Prevention Effectiveness: Some examples

Martin Meltzer, Ph.D.

Senior Health Economist

Office of Surveillance

NCID/CDC

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Economic analyses of health interventions

- **Two categories of analyses**
  - **Statistical analyses - “complete” data**
  - **Mathematical model - incomplete data**

Principles of Modeling

- **First: Define the question**
- **Cut the suit to fit the cloth (data)**
- **Always, always ask: “What if”**
- **Identify “drivers”**

CENTERS FOR DISEASE CONTROL AND PREVENTION

Household-level economics of using permethrin treated bednets: Kenya

Meltzer MI, Terlouw DJ, Kolczak MS, Odhacha A, ter Kuile FO, Vulule JM, Alaii JA, Nahlen BL, Hawley WA, Phillips-Howard PA

The question

- **What are the costs and benefits?**
  - **Household perspective**
  - **Reduced morbidity < 5 yrs**
- **Problem: Bednets given out free**
  - **No valuation of nets**
  - **No costs of maintenance**
- **No perfect data set**

Solution

- **Calculate threshold**

  Threshold = household reductions in direct + indirect costs due to bednets

- **Direct costs = visits to clinic**

- **Indirect costs: Time lost from work**

Results:Household expenditure (KSH, per 2 week interval)

Base household	**32**	**12; 52**
Had bednet	**-15**	**-23; -7**
< 20 yrs ed.	**-25**	**-43; -7**
2 children	**+20**	**+12; +28**
1st survey Mar-Feb	**+25**	**+17; +33**

Base: No nets, 1 child < 5 yrs, > 20yrs ed., survey data from Nov-Dec.

Modeling potential responses to smallpox as a bioterrorist weapon

Martin Meltzer[1], Inger Damon[1], Jim LeDuc[1], Don Millar[2]

1) CDC, NCID, Atlanta, GA
2) Don Millar & Assoc., Atlanta, GA.

Emerg Infect Dis 2001, 7:959-969 + 2 online appendices
http://www.cdc.gov/ncidod/eid/vol7no6/meltzer.htm

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

The problem

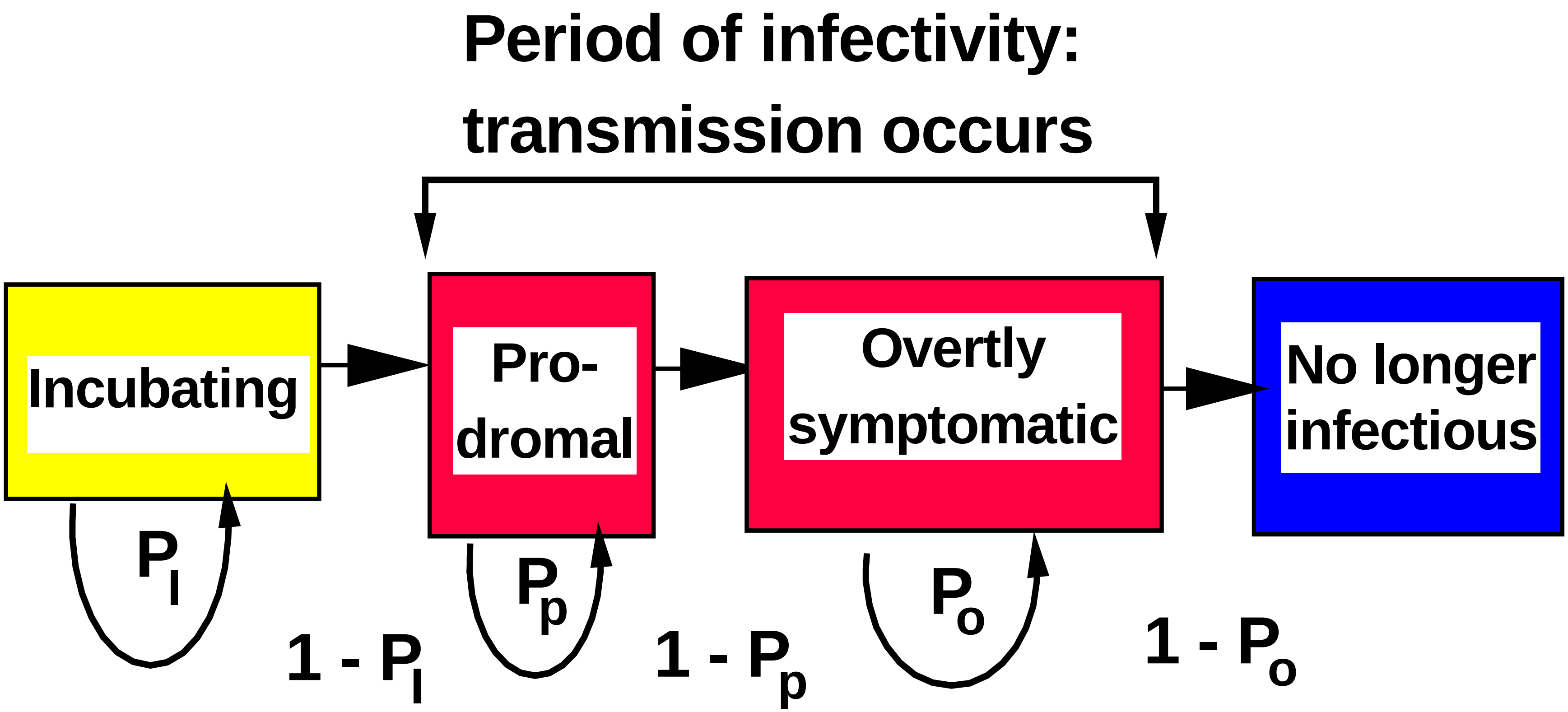
- **Smallpox - potential weapon**

- **Effectiveness of potential interventions**
  - **Vaccination & quarantine**

- **Number of doses need for stockpile**

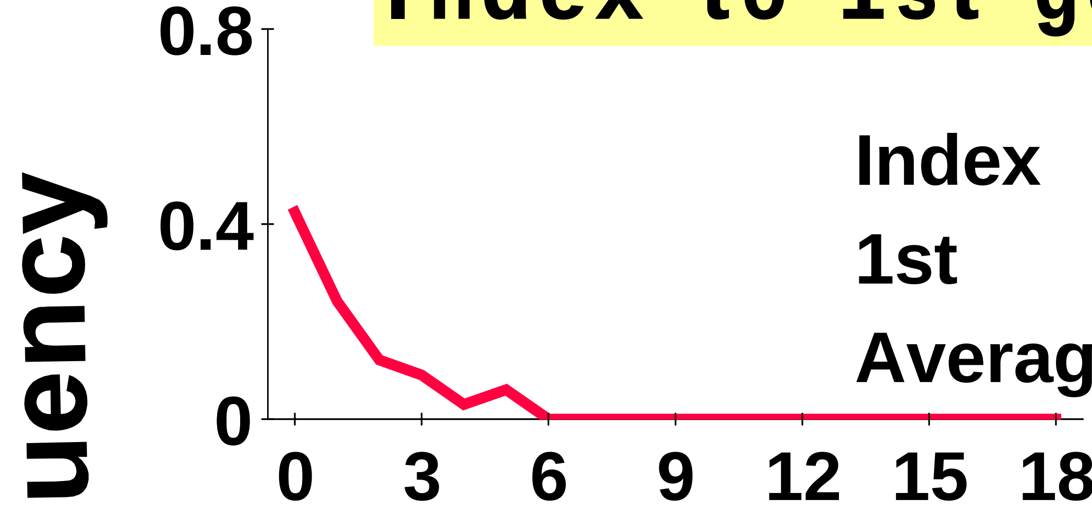
CENTERS FOR DISEASE CONTROL
AND PREVENTION

The Model



Period of infectivity:
transmission occurs
Incubating
Pro-
dromal
Overtly
symptomatic
No longer
infectious
P_I
$1 - P_I$
P_p
$1 - P_p$
P_o
$1 - P_o$

Index to 1st generation

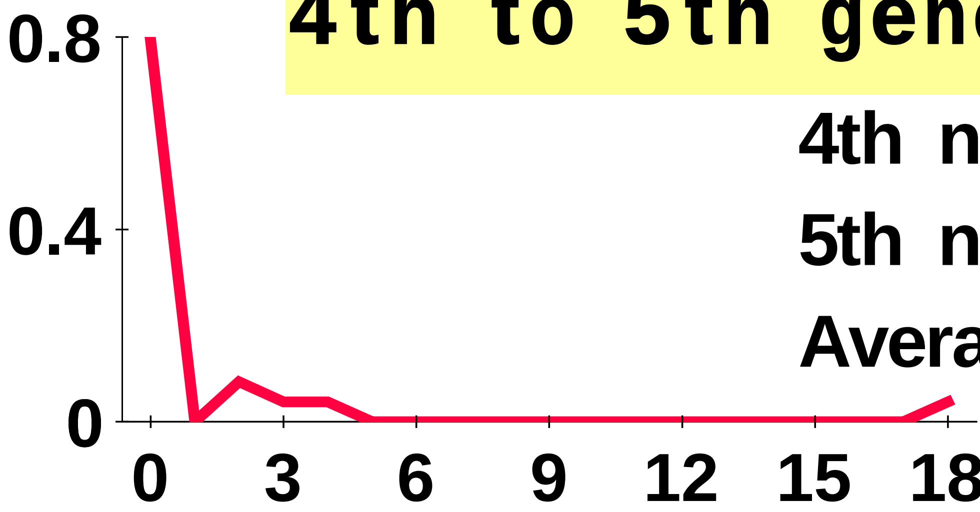


Index n = 33

1st n = 49

Average = 1.48

4th to 5th generation

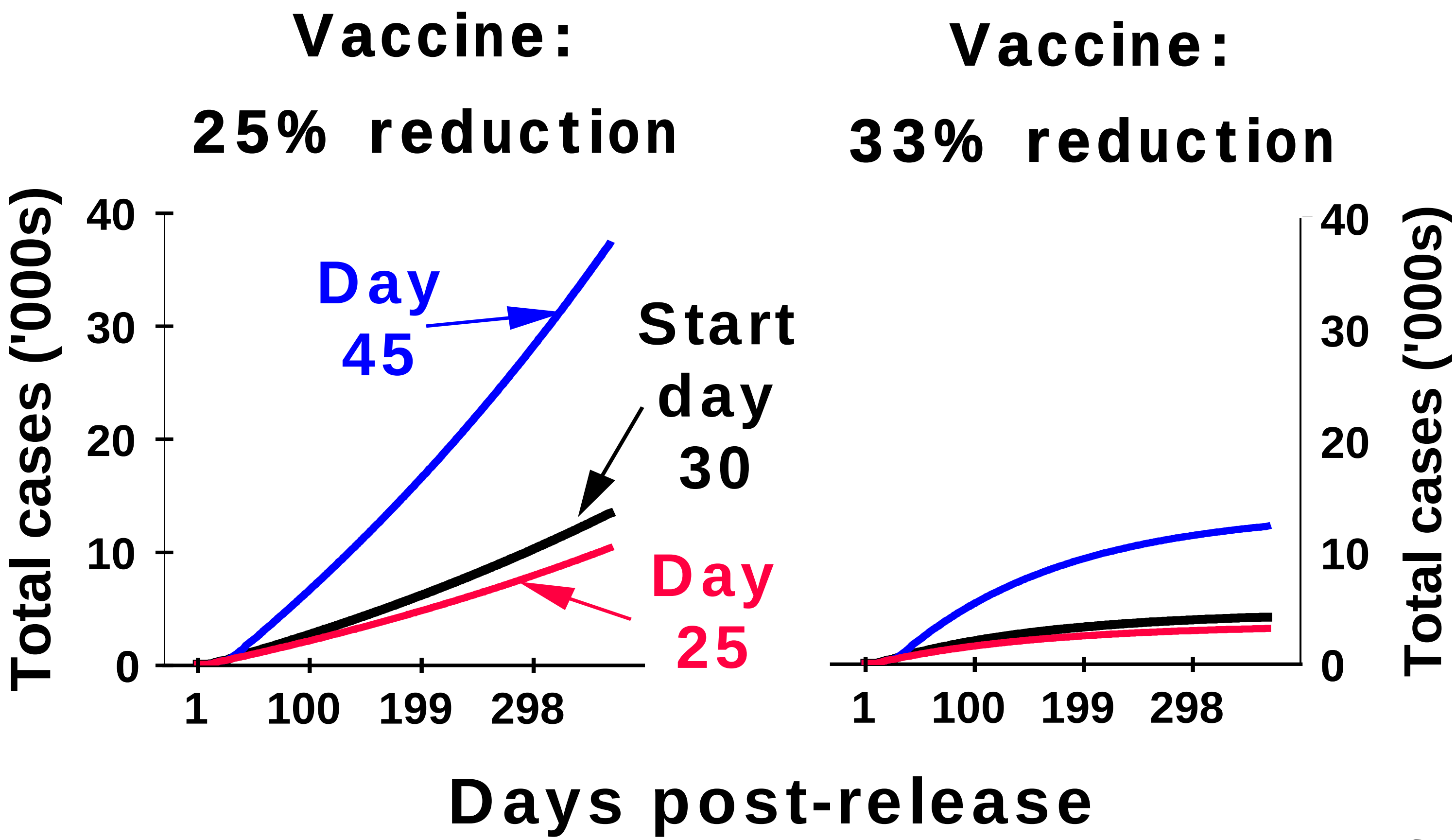


4th n = 24

5th n = 29

Average = 1.21

Results:
Vaccination + Quarantine



CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Results:
Sensitivity analyses

# infected	Trans.	Quarantine	Vaccine	Total cases
100	3	25%	33%	4240
100	2	10%	25%	10512
100	5	25%	33%	54.5 million

Results: Doses per case

Site	Yr	Suscept	Cases	Doses per case
India	1968	8%	40	34
Brazil	1969	57%	246	9
Botswana	1973	27%	30	1,667
Yugo.	1972	n/a	175	102,857
Cardiff	1962	n/a	47	19,148
		N = 14	Mean	14,411
			Med	2,511

Results: Doses in stockpile

	Trans. rate: 3	Trans. rate: 2
# of cases	4,200	1,548
Start	Day 30	Day 45
Initial infected	100	100
Median doses	**9 million**	**3 million**
95th percent	29 million	11 million
5th percent	15 thousand	5 thousand

Conclusions

- M.I.V. = Transmission rate
  - 3 infected per infective - very high
- Need quarantine + vaccination to control
  - Need 3 P's - stockpile alone inadequate
- 40 million dose stockpile - adequate
- Costly if delay in response
  - May take 150 days to stop outbreak

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Smallpox and modeling: Conclusions

- **First: Formulate precise question(s)**
- **Build model to answer question(s)**

- **Build simple (not simplistic) model to:**

  Analyze "What if", <u>no</u> single answer

  Identify "drivers" → policy "targets"

- **Less "black box" - improve understanding**

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION