**Force of infection**

The age-specific rates at which a susceptible person becomes infected () is a combination of β (probability of becoming infected per contact), c (the number of contacts per unit time) and the infectious prevalence. To include age-dependency, we used Euler’s discretization of the continuous variable ‘age’, so that force of infection is represented by

While, represents all the rest of the contacts traced but not infected

Where j=1,…,6 represents the 6 infectious levels, (haemorrhagic, flat, ordinary, modified, ordinary and modified with reduced contacts) and i=1,…,15 represents the age groups within the contact matrix.

**Model’s differential equations**

A previous model structure (1) was revisited and used.

SUSCEPTIBLES

; sever immunocompromised

mild immunocompromised

dS3; healthy never vaccinated

dS4; healthy previously vaccinated

dS5; HCWs never vaccinated,

dS6; HCWs previously vaccinated

LATENT UNTRACED

LATENT TRACED which we will vaccinate all of them and keep them isolated

UNINFECTED CONTACT TRACED

ISOLATION

INFECTIOUS with the 4 different diseases types

RECOVERED

DEATHS

SUCCESSFULLY VACCINATED

Parameter estimation for smallpox transmission, duration stages and age distribution rates for haemorrhagic, flat, ordinary and vaccine modified smallpox are listed in the technical appendix from our previous study (2), while parameters involved in the implementation of ring vaccination in the model and additional parameters are listed in the following table

|  |  |  |  |
| --- | --- | --- | --- |
| Symbol | Definition | Value | Source |
|  | Susceptibility of HCWs | 3 |  |
|  | Age specific distribution rate of haemorrhagic smallpox in healthy unvaccinated people | See Technical Appendix Table 3 | (2) |
|  | Age specific distribution rate of flat smallpox in healthy unvaccinated people | See Technical Appendix Table 3 | (2) |
|  | Percentage of infectious people isolated | 90%  Sensitivity analysis with 70% and 50% | (3) |
|  | Percentages of contacts traced and vaccinated | 95%  Sensitivity analysis on with 70% and 50% | (3) |
|  | Duration of isolation for contacts traced after vaccination | 17 | (1) |
|  | Duration of isolation for infectious symptomatic cases | 25 | (1) |
|  | Infectious duration for ordinary smallpox with full R0 | 2 days |  |
|  | Infectious duration for ordinary smallpox with reduced R0 | 14 days |  |
|  | Infectious duration for modified smallpox with full R0 | 3 days |  |
|  | Infectious duration for modified smallpox with reduced R0 | 13 days |  |
|  | Infectious duration for haemorrhagic and flat smallpox with reduced R0 from day 1 | 16 days |  |
|  | Vaccine effectiveness in latent infected previously vaccinated | 0.53 | (4) |
|  | Vaccine effectiveness in uninfected previously vaccinated | 0.98 | (4) |
|  | Vaccine effectiveness in latent infected never vaccinated before | 0.50 | (5,6) |
|  | Vaccine effectiveness in uninfected never vaccinated before | 0.95 | (7) |

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