PHSSR Research-In-Progress Series:

Quality, Cost and Value of Public Health Services

Wednesday, June 3, 2015 12:00 - 1:00 pm ET

Go With the Flow: Understanding the Temporal Dynamics of the HIV Treatment Cascade in the United States

To download today's presentation & speaker bios, see the 'Resources' box in the top right corner of the screen.

Agenda

Welcome: C.B. Mamaril, PhD, Research Assistant Professor, Health Management & Policy, University of Kentucky College of Public Health

"Go With the Flow: Understanding the Temporal Dynamics of the HIV Treatment Cascade in the United States"

Presenter: Gregg Gonsalves, M Phil, Research Scholar & Lecturer, Yale Law School, and PhD candidate, Epidemiology of Microbial Diseases Department, Yale School of Public Health *gregg.gonsalves@yale.edu*

Commentary: Paul D. Cleary, PhD, Dean, Yale School of Public Health; Director, Center for Interdisciplinary Research on AIDS *paul.cleary@yale.edu*
Elaine O'Keefe, MS, Executive Director, Center for Interdisciplinary Research on AIDS ; Yale School of Public Health Office of Public Health Practice *elaine.okeefe@yale.edu*

Questions and Discussion

Presenter

Gregg Gonsalves, M Phil

Research Scholar in Law and Lecturer in Law, Yale Law School

Co-director, Global Health Justice Partnership

PhD candidate, Epidemiology of Microbial Diseases Department, Yale School of Public Health

Pre-doctoral Scholar in Public Health Delivery, 2014 PHSSR award

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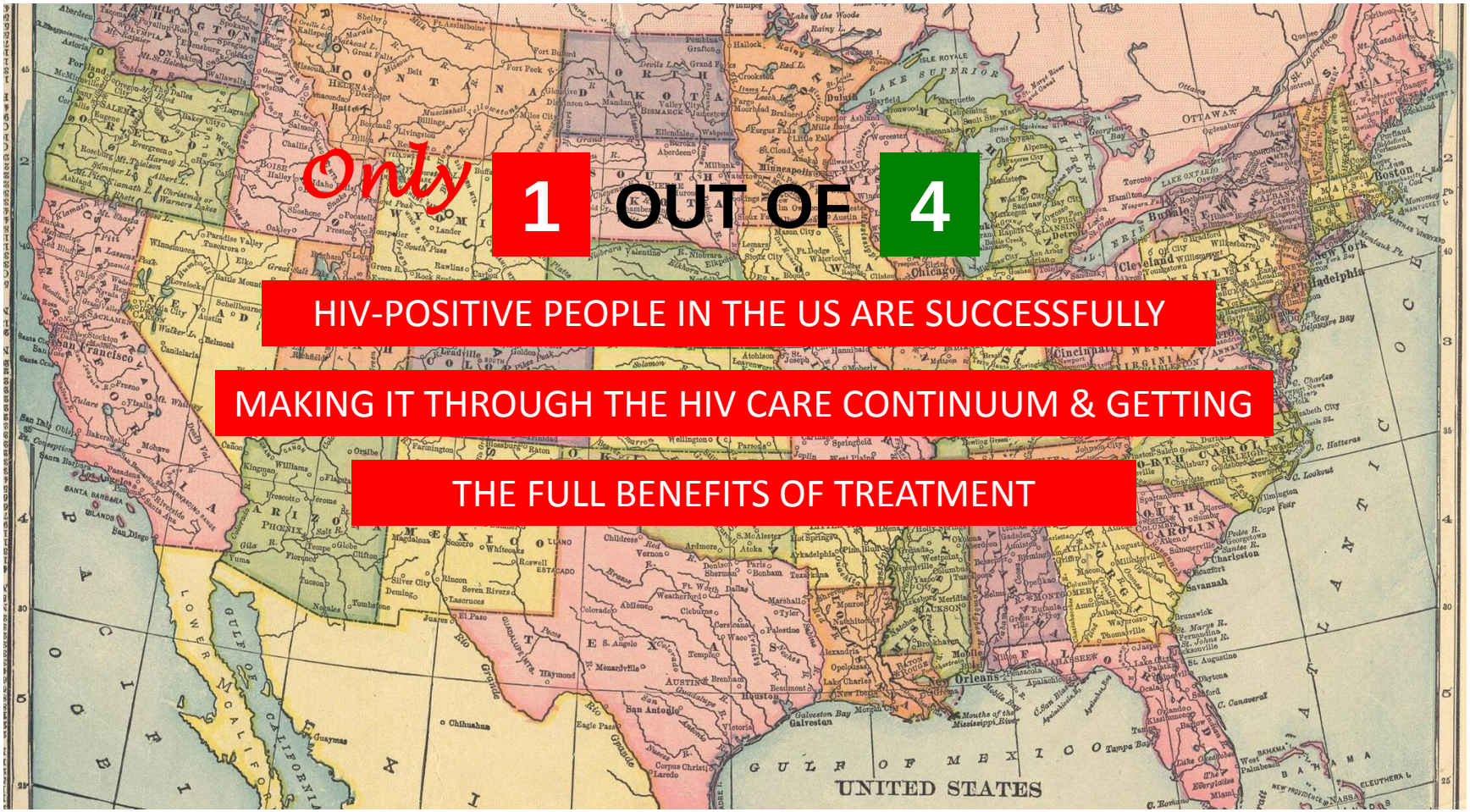
Go With the Flow: The Temporal Dynamics of the HIV Treatment Cascade

Gregg Gonsalves MPhil,[1] Edward Kaplan PhD,[2] David Paltiel PhD,[1] Paul Cleary PhD[1]

[1]Yale School of Public Health, New Haven, CT and [2]Yale School of Management, New Haven, CT

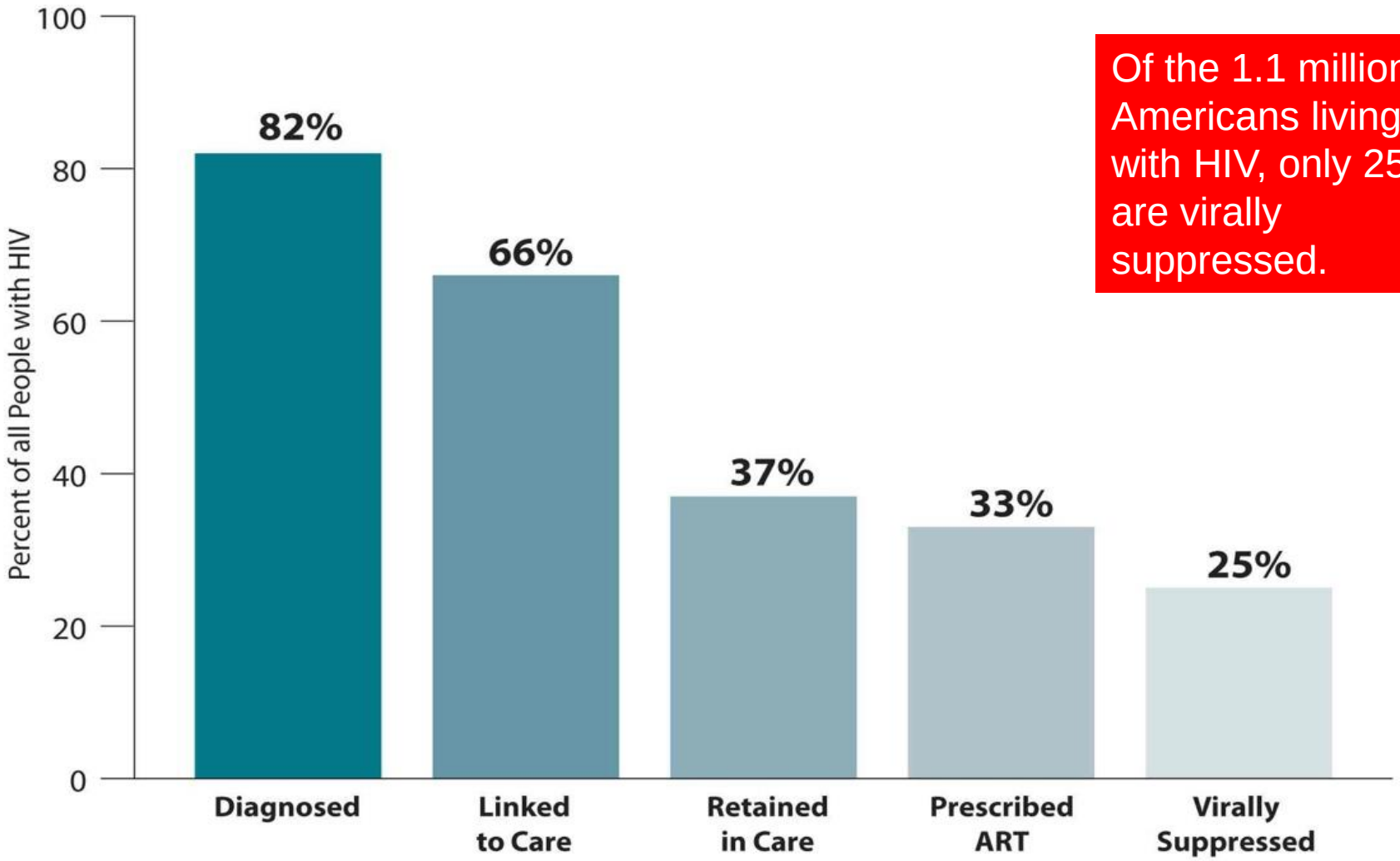

Only 1 OUT OF 4
HIV-POSITIVE PEOPLE IN THE US ARE SUCCESSFULLY
MAKING IT THROUGH THE HIV CARE CONTINUUM & GETTING
THE FULL BENEFITS OF TREATMENT
UNITED STATES

Each year, 9 out of 10 new HIV infections are transmitted by individuals who are not in care.

For every 100 people on successful antiretroviral therapy, less than 1 new infection occurs.

Skarbinski J, Rosenberg E, Paz-Bailey G, et al. Human Immunodeficiency Virus Transmission at Each Step of the Care Continuum in the United States. JAMA Intern Med. 2015;175(4):588-596

The HIV Treatment Cascade



Of the 1.1 million Americans living with HIV, only 25% are virally suppressed.

What does the HIV treatment cascade tell us?

If you wanted to get more people through the cascade and virally suppressed, what would you do?

We need more information

- To improve outcomes we need to know:
  - how long it takes an individual to get through each stage;
  - the probability of dropping out in each stage

- Operations research offers a new way to think about the treatment cascade.

Queueing Theory and Little's Law

- Queueing theory is used to model waits in lines.
- Little's law:

Average number of items in a system

Average wait time in the system

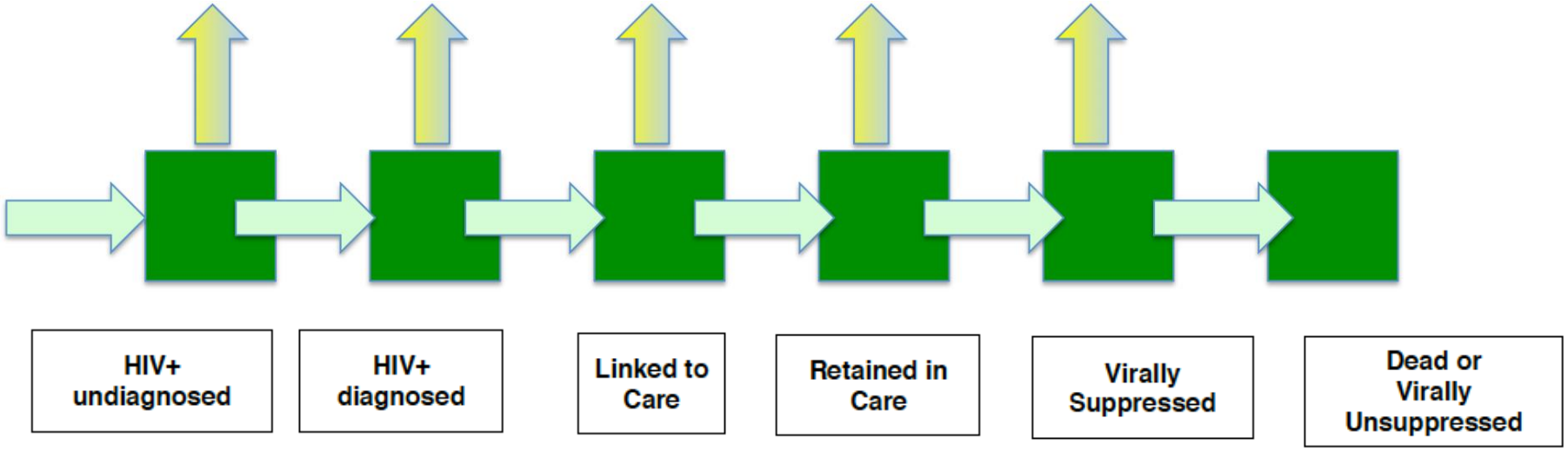
$$L = \lambda W$$

Average arrival rate

- Little's law for epidemiologists:

  prevalence = incidence × duration

A Queueing Model of the HIV Treatment Cascade



A Queueing Model of the Treatment Cascade: General Form

$$E(X_i) = \lambda \prod_{j}^{i-1} (1 - p_j) E(T_i)$$

prevalence	incidence	duration

where:

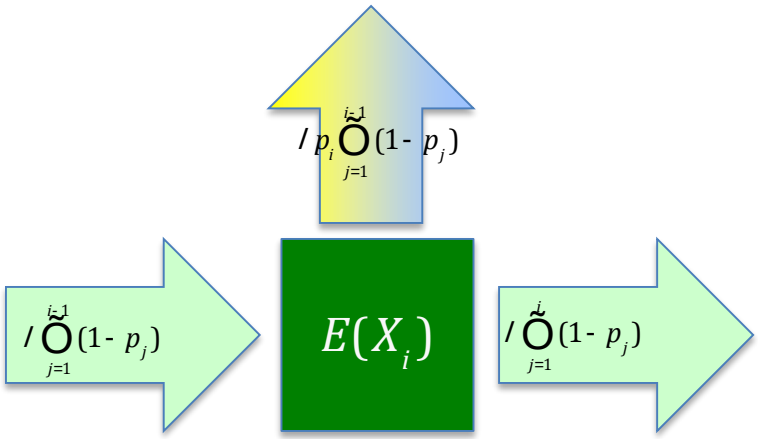
λ = new infection rate

x_i = number in stage i

T_i = time resident in stage i

p_i = probability of dropout after stage i

i = 1, 2, 3, 4, 5, 6



Direct and Indirect Measures for Stages in the Cascade

- treatment cascade studies often use proxy measures to stand in for *some* stages of the continuum of care:
    - *At least one viral load or CD4 test for linkage to care*
    - *≥ 2 viral load or CD4 tests for retention in care*

Data for Our Study

- Individuals aged ≥13 years and diagnosed with HIV infection in 2009
- Individuals are followed for their CD4/VL tests from the diagnosis date to 12/31/2012 (censor date is 12/31/2012)
- Individuals with ≥3 years follow up time
- CDC data from 2009-2012 from:
  - California (Los Angeles County and San Francisco only), the District of Columbia, Hawaii, Illinois, Indiana, Iowa, Louisiana, Michigan, Missouri, New Hampshire and New York (both NY State and New York City), North Dakota, South Carolina, West Virginia and Wyoming

Fitting the Data

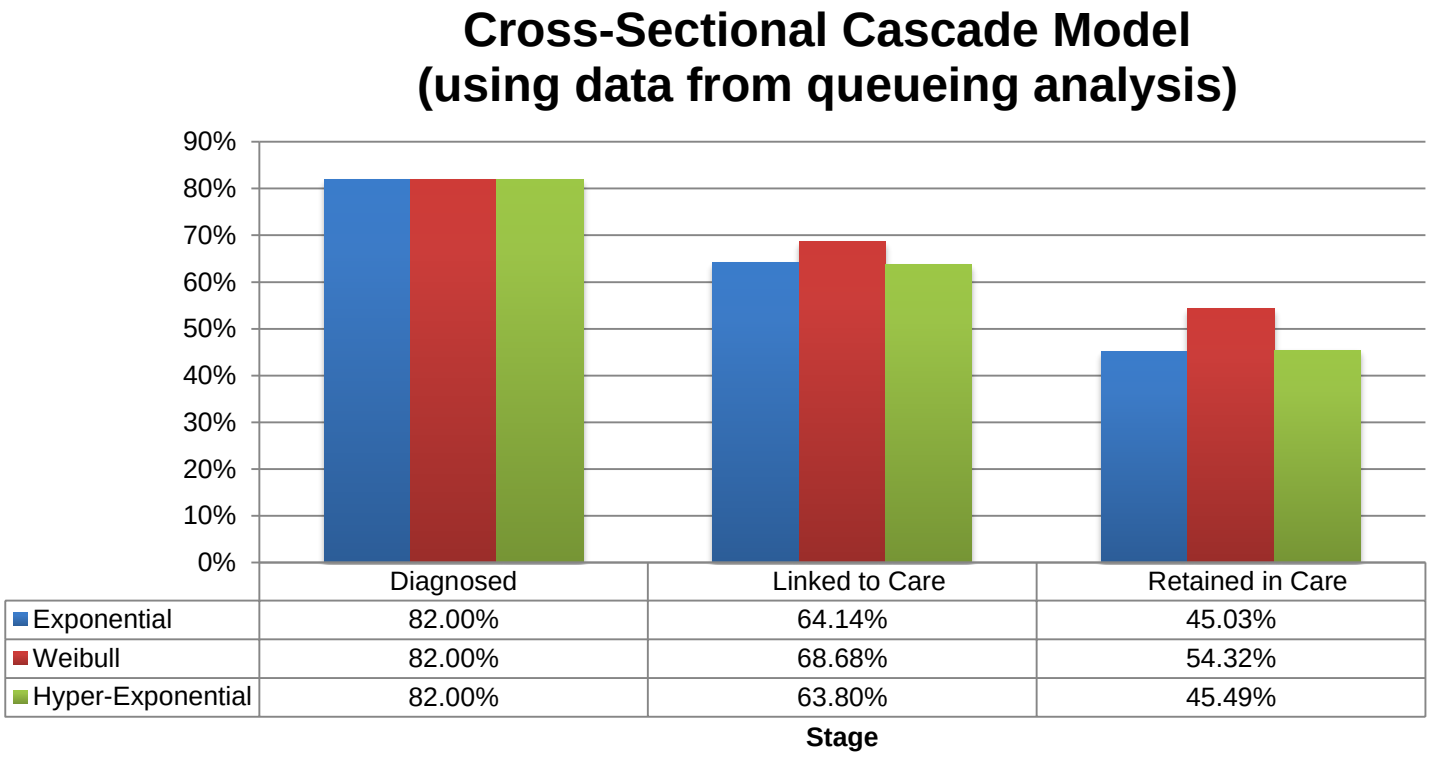
- To estimate the expected time in and the dropout probability from each stage, we have computed three survival models:
  - Exponential
    - progression into the next stage and the dropout rate constant over time
  - Weibull
    - hazard rates for progression to the next stage or dropping out proportional to each other
    - dropout probabilities do not depend on time spent in stage
  - Hyperexponential
    - two classes of patients, slow and fast progressors
    - each class has its own constant progression rate, and same constant dropout rate.
- log likelihood values used to assess degree of fit

Preliminary Results

Stage	Model *Exponential*	*Weibull*	*Hyperexponential*
Diagnosed (before 1st CD4/VL test)			
Time in Stage E(T_S) in months	3.13	3.11	4.84
95% CI	3.109-3.151	2.979-3.241	4.455-5.225
Dropout Fraction	0.0826	0.0785	0.0668
95% CI	0.0674-0.0978	0.0738-0.0832	0.0608-0.0728
Log Likelihoods	-31077.48	-27267.24	-26409.78
Linked to Care (before 2nd CD4/VL test)			
Time in Stage E(T_S) in months	3.65	3.64	5.22
95% CI	3.583-3.717	3.546-3.734	4.643-5.797
Dropout Fraction	0.0578	0.0561	0.0374
95% CI	0.0536-0.0620	0.0519-0.0603	0.0294-0.0454
Log Likelihoods	-29634.68	-28856.88	-28368.74
Retained in Care (before undetectable VL test)			
Time in Stage E(T_S) in months	9.13	14.59	13.47
95% CI	8.908-9.352	13.324-15.856	12.078-14.862
Dropout Fraction	0.1709	0.0938	0.1087
95% CI	0.1633-0.1785	0.0777-0.1099	0.0879-0.1295
Log Likelihoods	-33747.35	-33077.58	-33240.37

Cross Sectional Cascade from Queueing Analysis

- One can also construct a descriptive, cross-sectional model of the treatment cascade using a queueing model.



	Diagnosed	Linked to Care	Retained in Care
Exponential	82.00%	64.14%	45.03%
Weibull	82.00%	68.68%	54.32%
Hyper-Exponential	82.00%	63.80%	45.49%

Discussion

- We can construct a temporal model of the HIV treatment cascade using available data.

- Speeding progress through and reducing the probability of dropout from each stage are two complementary strategies to improve treatment and prevention outcomes in HIV/AIDS.

- Speeding progress through the cascade and reducing the probability of dropout are different operational tasks, with the first involving system efficiency, overall patient management and the latter involving one-on-one interactions with the patient.

Commentary

Paul D. Cleary, PhD

Dean, Yale School of Public Health

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Elaine O'Keefe, MS

Executive Director, CIRA

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Questions and Discussion

Archives of all Webinars available at:

http://www.publichealthsystems.org/phssr-research-progress-webinars

Upcoming Webinars – June 2015

Wednesday, June 10 (12-1pm ET)

ESTABLISHING THE EMPIRICAL FOUNDATION FOR MENTAL HEALTH-FOCUSED PUBLIC HEALTH SYSTEMS RESEARCH

Jonathan Purtle, DrPH, MPH, MSc, Drexel University School of Public Health

(PPS-PHD Award)

Thursday, June 18 (1-2pm ET)

INJURY-RELATED INFANT MORTALITY AMONG VULNERABLE POPULATIONS: ROLE OF PUBLIC HEALTH, PRIMARY CARE & POLICY

Sharla Smith, MPH, PhD, University of Kansas School of Medicine-Wichita

(PPS-PHD Award)

Upcoming Webinars – July and August 2015

Wednesday, July 1 (12-1pm ET)

The Affordable Care Act and Childhood Immunization Delivery in Rural Communities

Van Do-Reynoso, MPH, PhD Candidate, U. California-Merced *(PPS-PHD Award)*

Wednesday, July 8 (12-1pm ET)

National Evaluation of Leadership Styles and Outcomes in Local Health Departments

Laura Cassidy, MS, PhD, Medical College of Wisconsin *(RWJF PHS3 award)*

Wednesday, August 5 (12-1pm ET)

Applying failure Modes & Effects Analysis to Public Health: Breathe Easy at Home Programs

Megan Sandel, MD, MPH, FAAP, Boston Medical Center

Margaret Reid, RN, MPA, Director, Healthy Homes and Community Supports, Boston Public Health Commission *(RWJF PHS3 award)*

Thank you for participating in today's webinar!

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