Using a validated computer simulation to assess HIV prevention efforts in Connecticut

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Introduction

- Modeling can help health departments develop cost-effective prevention strategies.
- CIRA scientists and colleagues at the Connecticut Department of Public Health (CT DPH) have developed a mathematical model
  - Goal: Allocate DPH HIV prevention budget to maximize the number of HIV infections prevented.

Specific Aims

- To guide allocating HIV prevention resources to maximize the number of infections prevented.

- To interpret and apply the findings generated by the model to guide HIV prevention policy and funding decisions in Connecticut.

Why?

- Connecticut is 7th among the states in the rate of people living with AIDS.
  - We could do better
  - While there was a decline in the overall rate of new cases, some disturbing areas of persistence
- MSM now exceed IDUs.
  - MSM account for 45% of the 348 diagnosed HIV cases in 2011 versus 22% in 2002.
  - Approximately 5% of MSM in Connecticut are now estimated to be HIV positive.

Why?

- Although HIV/AIDS diagnoses occur statewide, the epidemic remains concentrated in small urban centers
  - Nearly 50% of all persons living with HIV/AIDS residing in the state's three largest cities of Bridgeport, Hartford and New Haven.
  - Blacks and Hispanics are disproportionately represented in both newly diagnosed and prevalent HIV/AIDS cases.

Why?

- Goals of the CT DPH for HIV
  - Similar to goals of adjacent jurisdictions
  - To decrease the incidence of HIV
  - To reduce community viral load by linking and retaining HIV-infected individuals to receipt of ART
  - To reduce HIV-related health disparities.
- As funds become more limited, it is increasingly important to optimize HIV prevention resources through a systematic, comprehensive, approach.
  - CT DPH has been working with CIRA to explore ways to support efficient (that is, most health per $ spent) decision making regarding HIV prevention strategies

"Essentially, all models are wrong, but some are useful."

- George E. P. Box, Statistician (b. 1918)

Methods – Data Sources

- HIV contact tracing results from CY2012 provided by CT DPH
  - 126 attempted interviewed
  - 115 interviewed
  - 10 newly identified positives
- Cascade data from CT DPH 2010-2011
  - For CT-funded program, linkage to care 88%
    - Better than for CT overall (64%)
  - Given in care, % with suppressed VL 72%

Methods – Data Sources

- Distribution of new HIV cases and STI co-infection based on 2011 CT DPH data
  - 69% MSM
  - 14% IDU
  - 17% WSM
  - 25% co-infected with STI
- Cost data from CT DPH

Methods – Data sources

- Some inputs extrapolated from NYC DOHMH data
  - Circumcision 57%
  - Always condom use 34%
  - Concurrent partners (2-3) 31%
  - Concurrent partners (>3) 9%
- Conservative assumptions about viral load suppression (non-RCT) from observational data
  - Suppressing viral load reduces infectivity by 7.7-fold
  - Consistent with HTPN 052 + pragmatic adherence assumptions

Results – Model Estimates

- Use simple adaptation of NYC sim (PLoS One 2013)
  - Using CT inputs, annual infections averted per newly detected
    - 0.085
  - Duration of infections averted per year
    - 2.8 years
  - Total infections averted per newly detected
    - = 0.085 infections/year X 2.8 years = 0.24 infections averted
- Cost per infection averted
  - $375,000 based on updating of Schackman et al
- Synthesizing above, to be cost-neutral, DOH could pay
  - $90k to find newly detected
  - $17k to link to care after finding
  - $13k/year virological suppression after finding

Cost Saving in long run?

Agencies	Type	Program Cost including HIV tests	Yield	Cost avoided by preventing HIV	Favorable value?
CT DPH		$853,931	10 identified 6 linked	$1,002,000	TRUE
	OTL	$172,200	2 identified and linked	$214,000	TRUE
	OTL	$161,440	2 identified and linked	$214,000	TRUE
	OTL	$159,600	3 identified and linked	$321,000	TRUE
	OTL	$166,980	1 identified and linked	$107,000	FALSE
	OTL	$71,577	0	$0	FALSE
	OTL	$182,040	0	$0	FALSE
	OTL	$148,992	2 identified and linked	$214,000	TRUE
	OTL	$79,948	0	$0	FALSE
	ETI	$173,850	1 identified and linked	$107,000	FALSE
	OTL	$913,473	9 identified and linked	$963,000	TRUE
	ETI	$117,693	6 identified and linked	$642,000	TRUE

Cost Saving in Long Run?

Agencies	Type	Total Cost	Yield	Cost avoided by preventing HIV	Favorable value?
CT DPH		$853,931	10 identified 6 linked	$1,002,000	TRUE
	OTL	$157,560	1 identified and linked	$107,000	FALSE
	OTL	$171,240	8 identified and linked	$856,000	TRUE
	OTL	$158,880	1 identified and linked	$107,000	FALSE
	OTL	$169,320	2 identified and linked	$214,000	TRUE
	OTL	$130,159	1 identified and linked	$0	FALSE
	ETI	$135,121	1 identified and linked	$107,000	FALSE
	OTL	$160,520	0	$0	FALSE
	ETI	$532,837	13 identified and linked	$1,391,000	TRUE
	ETI	$221,128	3 identified and linked	$321,000	TRUE
	ETI	$220,360	3 identified and linked	$321,000	TRUE
	ETI	$123,275	2 identified and linked	$214,000	TRUE
	ETI	$206,563	17 identified and linked	$1,819,000	TRUE

Conclusions

- 6 out of 8 ETIs and 7 out of 15 OTLs cost-saving
- If feasible
  - Incentives for high-performing contractors (green)
  - Incentives for low-performing contractors (red)
  - Consider value of performance
    - $90k – Find
    - $17k – Link
    - $107k – Find and link
    - $13k – Virological suppression per year

Limitations

- Statistical variation
  - Some sites may have bad year because of chance rather than poor performance
- Considers first generation infections only
- Does not consider varying time horizons
- Considers limited range of prevention options
  - Identification
  - Linking
- Does not consider success of linking
  - Gold standards:
    - Reduced viral load of linked
    - Reduced infectiousness

What did we do for NYC?

- Far more elaborate model
- More detailed representation of epidemic
- Different epidemic
- Could offer more detailed policy prescriptions

Interventions with favorable value

"favorable value": avert a new HIV infection at a lower cost than the estimated downstream cost of that infection (approximately $360,000 in 2011 dollars)

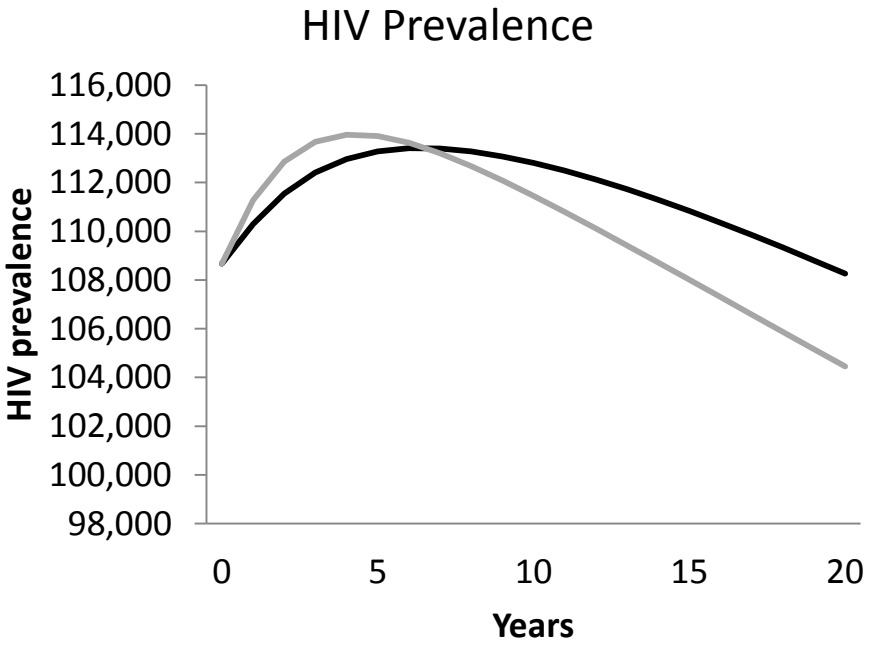
ECHPP Intervention	# Infections averted in NYC (20 years)	Cost per infection averted
Condom distribution, high-risk HIV+	1,514	$2,969
Social marketing – HIV+	5,352	$3,474
Condom distribution , HIV+	2,312	$5,854
Community-level interventions	11,562	$7,173
Targeted use of HIV and STD surveillance data to prioritize risk reduction counseling	603	$27,663
Interventions targeting cofactors; HIV+	2,092	$31,304
SBIRT, HIV+	317	$36,772
Linkage to care, HIV+	780	$76,425
Social marketing – providers	8,801	$81,315
Social marketing – general	11,562	$82,532
Social marketing – high risk	8,635	$108,291
Condom distribution, high risk HIV -	2,785	$128,715
Linkage to other medical/social services -HIV+	13,532	$124,291
Condom distribution, general	3,153	$187,212
Partner Services	373	$198,253

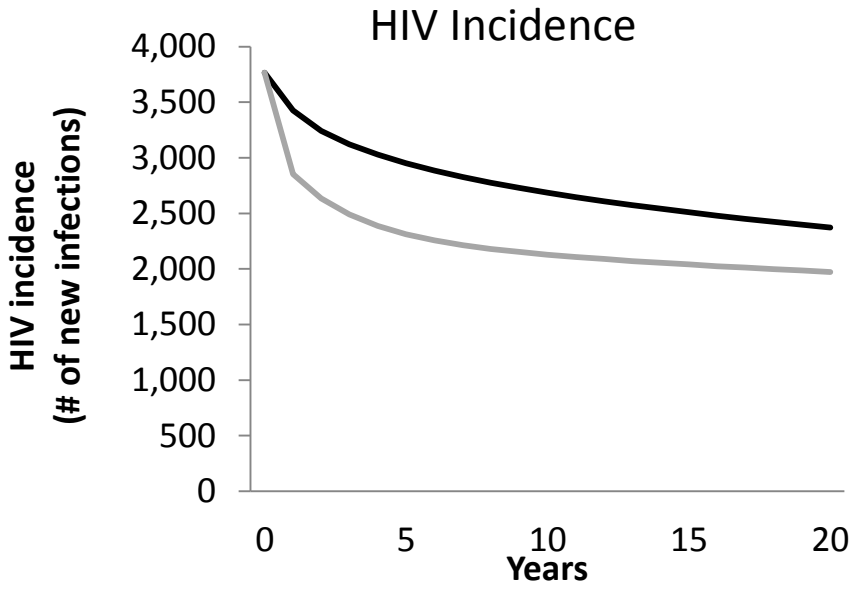
Interventions with high effectiveness

ECHPP Intervention	Cost per infection averted	Infections averted	Favorable value?
ART prophylaxis , General	$14,537,519	19,590	No
ART prophylaxis, High risk	$9,803,449	18,000	No
Linkage to other medical/social services, HIV+	$124,291	13,532	Yes
Social marketing, General	$82,532	11,562	Yes
Community-level intervention *	$7,173	11,562	Yes
Care Coordination	$1,158,199	10,877	No
Social marketing, providers	$81,315	8,801	Yes
Social marketing, High risk	$108,291	8,635	Yes
Behavioral risk screening followed by risk reduction interventions, HIV+	$767,431	5,352	No
Social marketing, HIV+	$3,474	5,352	Yes
Testing, clinical settings	$1,763,061	4,608	No
Testing, non-clinical settings	$3,110,381	4,215	No

*Community intervention = including formative activities such as identification of key stakeholders, assessment of the community using mapping, participant interviews, and focus groups. Presumes those identified will be more adherent with suite of adherence, retention (HIV+), and risk reduction interventions (HIV+ and HIV-)

HIV epidemic NYC over next 20 years – Model results





Model under base case (no new interventions)

"Optimized basket"

Thank You!

- Questions?