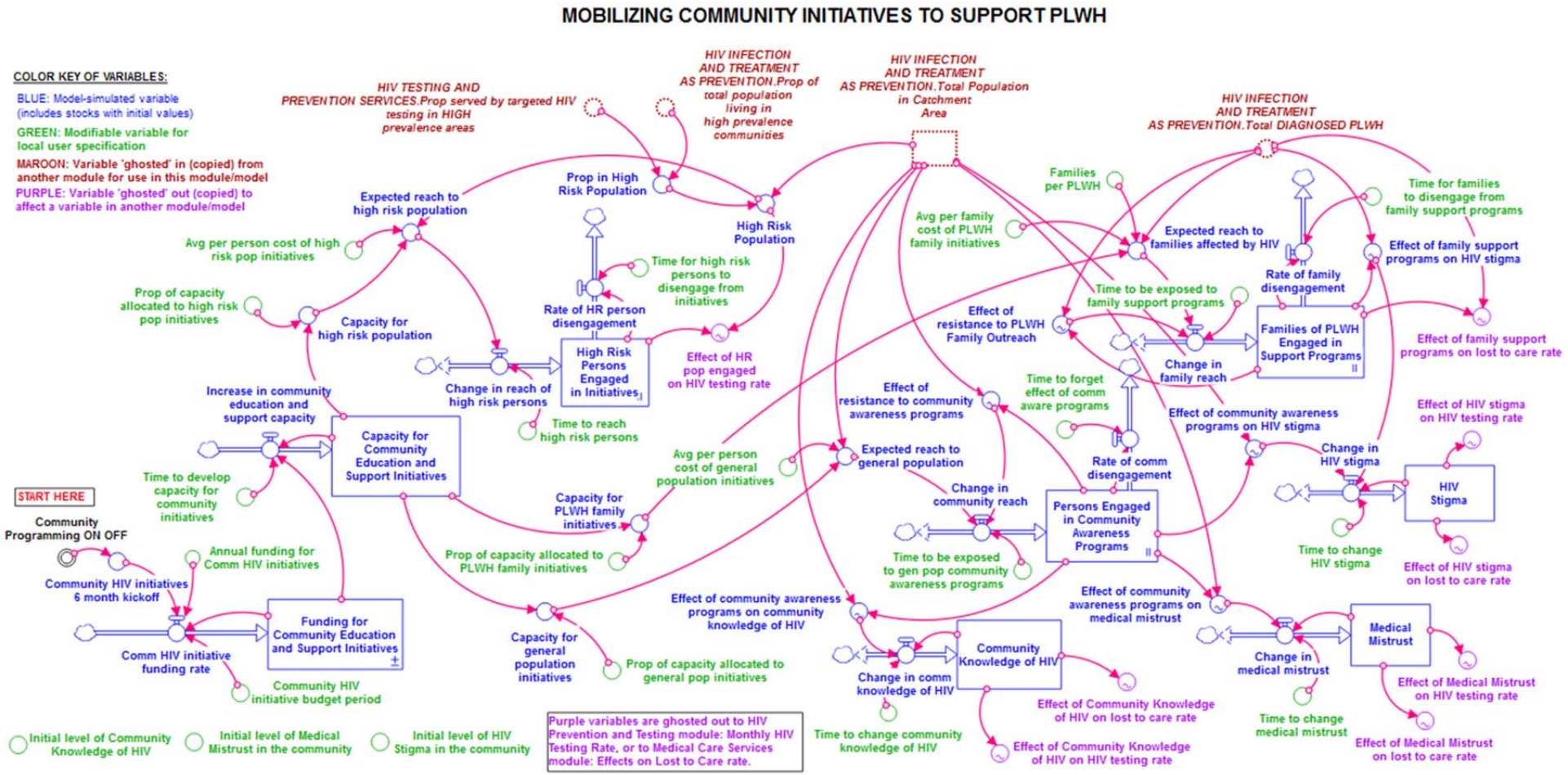
Chapter 11: MOBILIZING COMMUNITY INITIATIVES TO SUPPORT PLWH MODULE



Mobilizing Community Initiatives to Support PLWH Module: Causal Loop Diagram (CLD)



Mobilizing Community Initiatives to Support PLWH Module: Stock/Flow Model



Mobilizing Community Initiatives to Support PLWH Module: Key Modifiable Variables

MOBILIZING COMMUNITY INITIATIVES TO SUPPORT PLWH MODULE

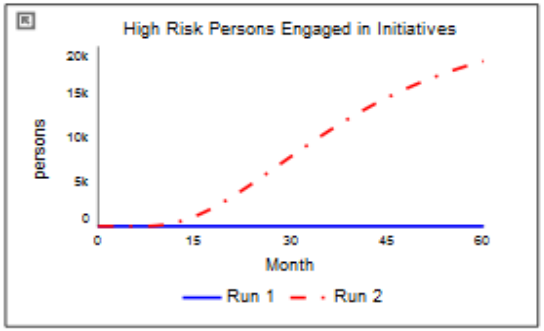
CALIBRATION WORKSHEET — **ESTIMATES USED IN THE BASE MODEL**

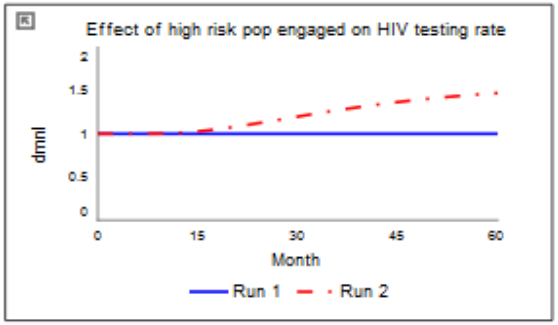
Catchment area: Hartford TGA

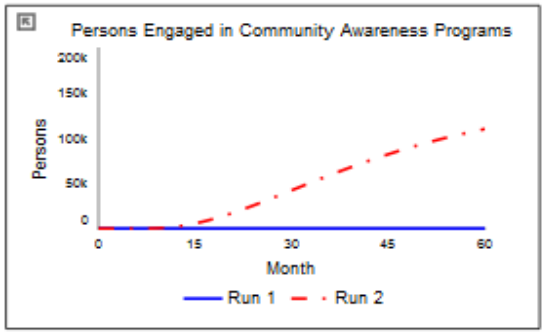
YEAR USED FOR INITIAL ESTIMATES: NA	Actual number used (units)		Equivalent to:	Code:
COMMUNITY PROGRAMMING				
Annual funding for community HIV initiatives	300000	(dollars)	$300,000/year	3
Community HIV initiative budget period	12	(months)	1 year	3
Time to develop capacity for community initiatives	6	(months)	6 months	3
Proportion of capacity allocated to high risk population initiatives	0.50		50% of comm initiative dollars	3
Average per person cost of high risk population initiatives	10	(dollars)	$10 per high risk person/yr.	3
Time (needed) to reach high risk persons (with initiatives)	12	(months)	1 year	3
Time (it takes) for high risk persons to disengage from initiatives	18	(months)	18 months	3
Proportion of capacity allocated to PLWH family initiatives	0.25		25% of comm initiative dollars	3
Average per family cost of PLWH family initiatives	50	(dollars)	$50 per family/yr.	3
Time (needed) to be exposed to family support programs	12	(months)	1 year	3
Time (it takes) for families to disengage from family support programs	48	(months)	4 years	3
Proportion of capacity allocated to general population initiatives	0.25		25% of comm initiative dollars	3
Average per person cost of general population initiatives	1	(dollars)	$1 per person/yr.	3
Time (needed) to be exposed to general population community awareness programs	12	(months)	1 year	3
Time (it takes) to forget effect of community awareness programs	24	(months)	2 years	3
Families per PLWH	1		1 family per PLWH	1
IMPACT OF COMMUNITY PROGRAMMING				
Initial level of HIV stigma (in the community) |range 0 - 100|	70		On a scale of 0 to 100: 70	3
Initial level of HIV medical mistrust (in the community) |range 0 - 100|	60		On a scale of 0 to 100: 60	3
Initial level of community knowledge of HIV |range 0 - 100|	50		On a scale of 0 to 100: 50	3
Time (needed) to change community knowledge of HIV	24	(months)	2 years	1
Time (needed) to change medical mistrust	24	(months)	2 years	1
Time (needed) to change HIV stigma	24	(months)	2 years	1

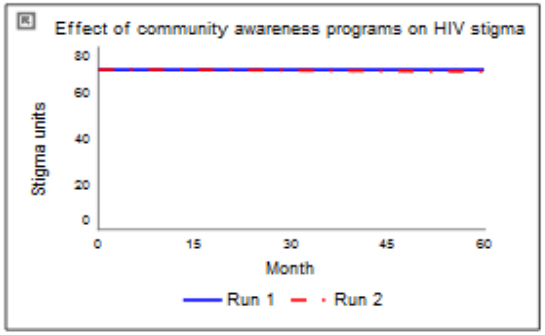
Codes:		
	1	Conditions of the Population and the Epidemic
	2	Service Delivery Conditions and Protocols
	3	Intervention Strategies to Improve the System
	4	Mathematical Calibrations

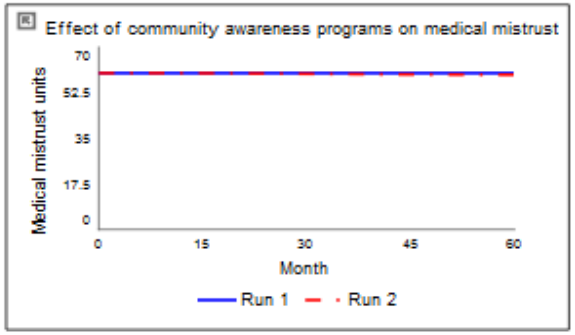
Mobilizing Community Initiatives to Support PLWH Module:
Base Case Run Output Graphs*
Community Initiatives and Effects

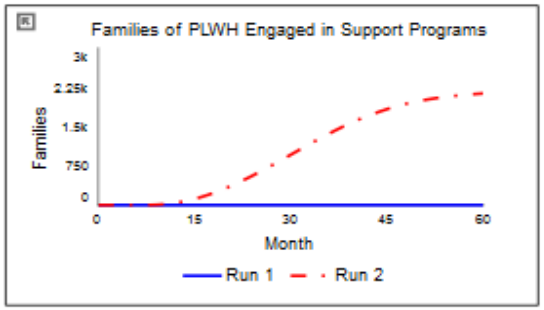


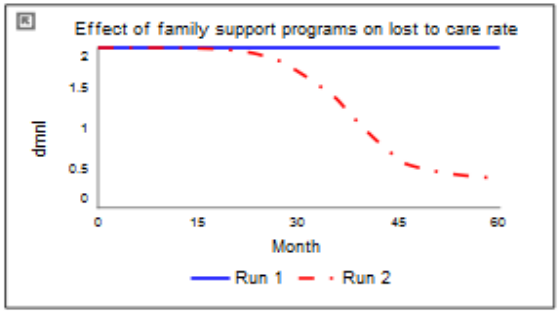


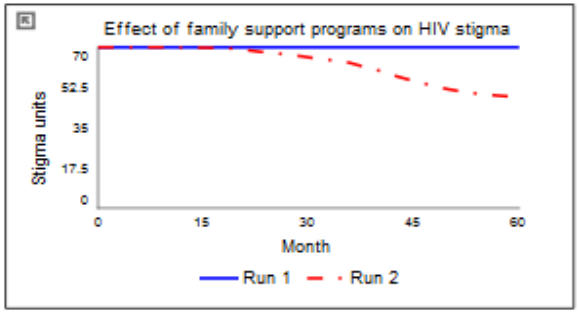










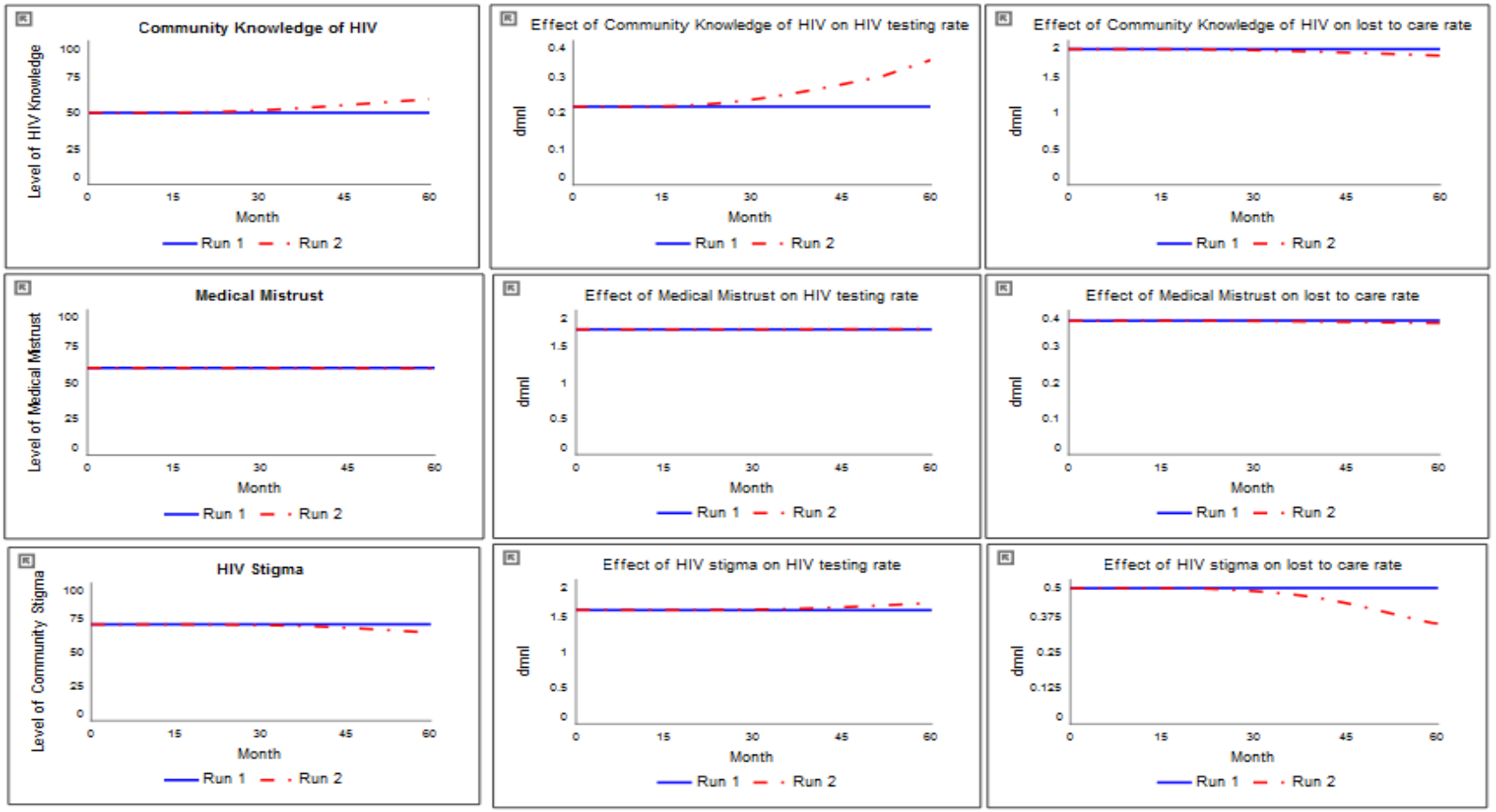


Run 1: Action strategy switch is turned off

Run 2: Action strategy switch is turned on starting at Month 6

* **Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

Mobilizing Community Initiatives to Support PLWH Module
Base Case Run Output Graphs*
Community Level HIV Knowledge and Attitudes: Effects on HIV Care Continuum



Run 1: Action strategy switch is turned off
Run 2: Action strategy switch is turned on starting at Month 6
*** Month 0 on all output graphs was calibrated to represent 2017 in the catchment area.**

ACKNOWLEDGEMENTS

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Greater Hartford HIV System Dynamics Modeling Task Force, February 14, 2018

Our research team included Maryann Abbott, Marcie Berman, Candace Corbile, Rosely Gonzalez, Helena D. Green, Matthew Hartman, Gary Hirsch, Jianghong Li, David Lounsbury, Heather Mosher, Lucy Rohena, Apoorva Salvi, and Margaret Weeks.

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Executive Director and Senior Scientist
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