

# Modelling the potential impact of 'MenB' vaccines

**Hannah Christensen** University of Bristol, UK

Caroline Trotter University of Bristol, UK

Matt Hickman University of Bristol, UK

John Edmunds London School of Hygiene & Tropical Medicine, UK

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# Introduction

- Meningococcal disease is still important cause of morbidity and mortality in young children
- New meningo vaccines with the capacity to protect against 'Men B' have/are being developed
- Only able to introduce new vaccine if shown to be CE
- Trial data show evidence of immunogenicity (correlate of protection) – unknown whether carriage will be affected
- Models can be used to estimate impact
  - Cohort model – direct protection only
  - Transmission dynamic model – herd immunity



# General approach

- Describe and estimate the burden of disease
  - Epidemiology: natural history; cases; deaths; QALYS
  - Economic: for a given perspective (e.g. NHS, society) what are the costs relating to health outcomes
- Describe the patterns of infection (transmission)
- Develop a model capturing the important features
- Bring together epidemiological and economic data to estimate the cost-effectiveness

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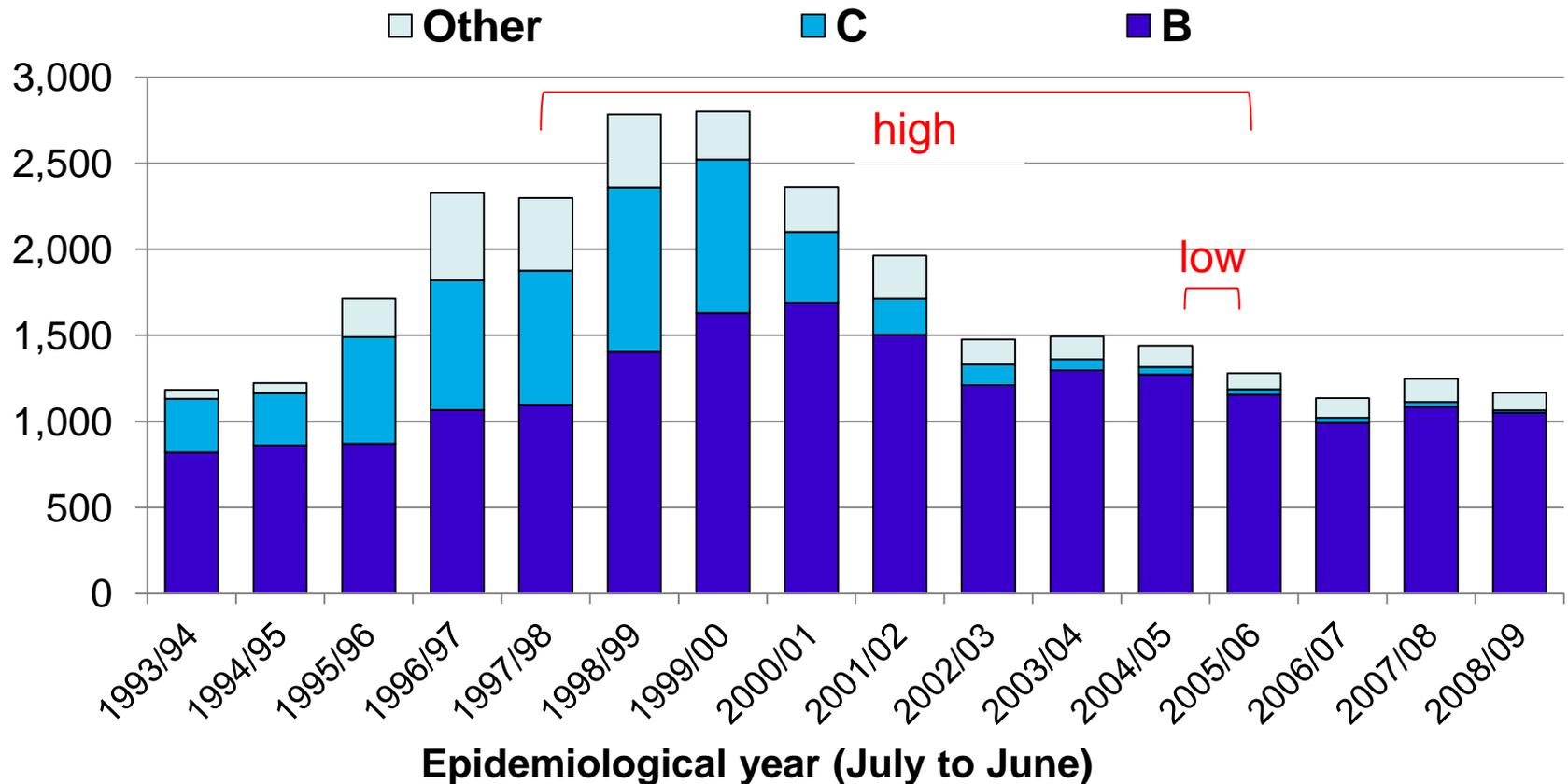
Assumptions - Model structure - Results - Conclusions



# Cohort model

# 🌿 Principal epidemiological assumptions

- Relatively low levels of disease at present - 2 scenarios (England)
- Most disease in young children



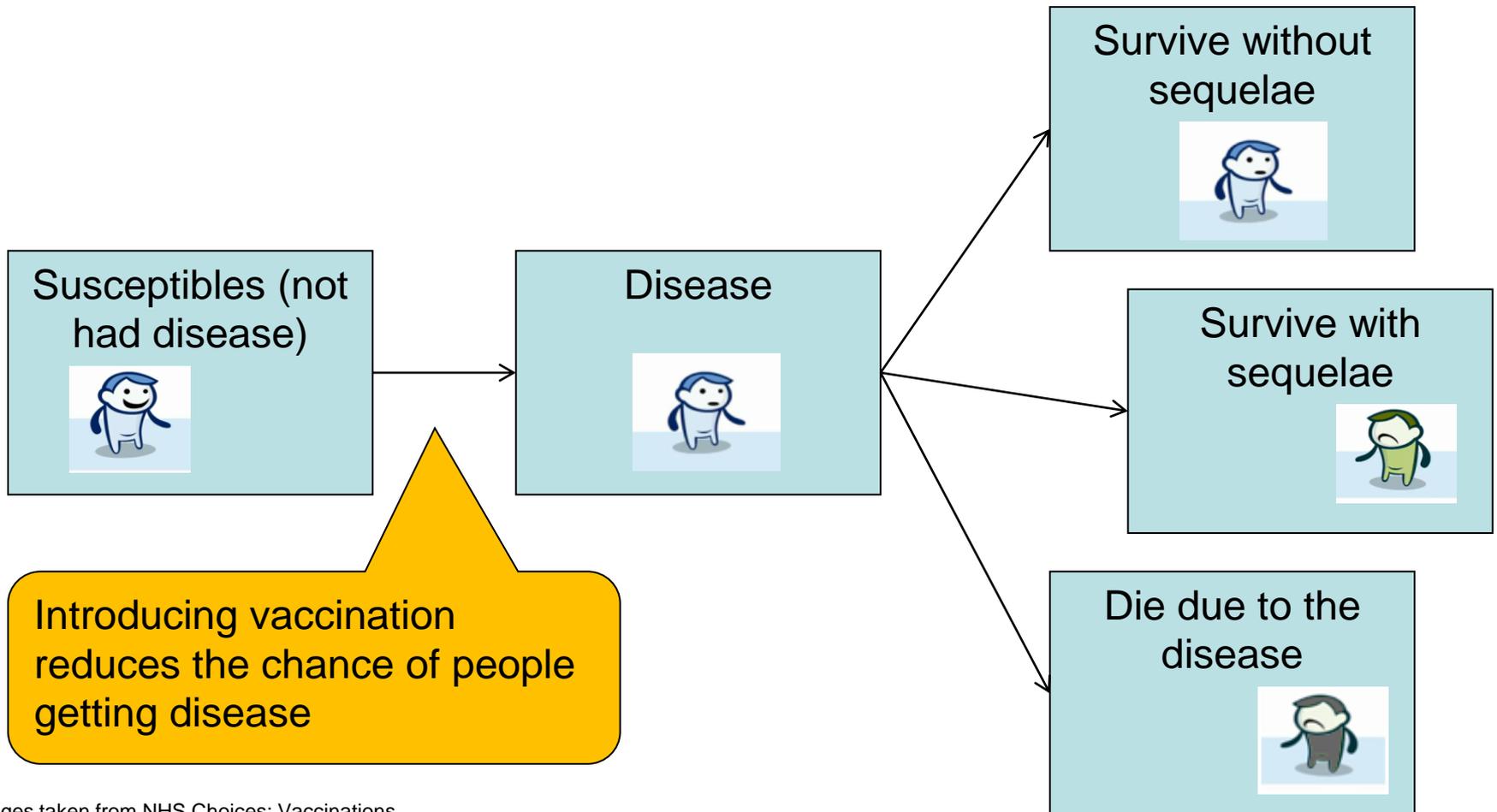
# Vaccine assumptions

- ‘Effective’ vaccine efficacy 75% (more data coming...)
- Average duration of protection from routine vaccination (2,3,4 months with booster at 12 months)
  - 18 months, 36 months following booster
- Protection modelled following the 2<sup>nd</sup> dose
- Strategies
  - Routine 2,3,4 or 2,4,6 months with booster
  - Catch-up 1-4s or 1-17s

# Cost assumptions

- Perspective: National Health Service and Personal and Social Services
- Discounted (back to 2008)
- Cost of care
  - acute care
  - ambulance transfer to hospital
  - follow-up and long term care for those with sequelae and
  - public health costs
- Cost of vaccine programme
  - cost per dose of vaccine £40 (assumed)
  - costs of administration includes extra clinic time
  - adverse reactions

# 🌟 Cohort model (simplified)



Images taken from NHS Choices: Vaccinations  
<http://www.nhs.uk/Planners/vaccinations/Pages/sciencevaccinations.aspx>

# Cohort model structure

- Cohort model – baseline model follows single 2008 birth cohort over their lifetime (max 100 years)
- Age structured model, inc. some demographics
- Assumes vaccine protects against disease but not carriage – cannot account for herd immunity
- Uncertainty around parameters: probabilistic and scenario based analysis
- Outcomes: cases averted, deaths averted, LYS, QALY gained

# Predicted impact of early infant schedule

Outcome	Result (mean of 1000 runs)
Undiscounted	
Cases avoided	484
Deaths avoided	11
Life years saved (LYS)	996
Quality adjusted life years (QALY) gained	1,600
Cost without vaccination (millions)	£102.9
Cost with vaccination (millions)	£176.5
Net cost (millions)	£73.6
Cost of vaccination (millions)	£103.7
Discounted	
Cost per QALY gained	£162,800*

\*assuming £40 per vaccine dose

*Cohort model – direct protection only*

# Alternative strategies

Vaccination strategy	Undiscounted			QALY gained	Discounted Cost per QALY gained
	Cases avoided	Deaths avoided	LYS		
Routine vaccination only strategies					
2,3,4 months + booster at 12 months	484	11	996	1,600	£162,800
Routine and catch-up strategies - catch-up campaign in addition to a 2,3,4 months + booster at 12 months schedule					
Catch-up in 1-4 year olds	1,261	28	2,455	4,075	£238,500
Catch-up in 1-17 year olds	2,615	74	5,684	8,836	£290,000

*Each vaccination strategy is compared with the current situation (no vaccination effective against serogroup B meningococcal disease) – i.e. not formal incremental analysis*

# Scenario based analysis

- **↑** VE (from 75 to 90%) **↑** cases averted (from 484 to 581) and **↓** cost per QALY gained (from £162,800 to £132,200)
- **↑** duration of protection (from 18 [36] to 36 [72]) **↑** cases averted (from 484 to 589) and **↓** cost per QALY gained (from £162,800 to £133,100)
- **↓** cost of vaccine dose (from £40 to £20) **↓** cost per QALY gained (from £162,800 to £77,000)
- Changing to differential discounting (6% costs 1.5% benefits) **↓** cost per QALY to £106,300



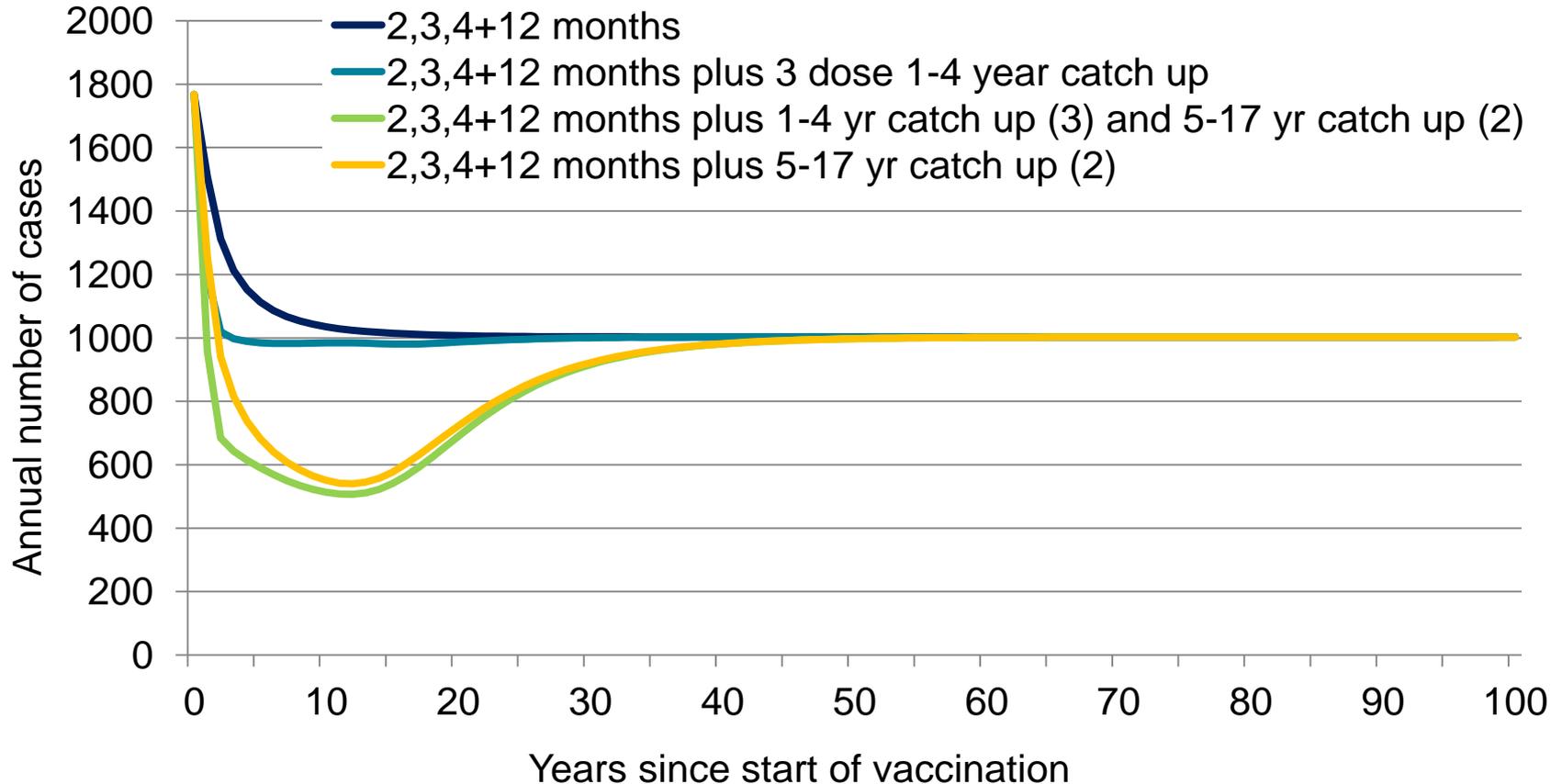
# Dynamic model

# Dynamic model structure

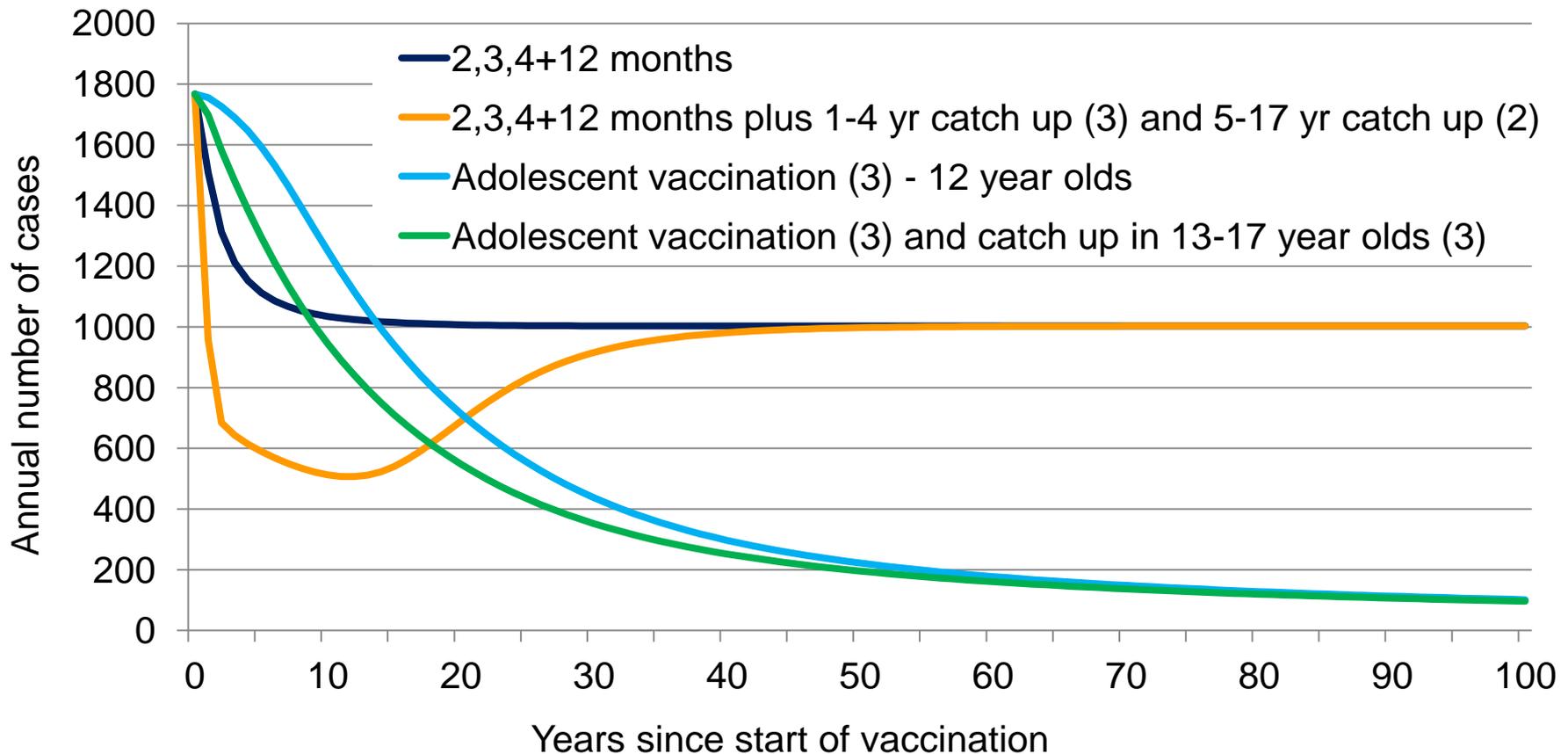
## *Differences to cohort model*

- Principle difference is that this model, models carriers in the population
  - Cases arising are a function of the number of carriers
  - Carriage prevalence from review
- **Able account for herd immunity**
- Follows multiple cohorts over their lifetime (max 100 years)
- Uncertainty around parameters: scenario based analysis
- Additional vaccination strategies considered

# 🌟 The addition of catch-up (k0.6)



# 🌿 Routine adolescent vaccination (k0.6)



# Sensitivity analysis

- The model is sensitive to changes in assumptions around levels and duration of carriage and mixing in the population
- Discount rates have a large effect, particularly differential discounting (6% costs 1.5% benefits ↓ cost per QALY to £12,500 for routine infant vacc)

*The model does not allow for any replacement effects, so may be optimistic*



# Conclusions

- Introducing routine infant vaccination with direct protection only could prevent an estimated 27% of cases over the lifetime of a birth cohort.
- Substantial sustained reductions in disease levels could be seen if a new vaccine had a reasonable effect on carriage as well as disease.
- Models were sensitive: disease incidence, vaccine cost, sequelae parameters; vaccine duration of protection and efficacy; carriage prevalence, popn. mixing and discounting.
- Most scenarios were not cost-effective at £40 per dose, but with competitive pricing CE thresholds can be reached.



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