

Development and validation of sexual network model based on published Natsal-3 data

Fabian Sailer (f.sailer@ucl.ac.uk) supervised by Rachael Hunter, Greta Rait and John Saunders

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School for
Primary Care
Research

The National Institute for Health Research School for Primary Care Research (NIHR SPCR) is a partnership between the Universities of Bristol, Cambridge, Keele, Manchester, Newcastle, Nottingham, Oxford, Southampton and University College London.

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Agenda

- Background
- Development
- Results
- Validation
- Discussion

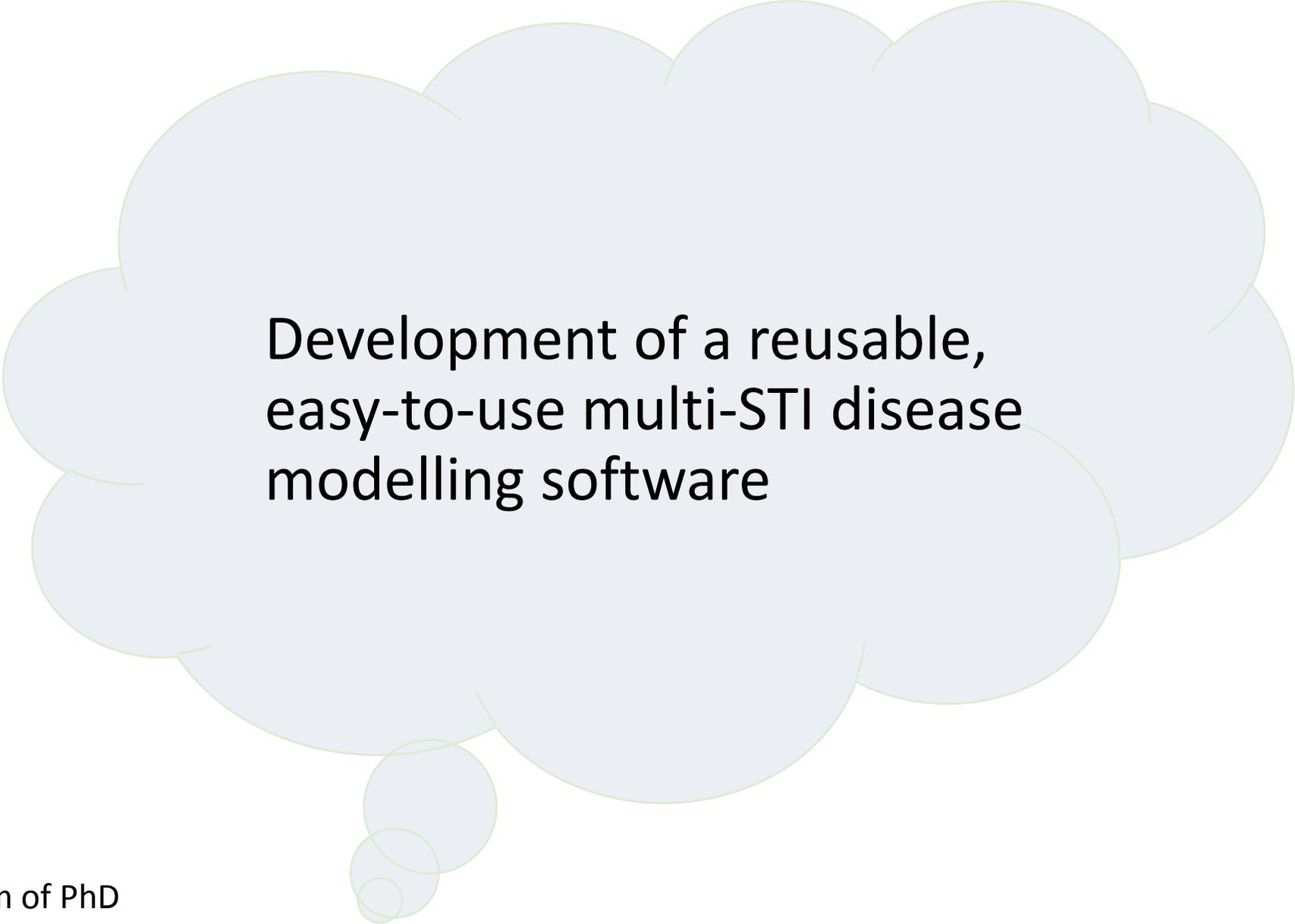
What are Sexually Transmitted Infections (STI)?

- Caused by bacteria, viruses, fungi or parasites
- Primarily transmitted via Sexual Contact
- Co-Infection

STIs and Disease Modelling

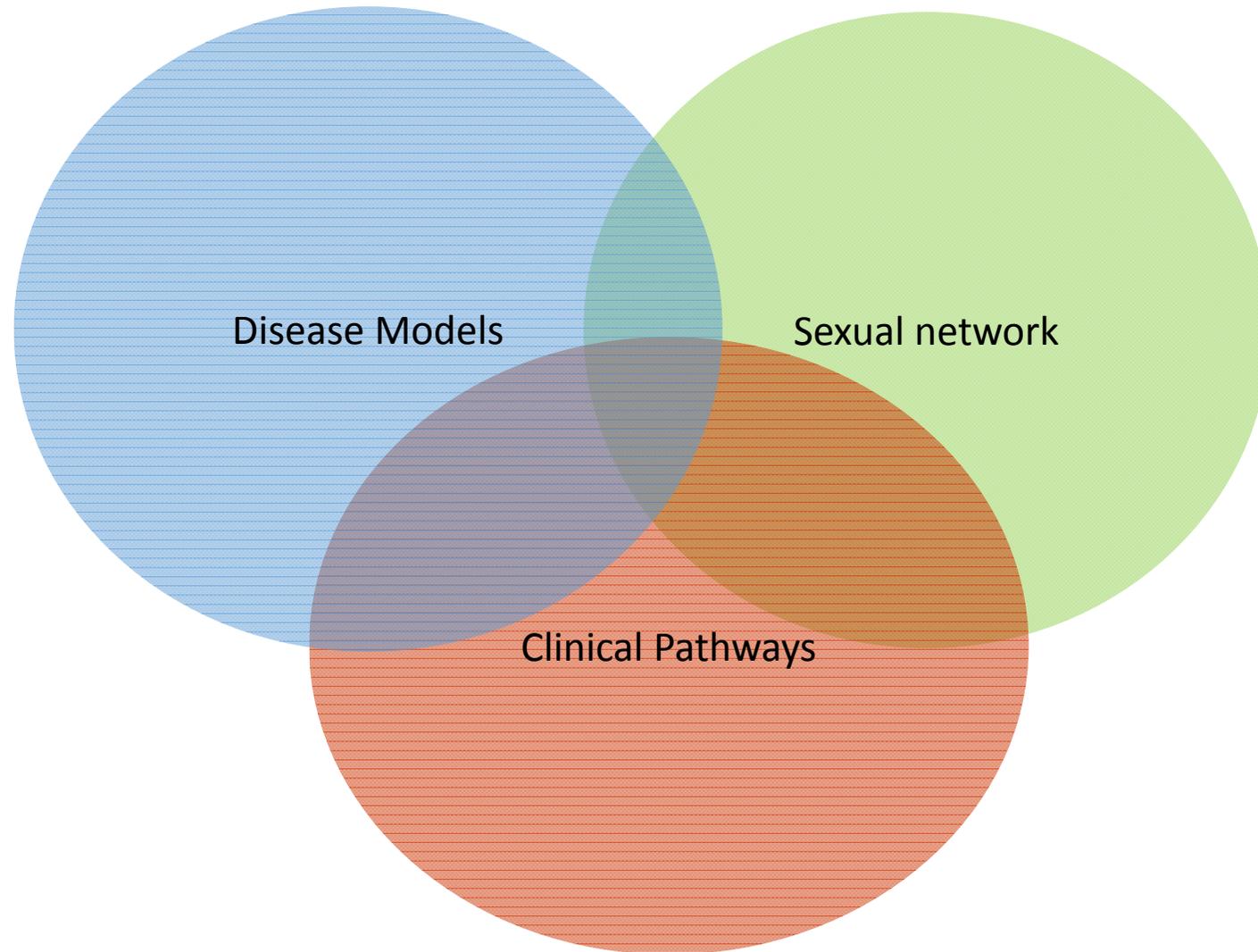
Status Quo

- Only few models look at multiple STIs
- One purpose modelling

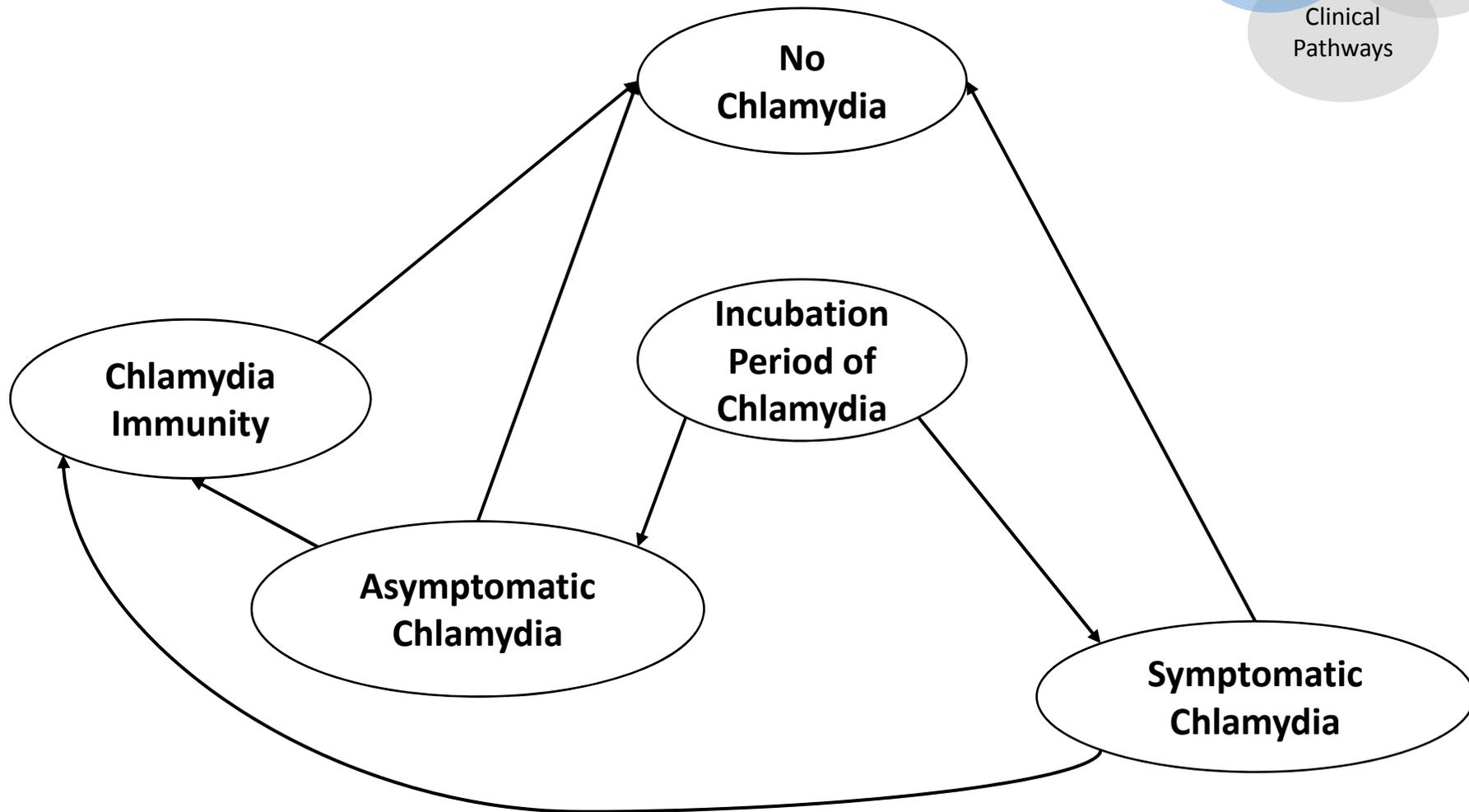
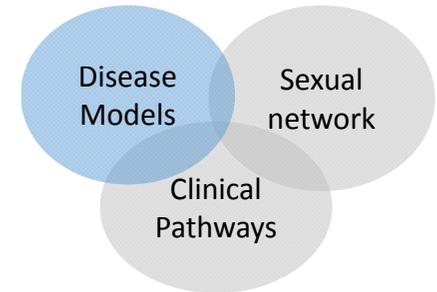


Development of a reusable,
easy-to-use multi-STI disease
modelling software

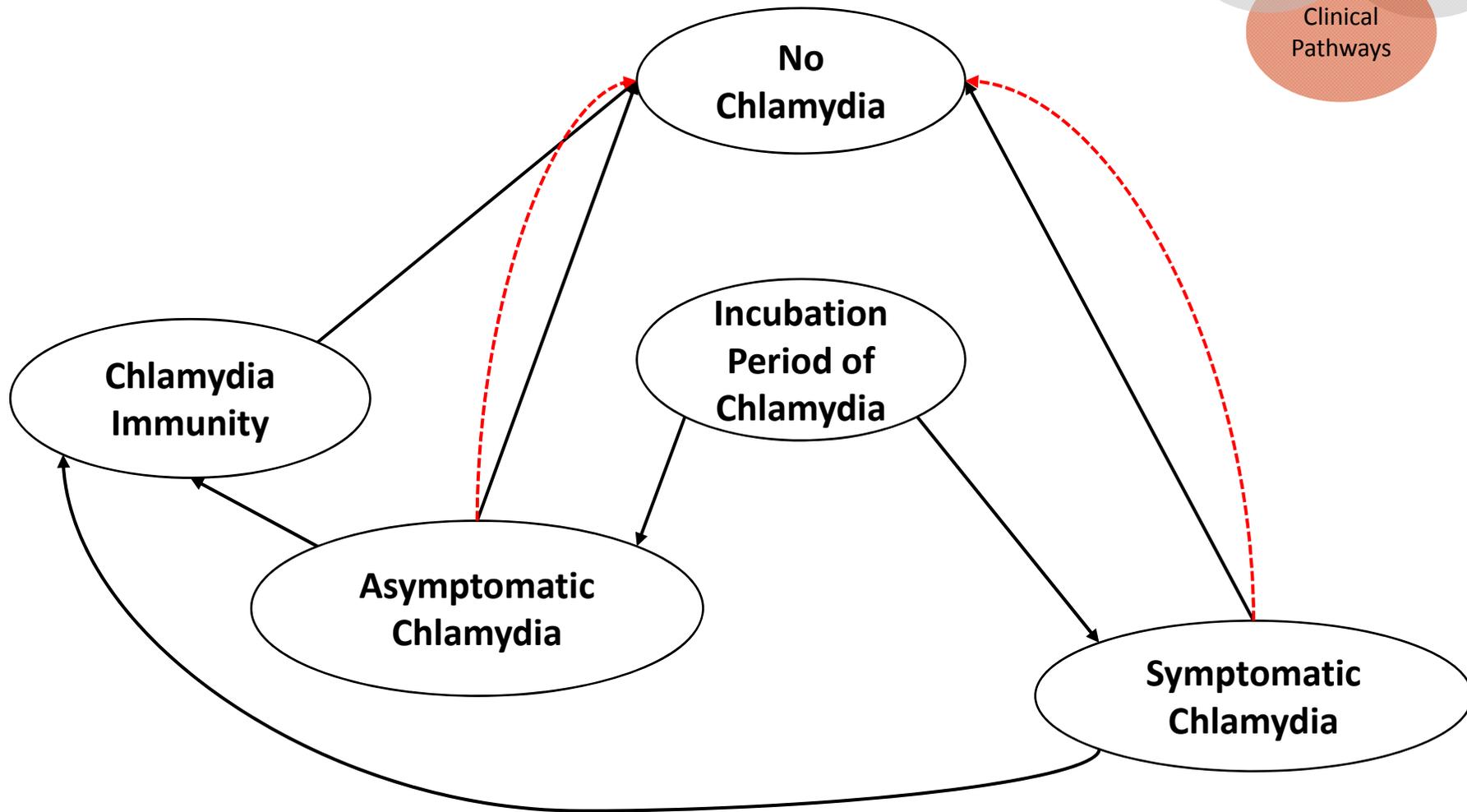
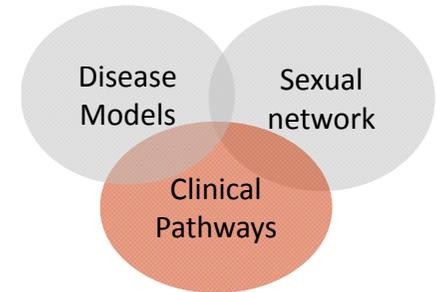
Model Structure



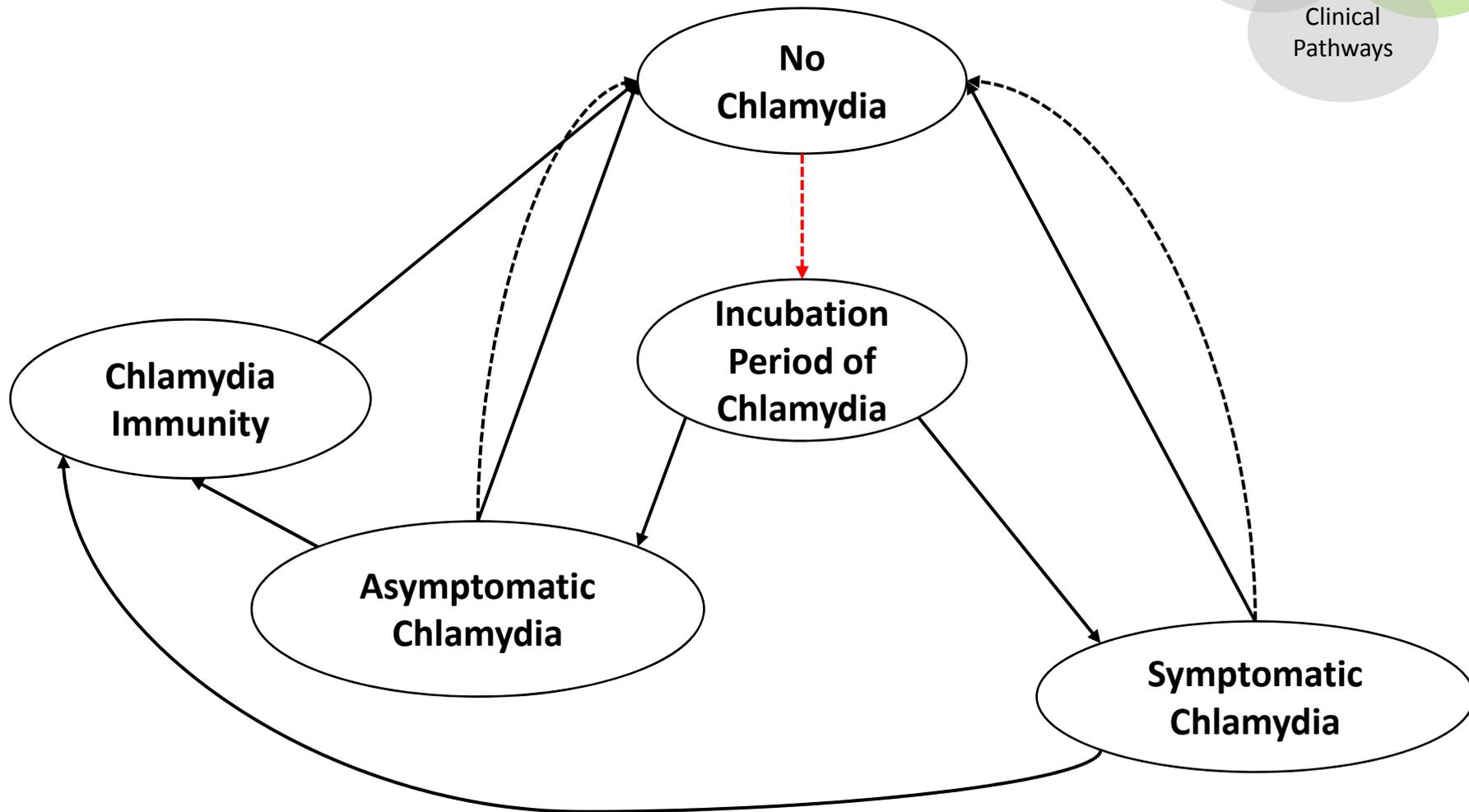
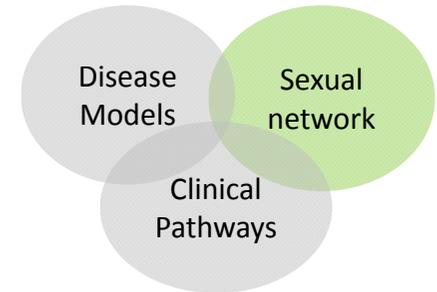
Disease Model

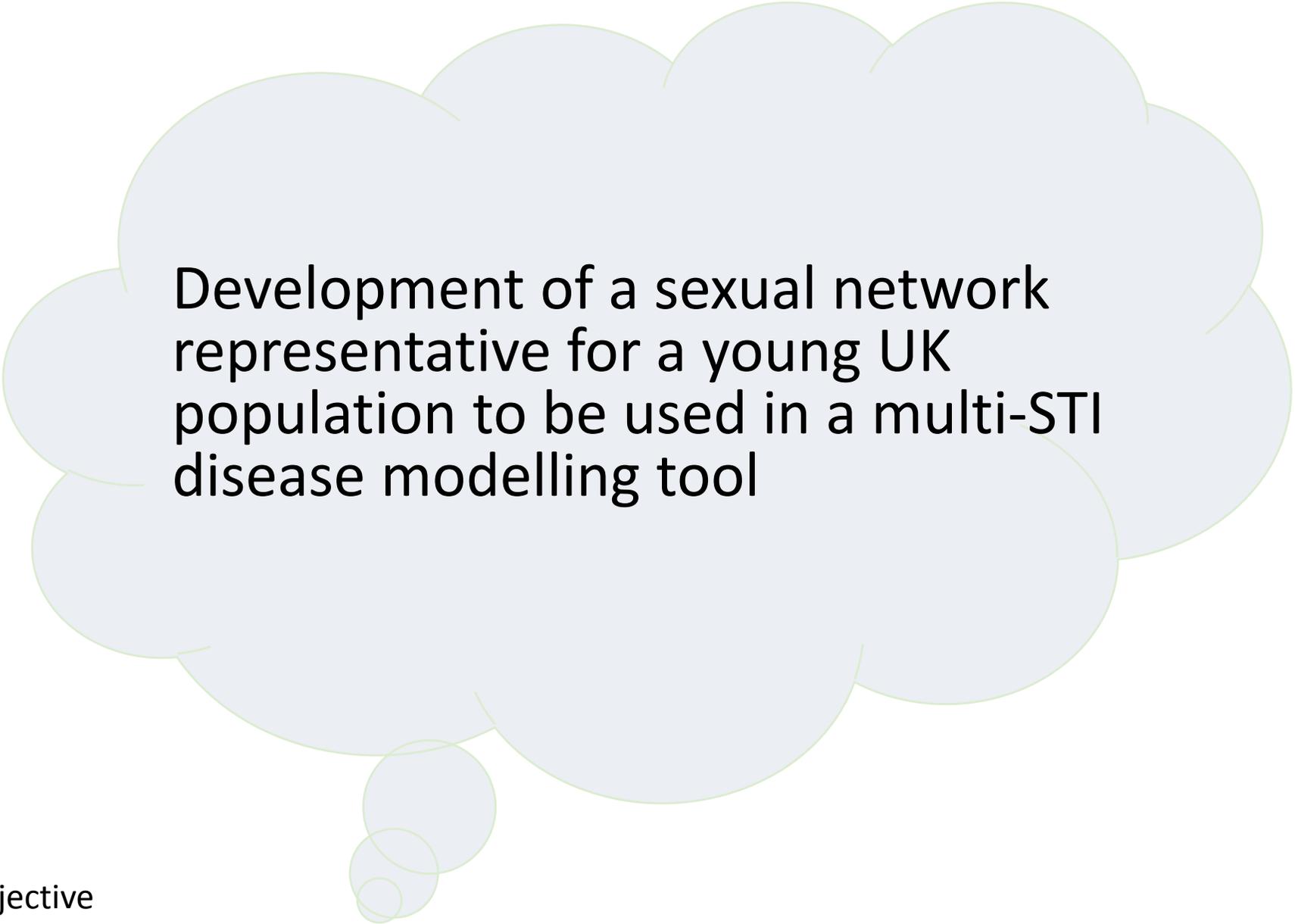


Clinical Pathways



Sexual Network





Development of a sexual network
representative for a young UK
population to be used in a multi-STI
disease modelling tool

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Natsal-3 study

- National Survey of Sexual attitudes and lifestyles in Britain
- Interviewed 15'162 persons between September 2010 and August 2012

Development Process

- Based on existing sexual networks

Research

Open Access

Developing a realistic sexual network model of chlamydia transmission in Britain

Katherine ME Turner*¹, Elisabeth J Adams¹, Nigel Gay¹, Azra C Ghani², Catherine Mercer³ and W John Edmunds¹

- Parameters from literature

Age Limits: Men's and Women's Youngest and Oldest Considered and Actual Sex Partners

Jan Antfolk¹

Age preferences for mates as related to gender, own age, and involvement level

Bram P. Buunk^{a,*}, Pieterneel Dijkstra^a, Douglas T. Kenrick^b, Astrid Warntjes^a

^aDepartment of Social and Organizational Psychology, University of Groningen, Grote Kruisstraat 2/1, 9712 TS Groningen, The Netherlands

^bDepartment of Psychology, Arizona State University, Tempe, AZ 85287-1104, USA

Parametrisation

Table 11

Sexual experience, by age and sex

Aged 16-74

2010-2012

Sexual experience	Age at interview						Total aged 16-44	Total aged 16-74
	16-24	25-34	35-44	45-54	55-64	65-74		
	%	%	%	%	%	%	%	%
Men								
Women only	87	92	94	93	91	95	91	92
More often women, men at least once	5	5	4	5	6	4	5	5
About equally often men and women	<1	<1	<1	-	1	<1	<1	<1
More often men, women at least once	1	1	1	1	1	-	1	1
Men only	1	1	1	1	1	<1	1	1
Never had sexual experience with anyone at all	6	1	<1	<1	1	1	2	1
Women								
Men only	75	82	89	92	94	98	82	88
More often men, women at least once	16	16	9	6	5	1	14	9
About equally often women and men	2	<1	1	<1	<1	<1	1	1
More often women, men at least once	1	1	1	1	1	<1	1	1
Women only	<1	<1	<1	<1	<1	<1	<1	<1
Never had sexual experience with anyone at all	6	1	<1	-	<1	<1	2	1
<i>Unweighted bases</i>								
Men	1726	1520	804	785	767	661	4050	6263
Women	2134	2479	1209	1119	1028	874	5822	8843
<i>Weighted bases</i>								
Men	1236	1370	1423	1400	1191	853	4029	7474
Women	1203	1375	1447	1435	1232	935	4025	7628

Development Process

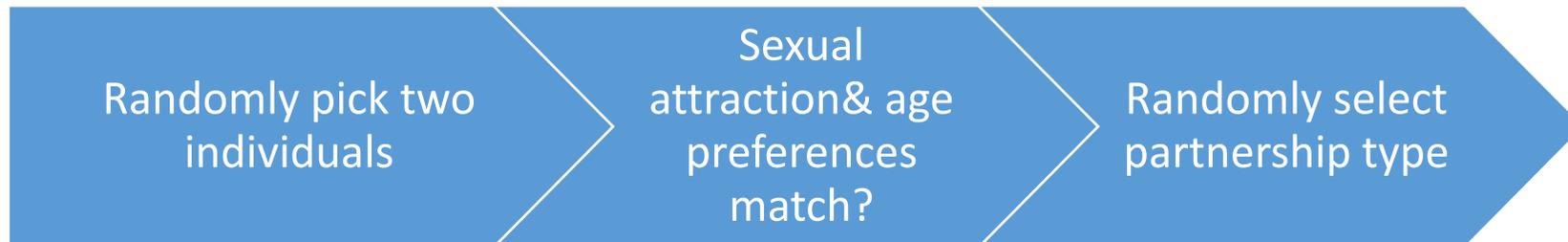
- Not for all parameters appropriate values could be found
 - parameter fitting

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Results

- Partnership formation process:



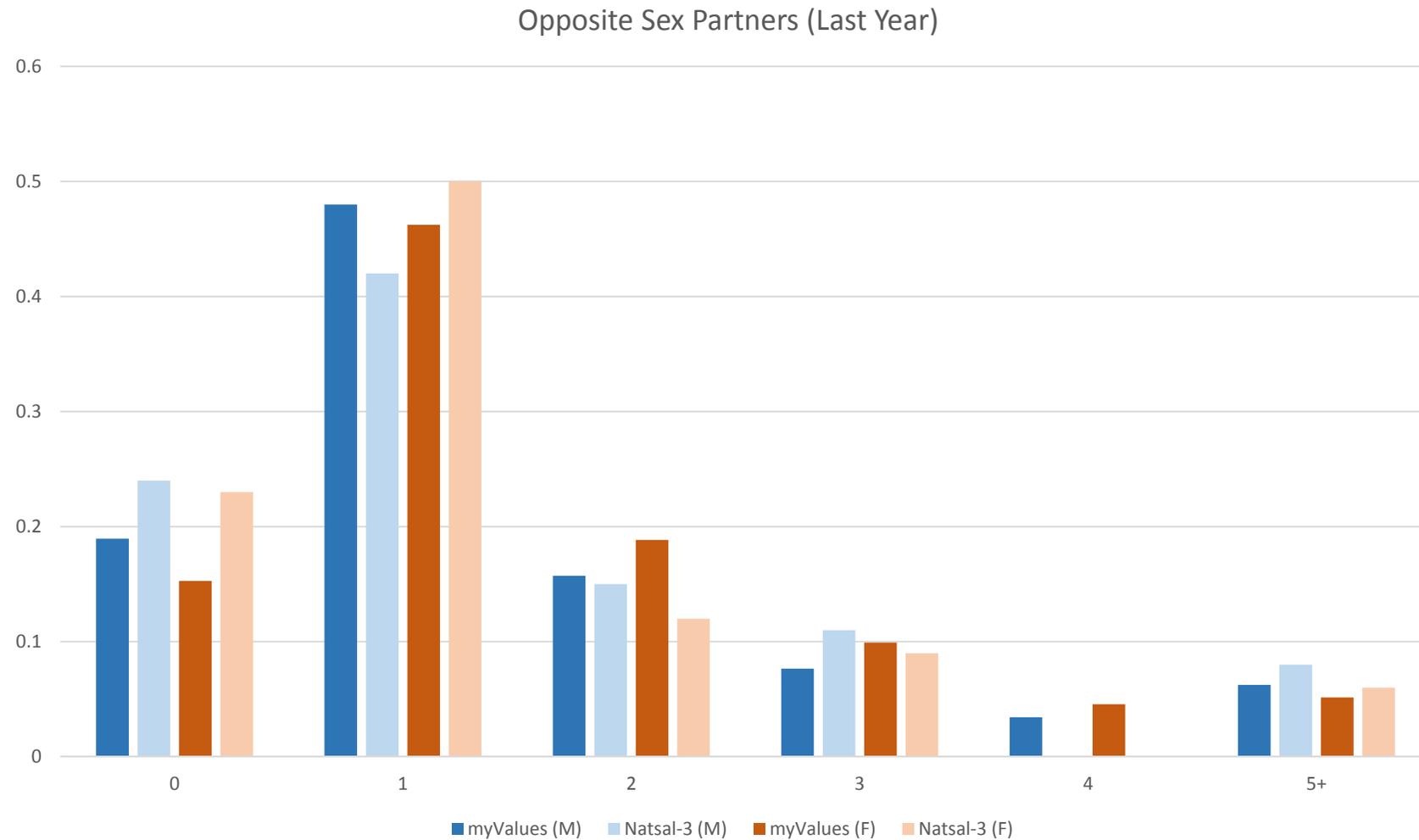
- Partnership types

Partnership type	Duration	Gap	Frequency of Sexual Contact
Short	7 – 14 days	0 days	Every day
Long	56 days – time horizon	30 days	Once in four days

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Comparison

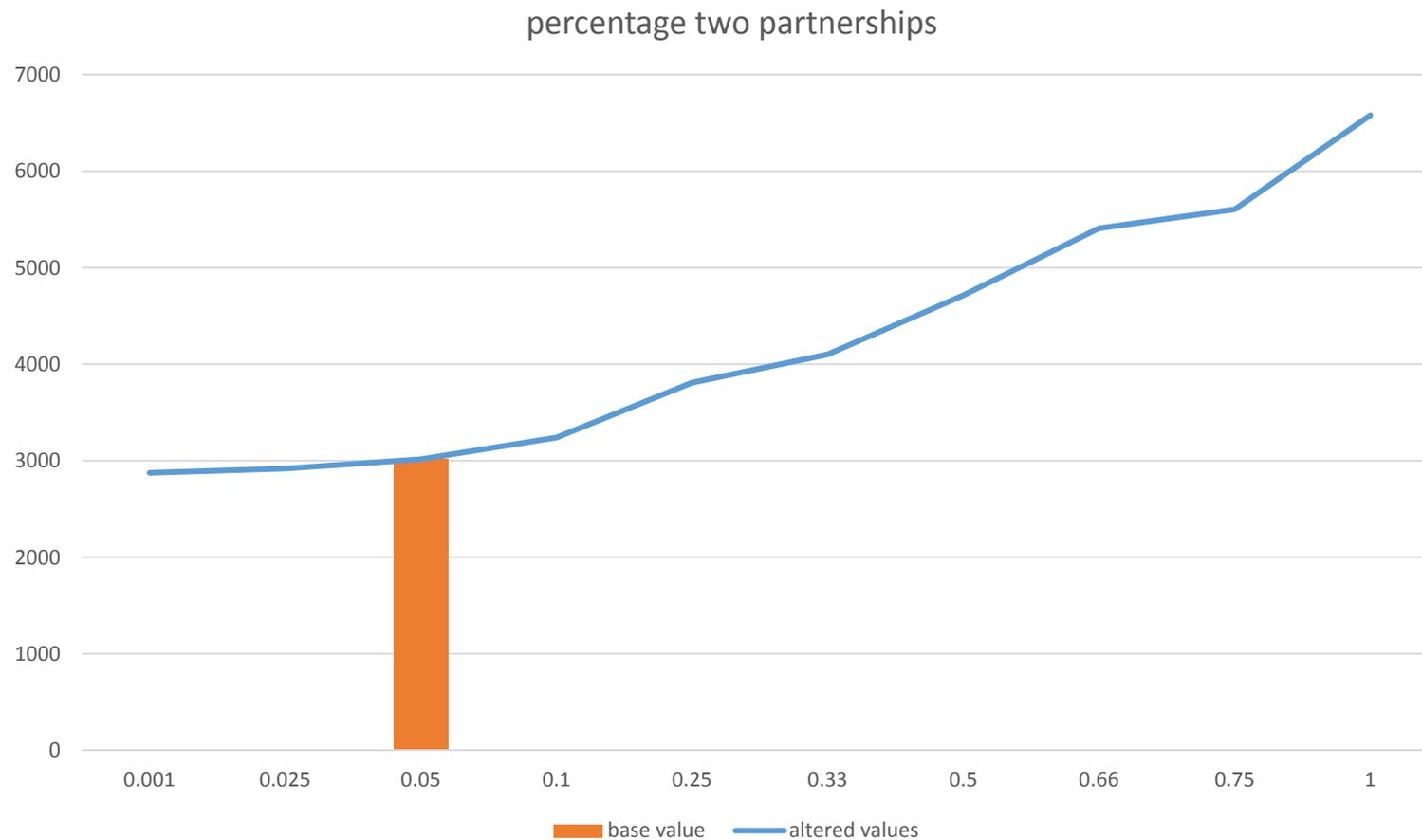


Comparison

- Test for difference
 - Kolmogorov Smirnov (0.0505)
 - Kuiper (0.0680)
 - Cramer von Mises (0.0417)
- Tests for similarity
 - Chi-Square
 - on distribution (0.9998)
 - on distribution sum (0.9999)
 - Pearson
 - on distribution (0.9699)
 - on distribution sum (0.9981)

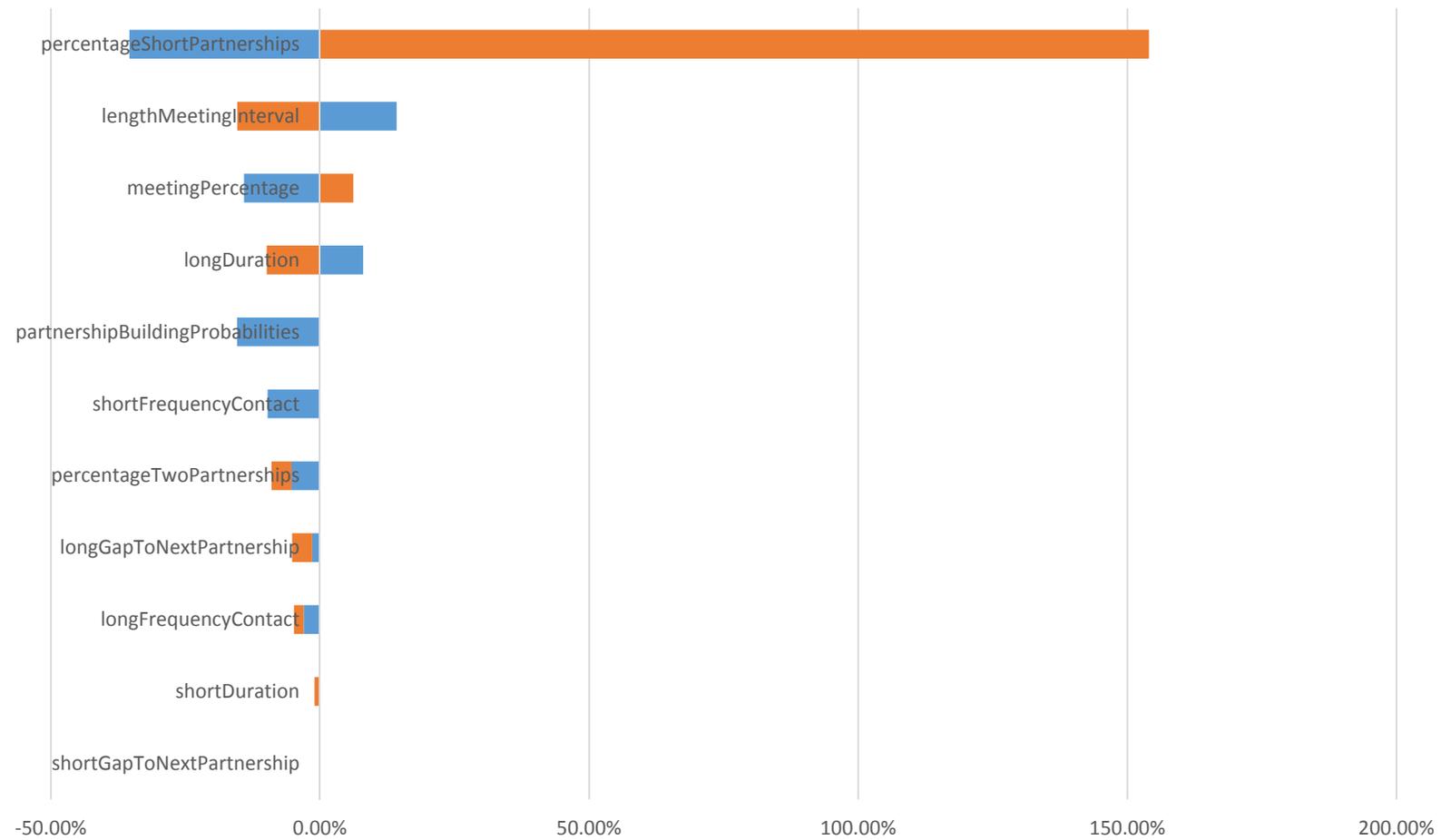


Sensitivity Analysis



Sensitivity Analysis

Tornado Plot



Validation

■ -25% ■ +25%

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Discussion

- Natsal-3 and others used to parametrise the sexual network model
- Natsal-3 used to validate this sexual network model
- Good fit is not good enough
- Sexual network embedded in multi STI model as part of a decision support software for decision makers in health care

Acknowledgements

This presentation presents independent research funded by the National Institute for Health Research School for Primary Care Research (NIHR SPCR).

The views expressed are those of the author(s) and not necessarily those of the NIHR, the NHS or the Department of Health.

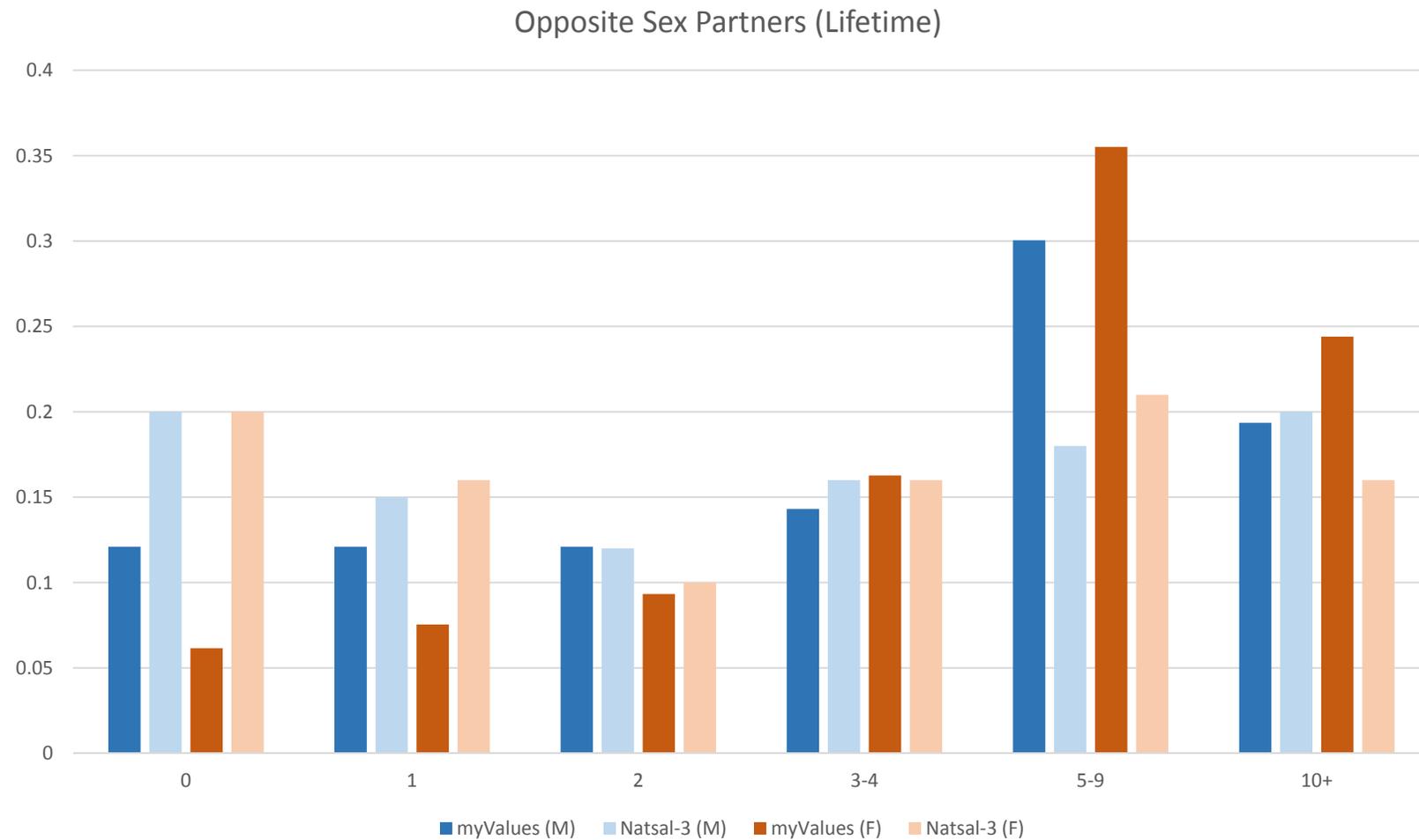
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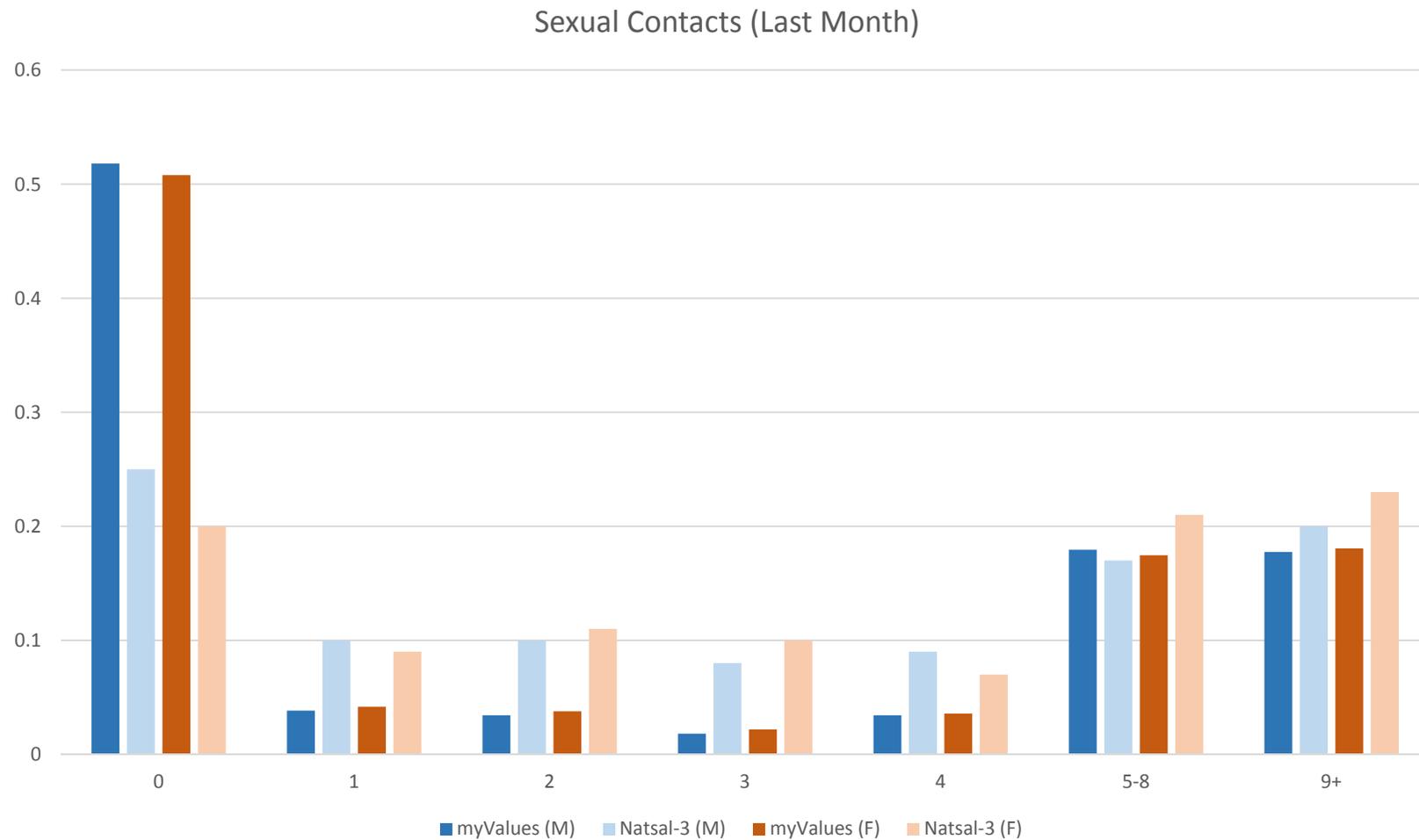
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Thank you for your attention!

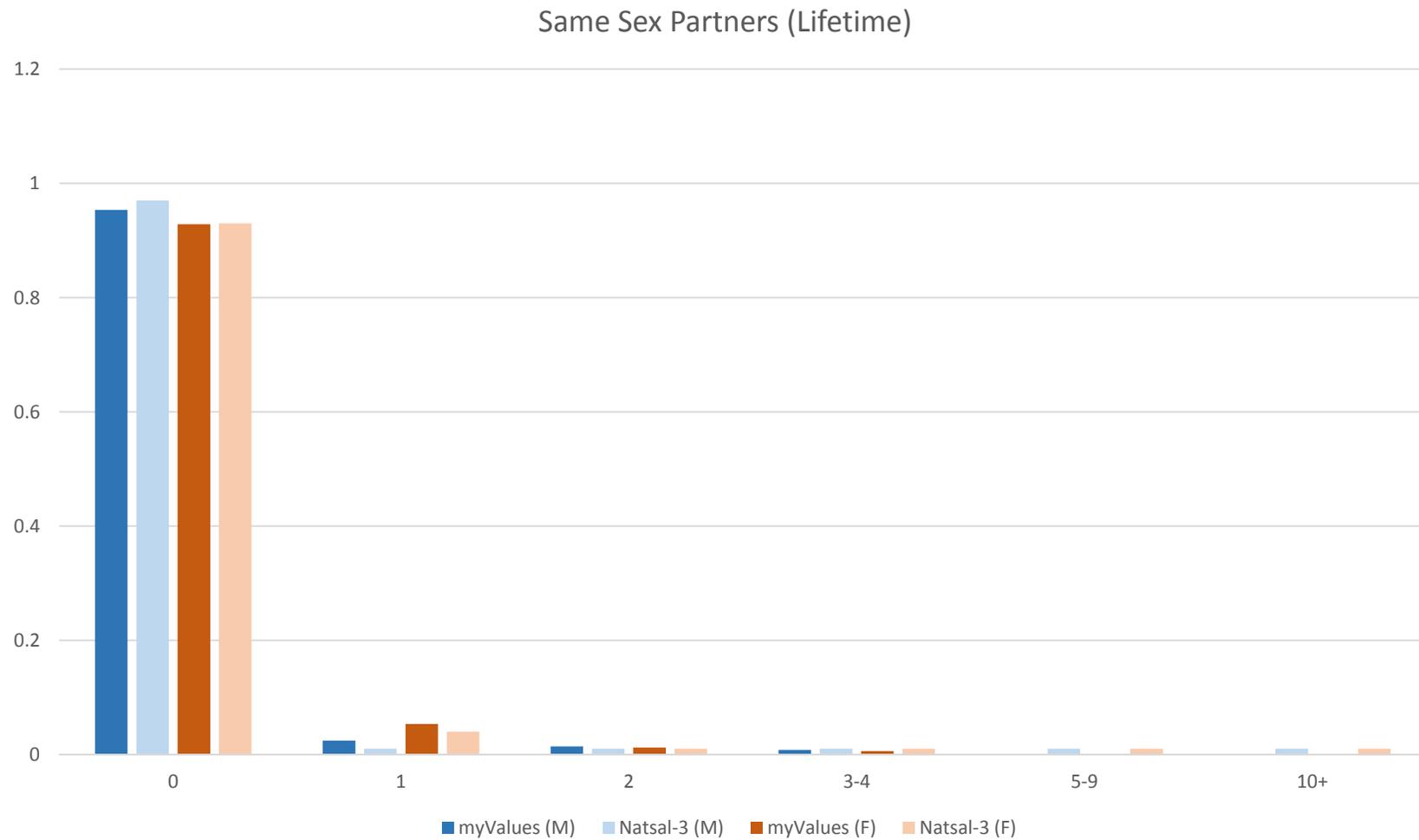
Validation



Validation



Validation

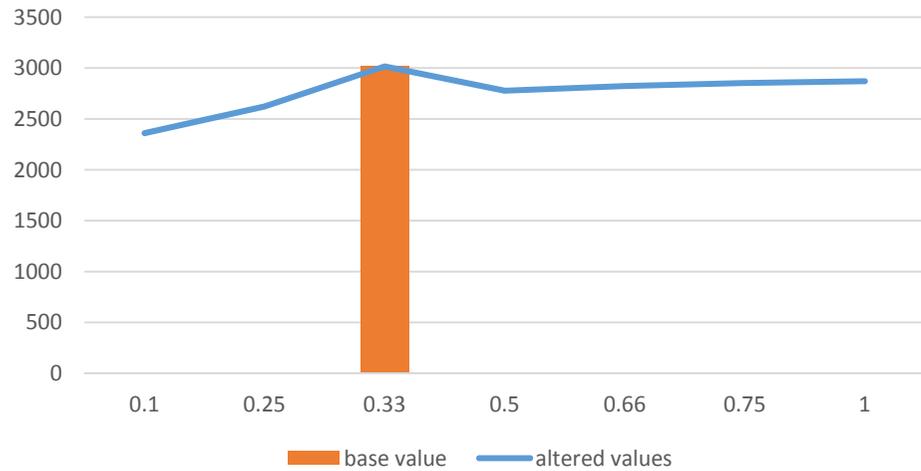


Validation (Tests)

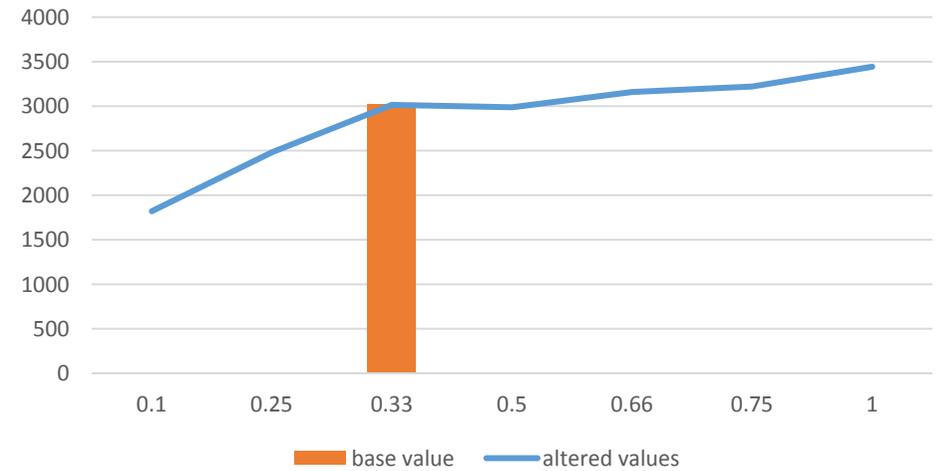
	Kolmogorov-Smirnov	Kuiper's test	Chi Square (dist)	Chi Square (dist sum)	Cramer von Mises	Pearson's (dist)	Pearson's (dist sum)
# of contacts last month (male)	0.268145	0.258145	0.99835*	0.998212*	0.178571 ¹⁰	0.931147 ¹⁰	0.966779*
# of contacts last month (female)	0.307937	0.317937	0.995654927*	0.991246203*	0.30102*	0.691778	0.978254*
# opposite sex partners lifetime (male)	0.123952	0.120403	0.99975*	0.999749*	0.041667	0.377546	0.993719*
# opposite sex partners lifetime (female)	0.229841	0.231905	0.997908*	0.994146*	0.125 ²⁰	0.431884	0.98228*
# opposite sex partners last year (male)	0.050484	0.067984	0.999866*	0.999999*	0.041667	0.969864*	0.998155*
# opposite sex partners last year (female)	0.114921	0.123333	0.999146*	0.999973*	0.041667	0.959945*	0.993203*
# same sex partners lifetime (male)	0.016371	0.026371	0.999972*	1*	0.125 ²⁰	0.999803*	0.930187 ¹⁰
# same sex partners lifetime (female)	0.014048	0.015476	0.999998*	1*	0.152778 ¹⁵	0.999817*	0.975229*

Sensitivity Analyses

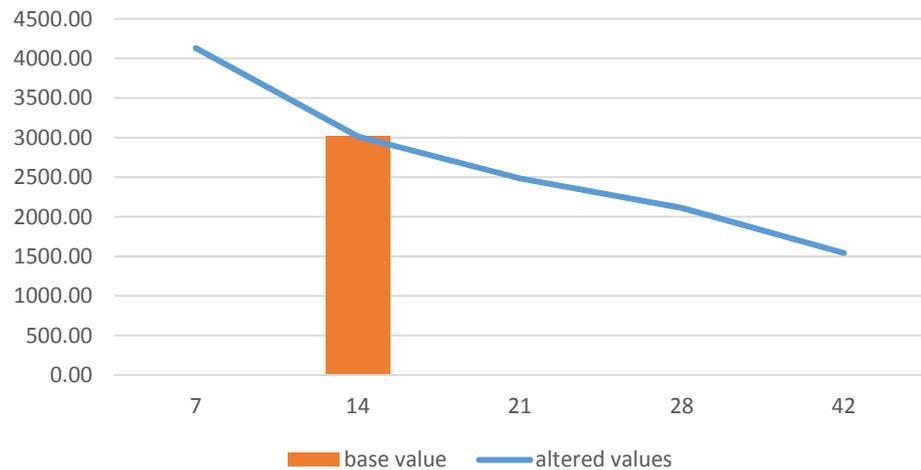
infectiosity symptomatic chlamydia



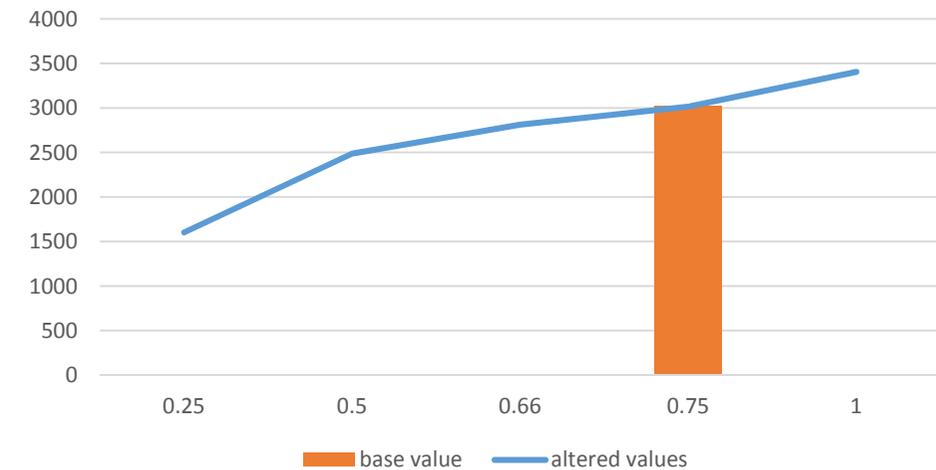
infectiosity asymptomatic chlamydia



length meeting interval

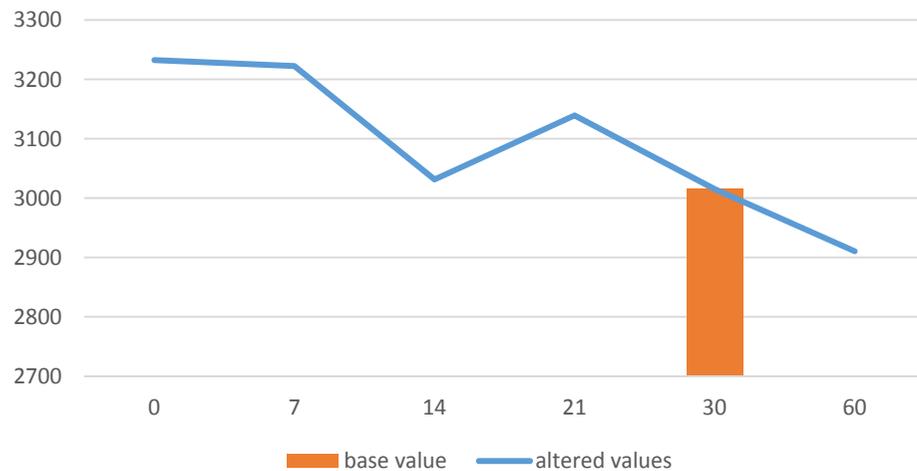


meeting percentage

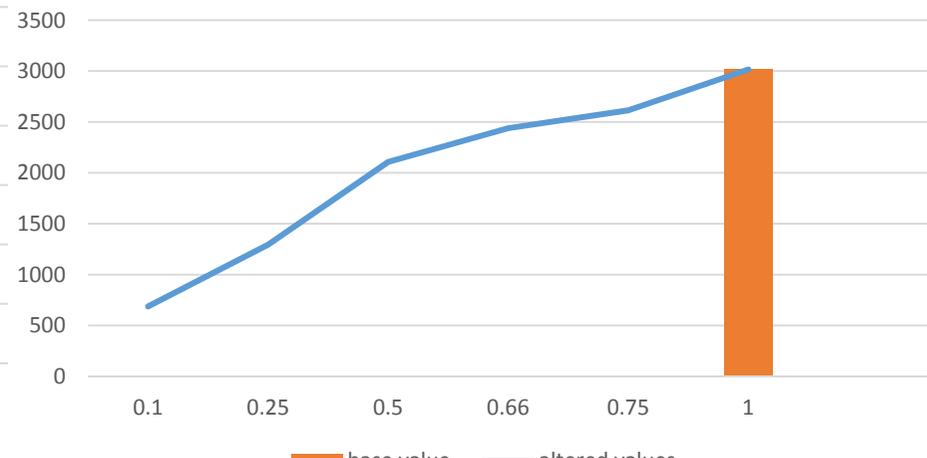


Sensitivity Analyses

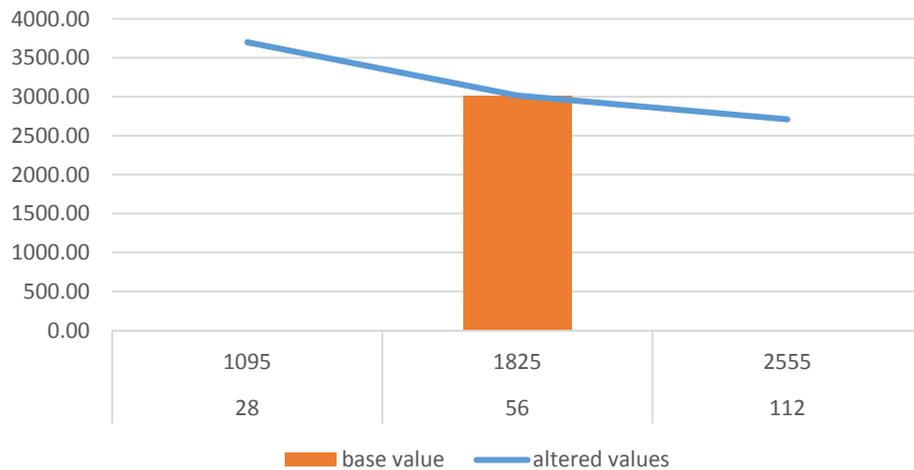
gap after long partnership



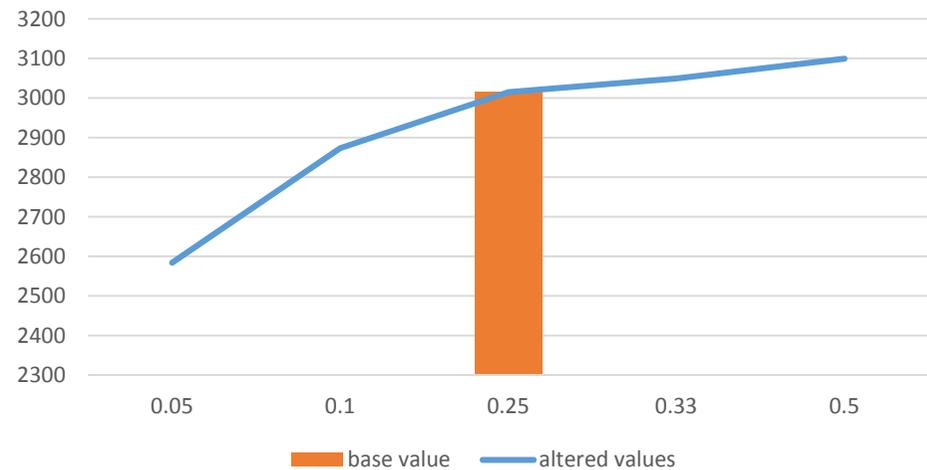
partnership building probability



duration long partnerships

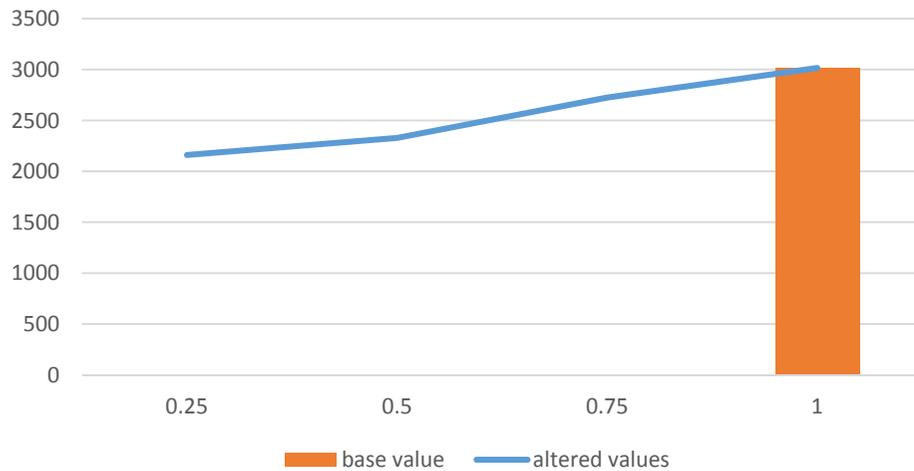


frequency contact long partnerships

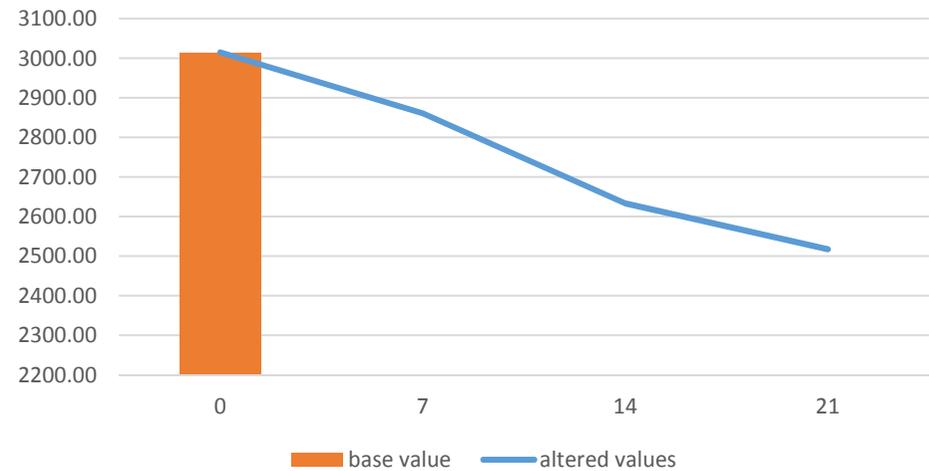


Sensitivity Analyses

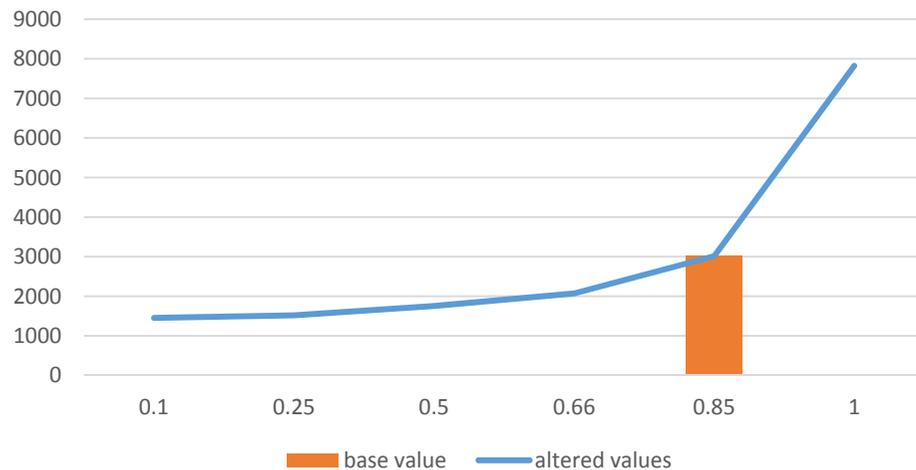
frequency contact short partnerships



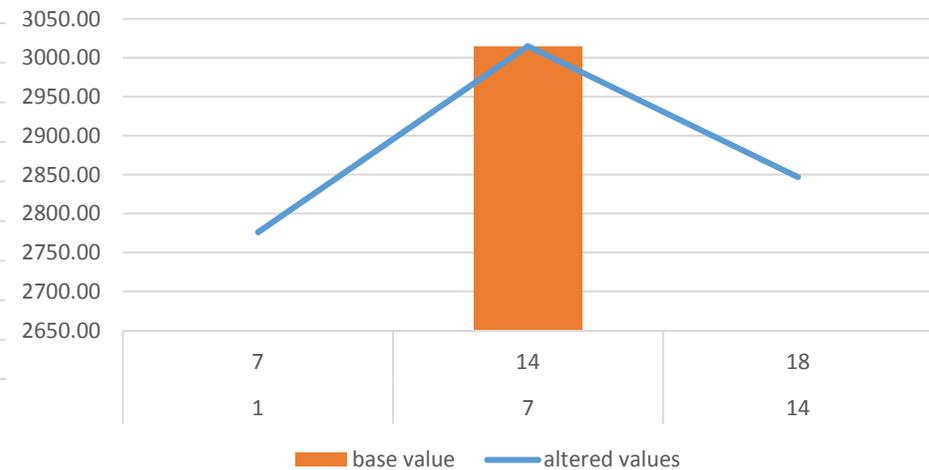
gap after short partnership



percentage short partnerships



duration short partnerships

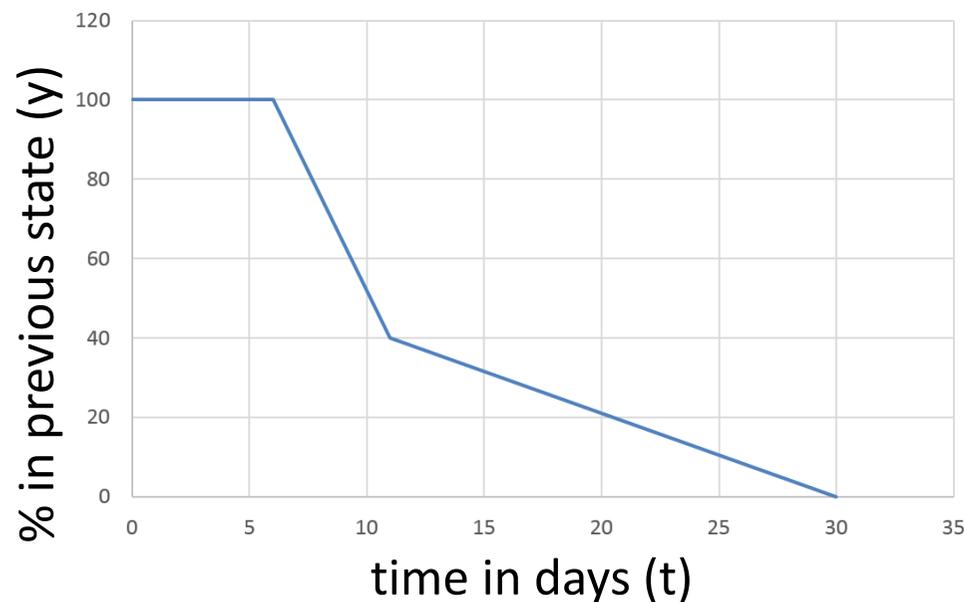


Discrete Event Simulation

- Event Queue
- Model jumps on time axis
- Events can influence other events in the queue

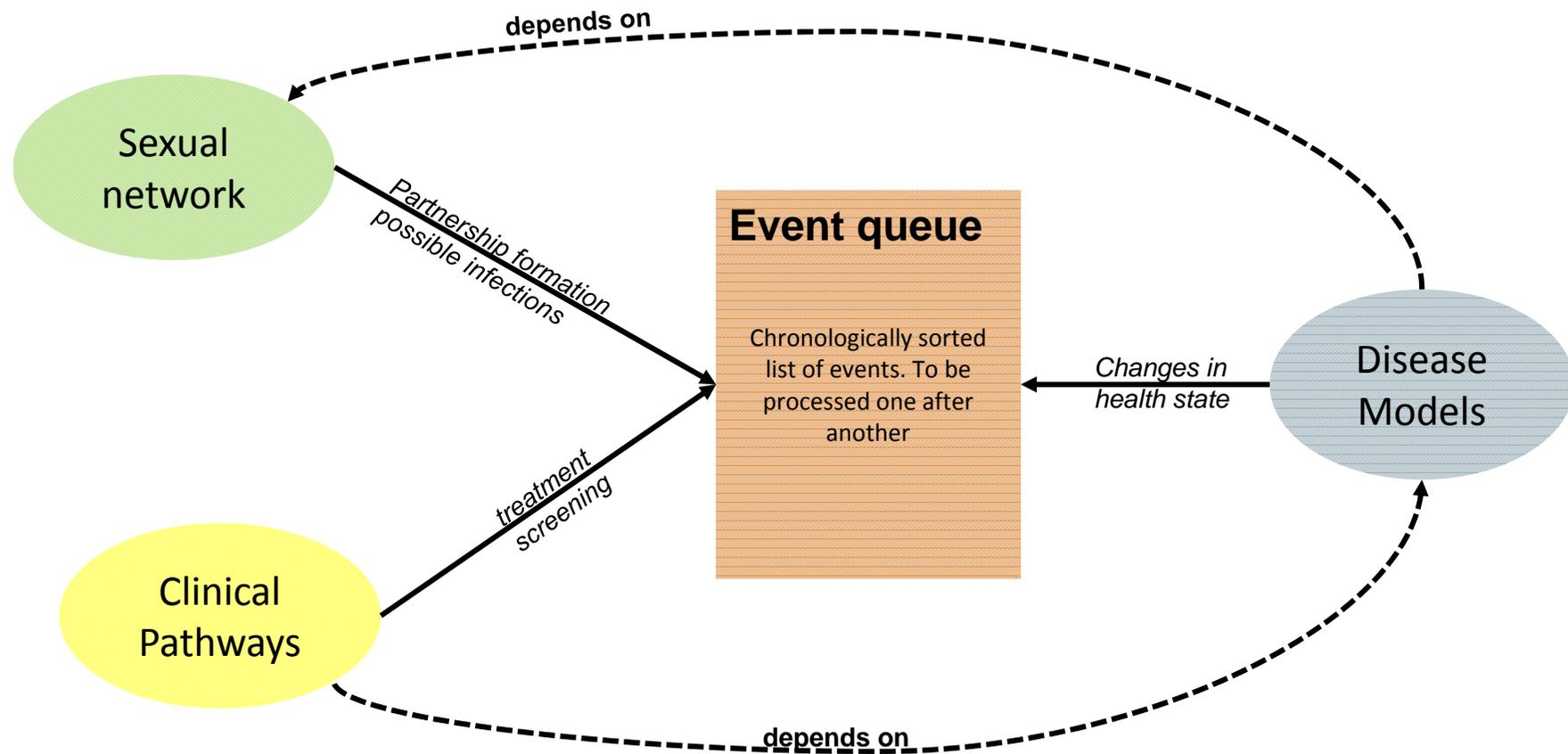
Why Discrete Event Simulation?

- Parametrisation easier to understand and more precise



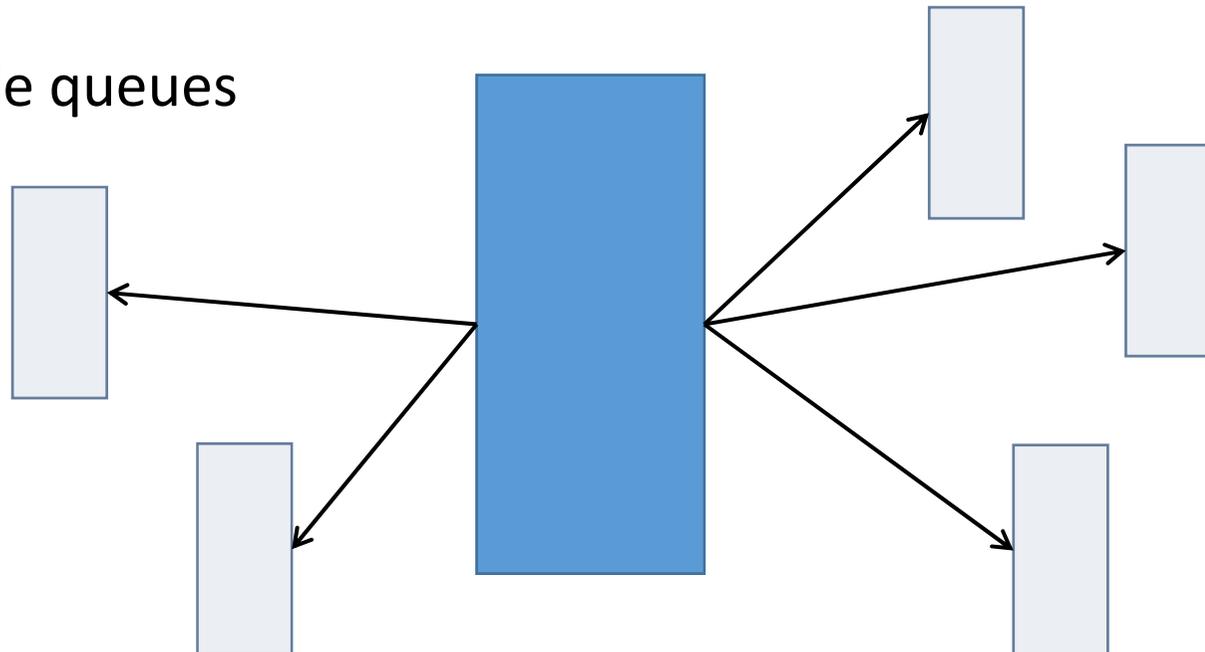
Days	MMS daily probabilities	DES formulas
0-6	0%	$y = 1$
7-11	16.74%	$y = 1.72 - 0.12t$
12-30	4.96%	$y = 0.63 - 0.02t$

Model Structure



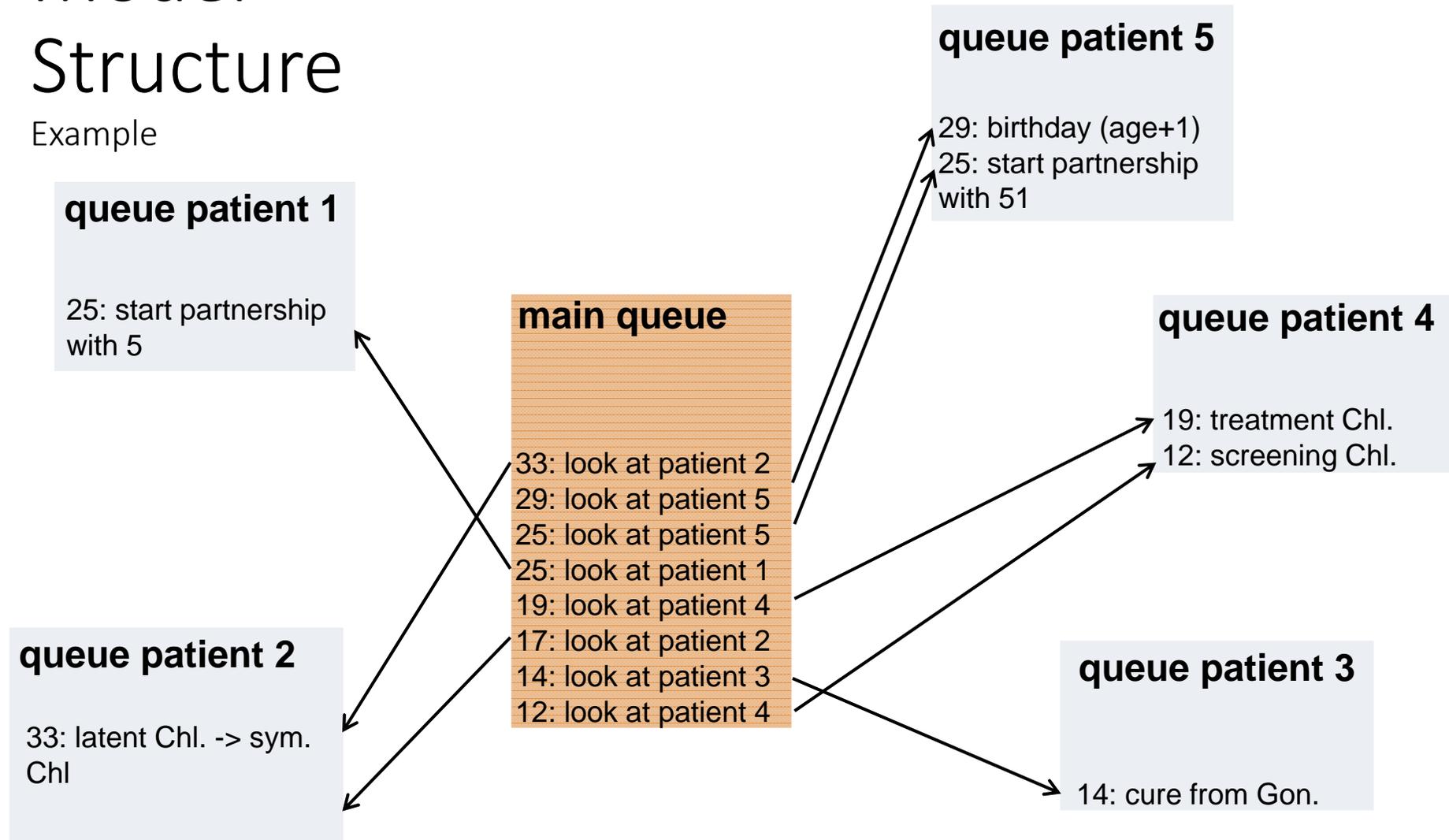
Model Structure

- Problem:
 - Many possible updates
 - Time consuming and often unnecessary
- Solution:
 - Multiple queues

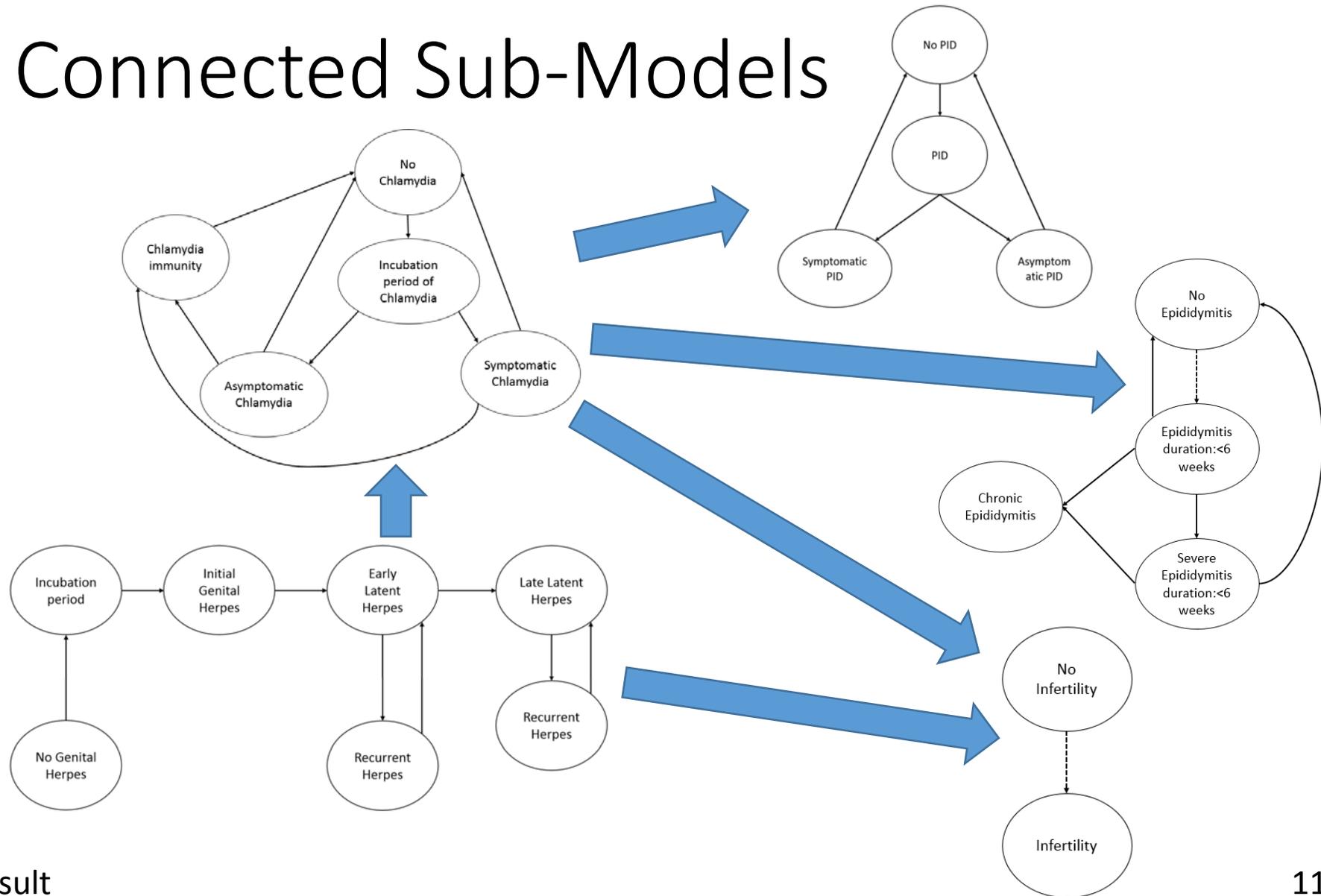


Model Structure

Example



Connected Sub-Models



Graphical User Interfaces

File

days:

individuals:

save results to:

create 0:07 min

warmup 0:14 min

simulate 1:14 min

analyse 0:00 min