Modelling strategies for long-term use of MenAfriVac®

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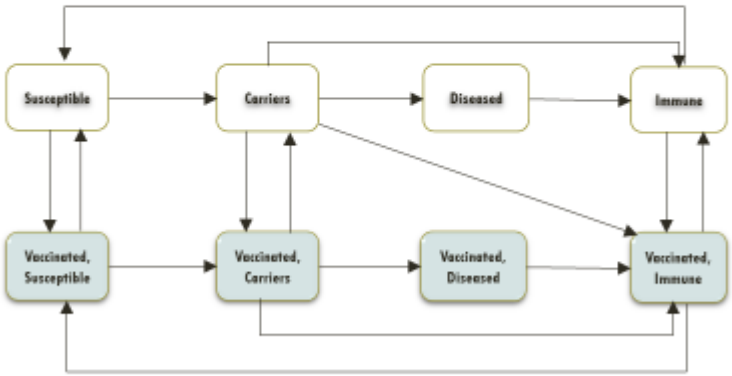
AIMS

- To describe results from mathematical models of *Neisseria meningitidis* group A (MenA) transmission and disease designed to investigate the optimal use of MenAfriVac® in the long term
- To highlight lessons from the meningococcal group C conjugate vaccine (MenC) programme in the UK
- To discuss future evidence needs to inform MenAfriVac® policy

MODEL DESCRIPTION

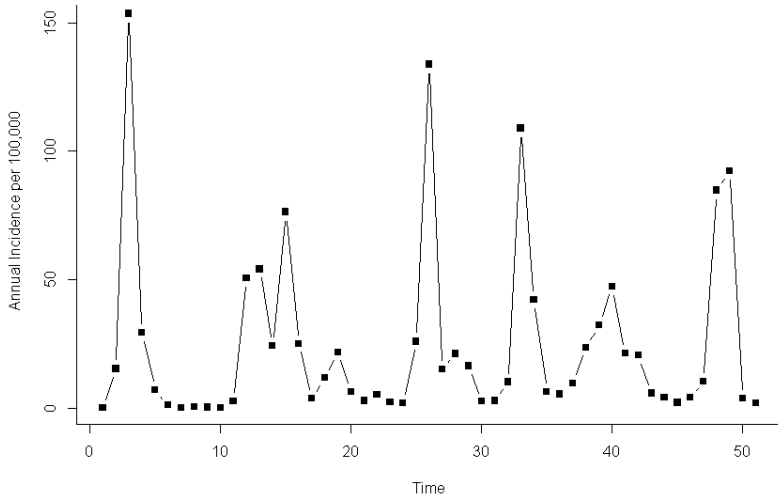
We used an **age-structured transmission dynamic** model that was able to capture these key epidemiological features of MenA in the African meningitis belt

- Periodic but irregular epidemics
- Seasonality
- Epidemics of varying size (stochastic)
- Variable risk of disease by age
- Variable prevalence of carriage by age
- Transmission between asymptomatic carriers
- Temporary immunity from carriage
- Susceptible- Infected- Recovered (SIRS) structure
- African specific parameters

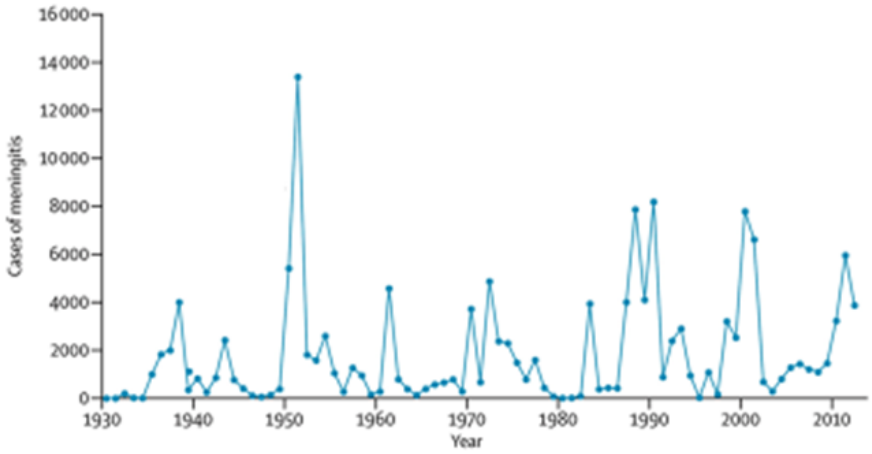


Model reviewed by IVIR-AC in September 2014

DISEASE DYNAMICS



Example model run (no vaccination) showing incidence of meningitis over 50 year period



Cases of meningitis in Chad 1930-2012, Daugla et al, Lancet 2014

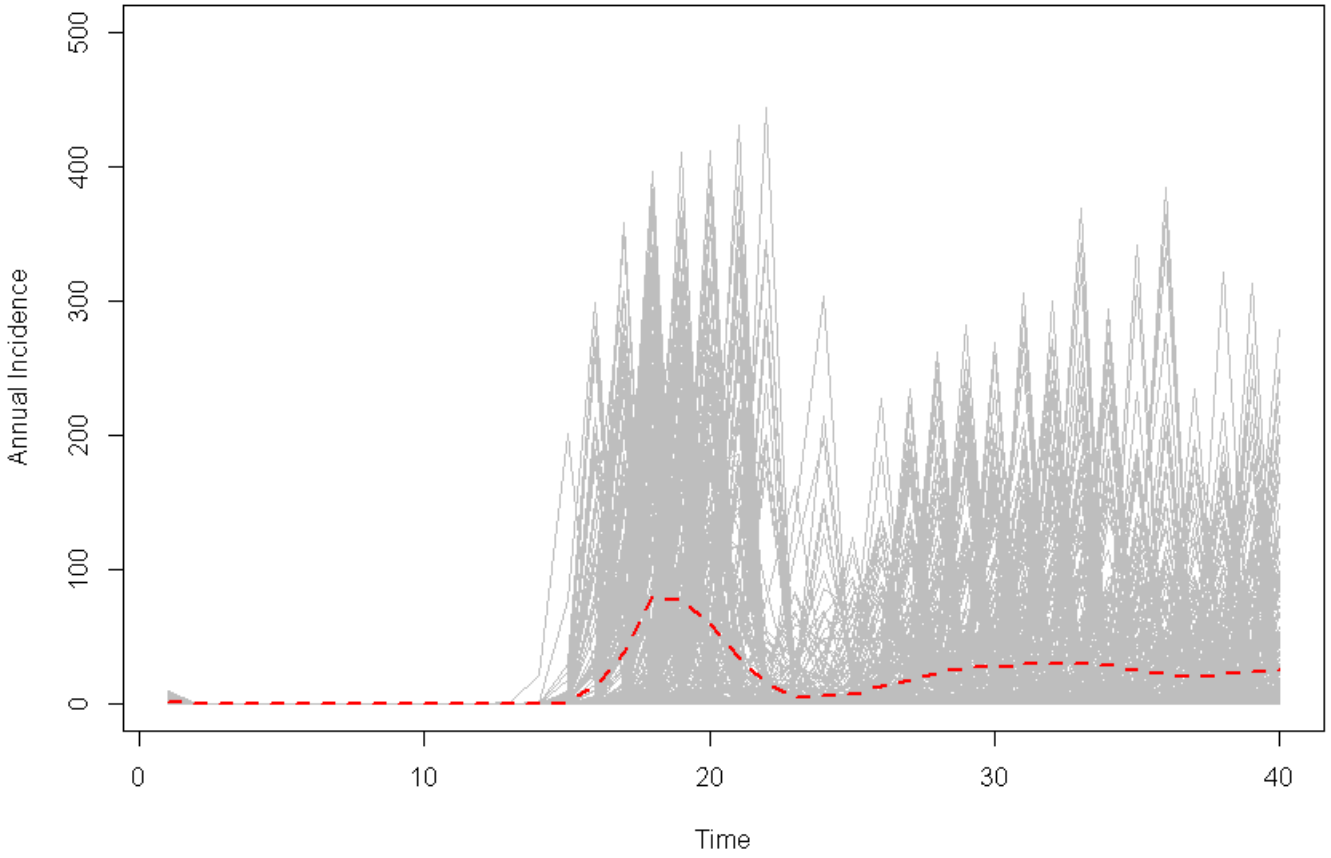
VACCINE STRATEGIES

Vaccine strategy	Introduction	Long-term
A. Initial campaign only	Mass immunisation of 1-29 year olds	Nothing
B. Periodic campaigns	Mass immunisation of 1-29 year olds	Periodic mass immunisation of 1-4 year olds
C. Routine EPI	Mass immunisation of 1-29 year olds	Routine EPI @ 9 months, 5 years after introduction
D. Combination	Mass immunisation of 1-29 year olds	Routine EPI @ 9 months, 5 years after introduction plus 1-4 year old catch-up

Vaccinated individuals assumed to have some protection against carriage and disease resulting in direct and indirect (herd immunity) protection

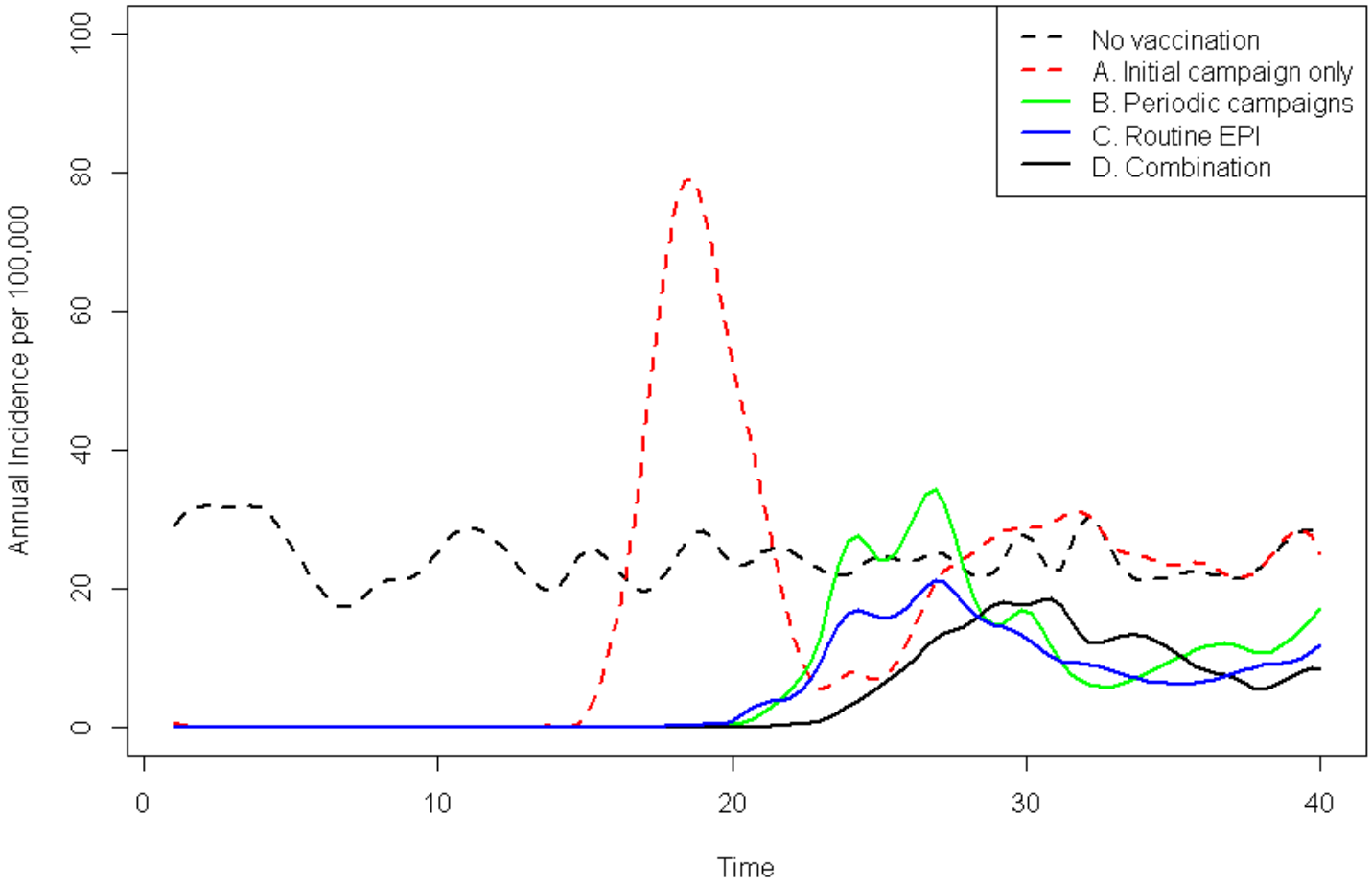
A. MASS 1-29 YEAR OLDS ONLY*

Because of stochastic variation each scenario was simulated 300 times.



*Assumes 10 years average vaccine protection

COMPARISON OF STRATEGIES A-D



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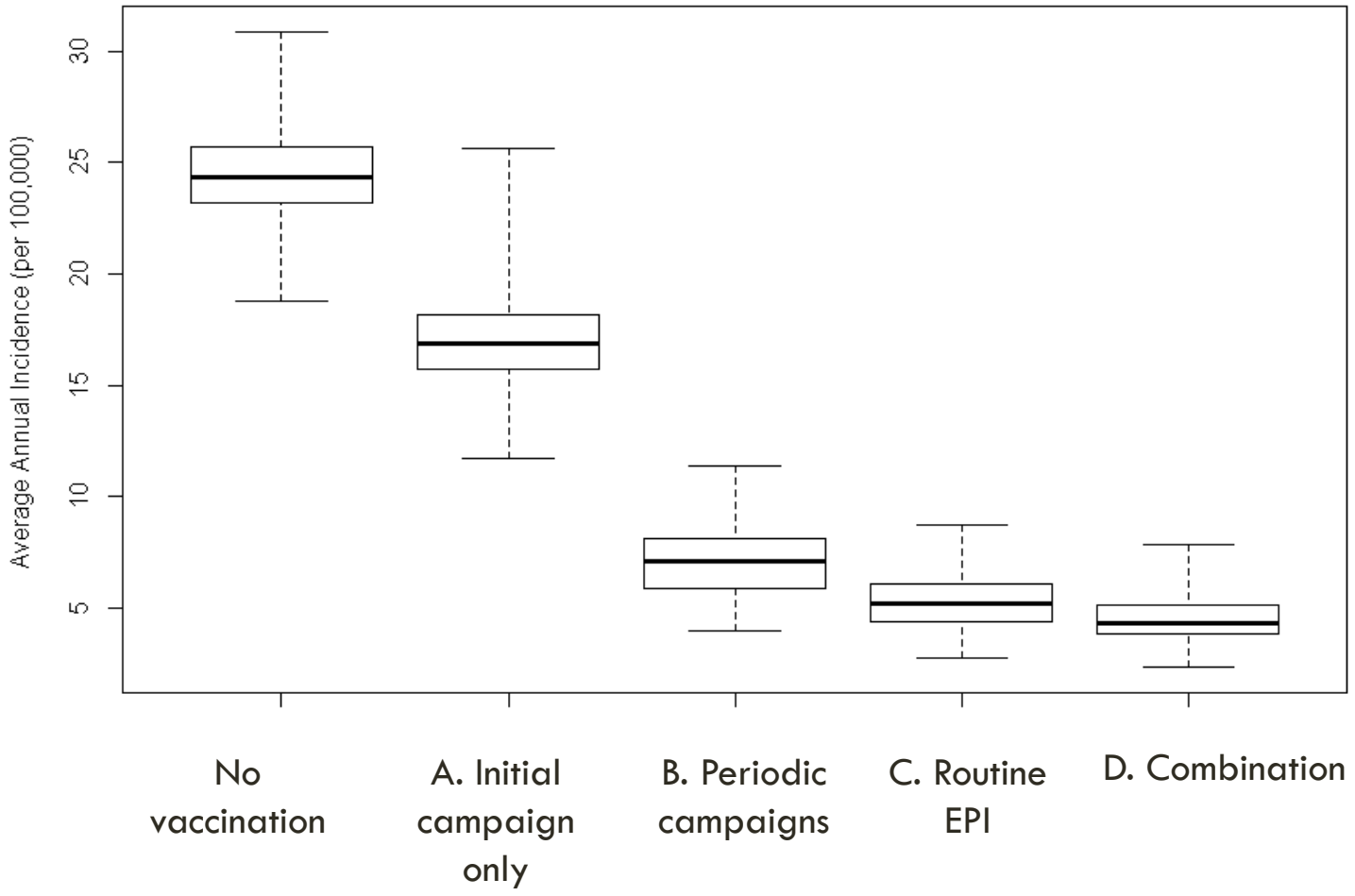
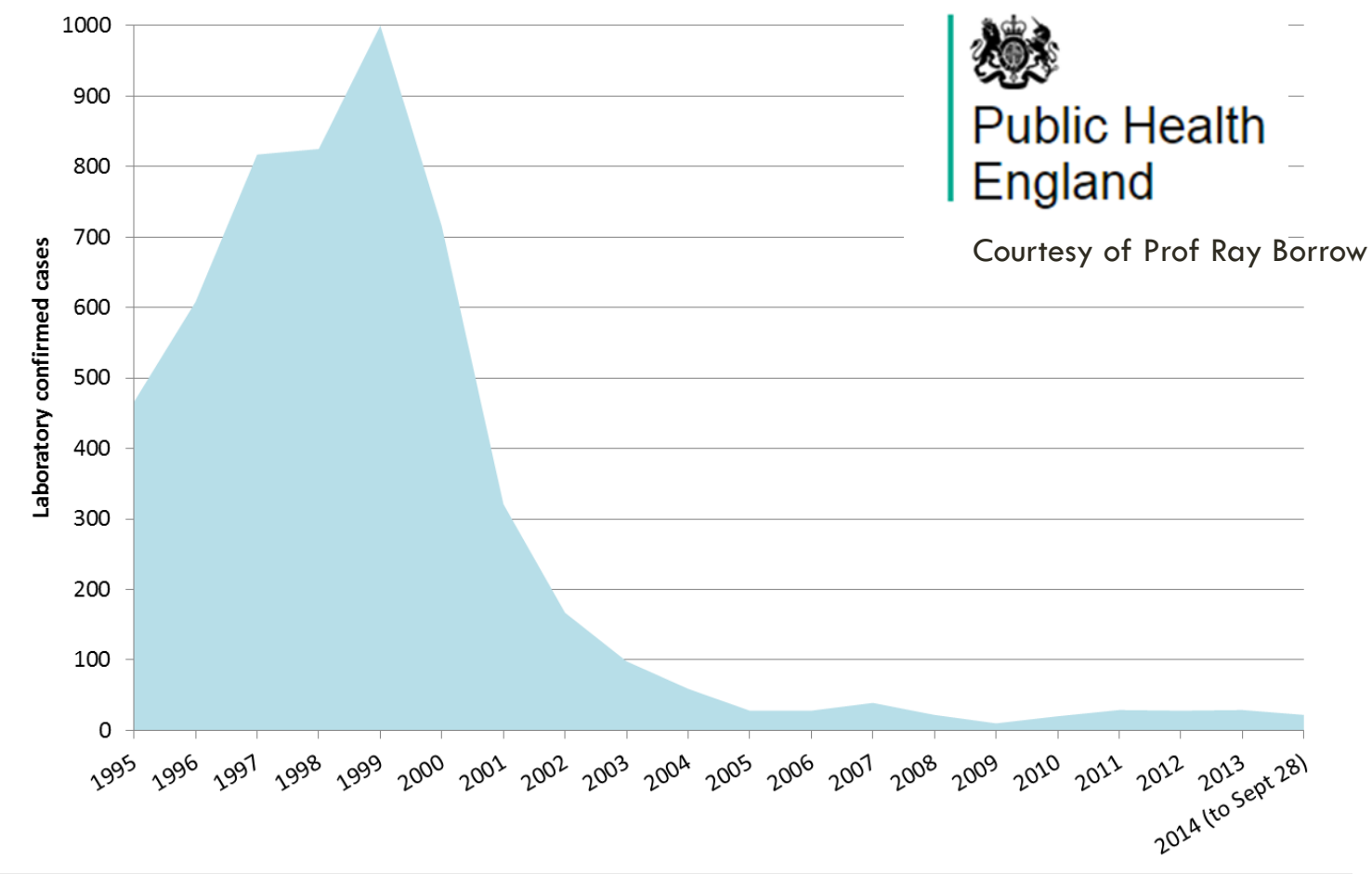


MENC IN THE UK: DISEASE CONTROL



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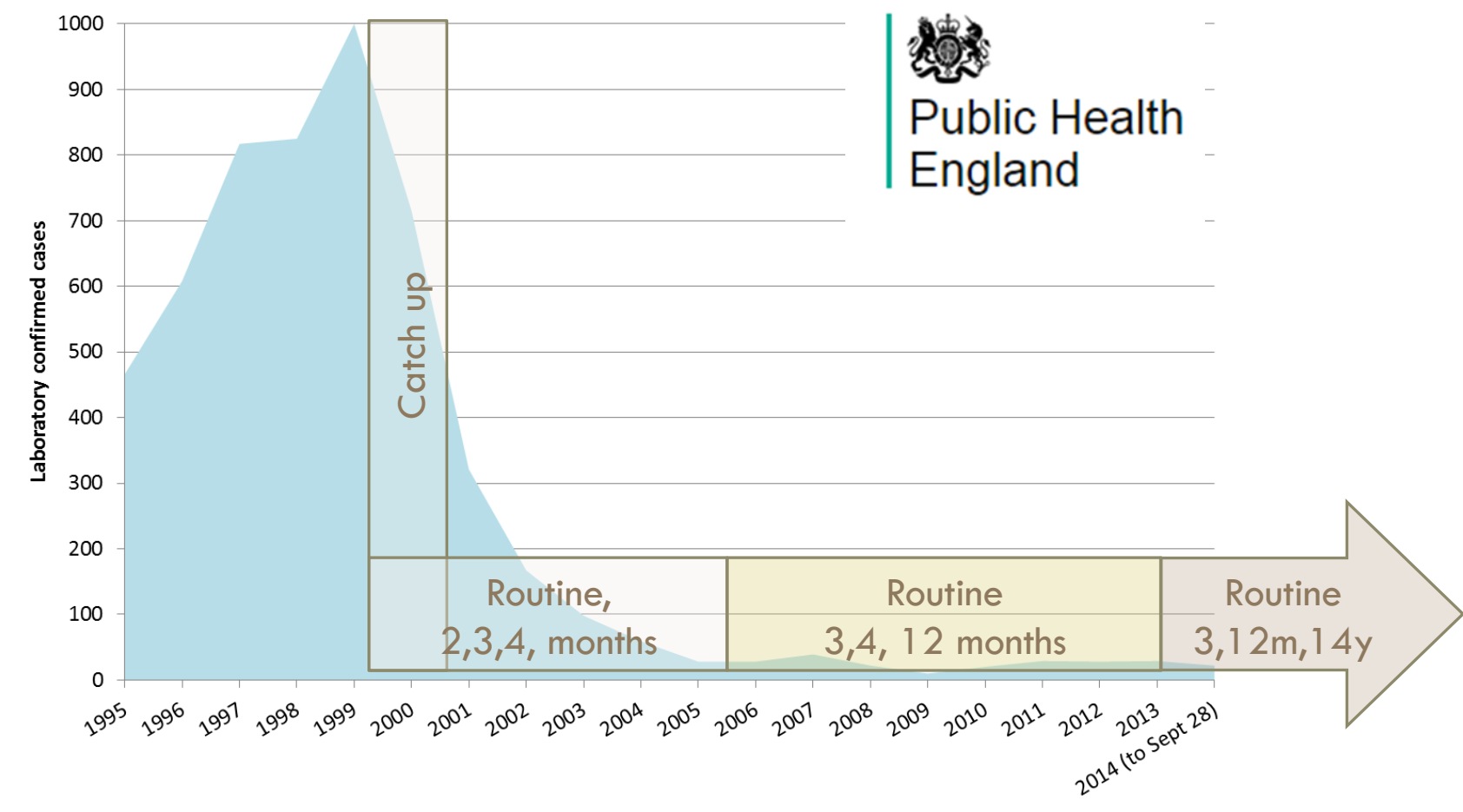

MENC IN THE UK: A DYNAMIC PROGRAMME

1999 vaccine introduction

- 2, 3, 4 month routine infant immunisation
- Catch up of all<18 year olds (extended later to <25 years)

2006 routine schedule changed

- 3,4, 12 month programme
- Rapid waning of protection from 2,3,4 month schedule observed (Trotter et al, Lancet 2004)
- Good control through herd protection resulting from catch-up campaign
- Evidence of sufficient protection from 2 infant doses

2013 teenage dose and routine infant change

- 1+1+1 schedule, 3 months, 12 months, 14/15 years
- Still rapid waning of antibody from infant programme even post-booster
- Maintain herd protection by immunising teenagers who drive transmission

FUTURE EVIDENCE NEEDS

Long term surveillance and evaluation of vaccine effectiveness

Assessment of vaccine coverage

Long-term follow up of individuals in vaccine trials to measure antibody persistence

Serial seroprevalence studies to measure population immunity to MenA and TT and identify potentially vulnerable groups

Evaluation MenAfriVac ® in pregnant women and in their infants

Definition of a reliable correlate of protection

Carriage studies

Contact patterns in African populations (WAIFW matrices)

Economic impact of MenAfriVac on households and on health systems

SUMMARY

Model developed to describe epidemiology of MenA in African meningitis belt

Initial campaigns predicted to result in low meningitis incidence for around 15 years (assuming 10 years duration of protection)

All long-term strategies were effective

- Mean incidence and time to peak were lowest for the combination strategy but range of results overlapped
- EPI > periodic mass campaigns if EPI coverage greater than approx. 60%

MenC programme in UK is good example of a dynamic strategy maintaining excellent control

Important future information needs to allow evaluation and evolution of MenAfriVac® programme

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