Each indi id al in he comm ni can be ega ded a a e e in he ne o k, and each con ac be een o indi- id al i e e en ed a an edge (line) connec ing he e - ice . The n mbe of edge emana ing f om a e e — ha i , he n mbe of con ac a e on ha — i called he deg ee of he e e . The efo e, e a me ha he o la ion i di ided in o n di inc g o of i e N_k (k = 1, 2, ..., n) ch ha each indi id al in g o k ha e ac l k con ac e da . If he hole o la ion i e i N ($N = N_1 + N_2 + ... + N_n$), hen he obabili ha a ni- fo ml cho en indi id al ha k con ac i $P(k) = N_k/N$, hich i called he deg ee di ib ion of he ne o k. Em i ical die ha e ho n ha man eal ne o k ha e cale-f ee (SF) deg ee di ib ion $P(k) \approx k^{-\gamma}$

an den D ie che and Wa mo gh [20], e no e ha onl com a men E_k, A_k and I_k a e in ol ed in he calc la- ion of R_0. In he infec ion-f ee a e P^0, he a e of a ea ance of ne infec ion F and he a e of an fe of indi id al o of he o com a men V a e gi en b

$$F = \begin{bmatrix} F_{11}^{\times} & F_{12}^{\times} & F_{13}^{\times} \\ F_{21}^{\times} & F_{22}^{\times} & F_{23}^{\times} \\ F_{31}^{\times} & F_{32}^{\times} & F_{33}^{\times} \end{bmatrix},$$

he e $F_{11}^{\times}, F_{21}^{\times}, F_{22}^{\times}, F_{23}^{\times}, F_{31}^{\times}, F_{32}^{\times}, F_{33}^{\times}$ a e e o ma ice ,

$$F_{12}^{\times} = \frac{I_1}{\langle\ \rangle} \begin{bmatrix} (1) & 2\,(2) & \cdots & (\ ) \\ 2\,(1) & 2^2\,(2) & \cdots & 2\,(\ ) \\ \vdots & \vdots & & \vdots \\ (1) & 2\,(2) & \cdots & (\ ) \end{bmatrix}$$

$$F_{13}^{\times} = \frac{I_2}{\langle\ \rangle} \begin{bmatrix} (1) & 2\,(2) & \cdots & (\ ) \\ 2\,(1) & 2^2\,(2) & \cdots & 2\,(\ ) \\ \vdots & \vdots & & \vdots \\ (1) & 2\,(2) & \cdots & (\ ) \end{bmatrix}$$

=Š

and

$$= -\begin{bmatrix} -d & 0 & \cdots & 0 & 0 & \cdots & 0 & 0 & \cdots & 0 \\ 0 & -d & \cdots & 0 & 0 & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & \vdots & & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & -d & 0 & \cdots & 0 & 0 & \cdots & 0 \\ g^d & 0 & \cdots & 0 & -a_1 & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & \vdots & & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & g^d & 0 & \cdots & -a_1 & 0 & \cdots & 0 \\ (1-g)d & 0 & \cdots & 0 & 0 & \cdots & 0 & -a_2 & \cdots & 0 \\ \vdots & \vdots & & \vdots & \vdots & & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & (1-g)d & 0 & \cdots & 0 & 0 & \cdots & -a_2 \end{bmatrix}.$$

U ing he conce of ne -gene a ion ma i [20], he e od c ion n mbe i gi en b $R_0 = \rho(FV^{-1})$, he ec al adi of he ma i FV^{-1}.

To de e mine he ec al adi of FV^{-1}, e fi e e en he in e e of V b he follo ing ma i :

We no com e he ime de i a i e of L(t) along he ol ion of em (1)-(5). I i een ha

$$'(\;) = -\sum (\;)(I_1 \;\Theta^A + I_2 \;\Theta^I) + 2 \;(\;)(I_1 \;\Theta^A + I_2 \;\Theta^I - bE\;)$$

$$(\;)(\quad — \quad) \qquad (\;)(\quad —— \quad)$$

$$(\;)\;($$

If $S_k(0) = S_{k0}$, $I_k(0) = I_{k0}$, $E_k(0) = E_{k0}$, $A_k(0) = A_{k0}$, hen he final i e ela ion become

$$\ln \frac{\ \ 0}{\ \infty} = \ _0 \frac{}{\langle\ ^2 \rangle} \sum (\ )(\ _0 - \ _\infty) + \ _0 \frac{}{\langle\ ^2 \rangle} \sum (\ ) E\ _0 + \frac{l_1}{a_1 \langle\ \rangle} \sum (\ ) A\ _0$$

$$+ \frac{l_2}{a_2 \langle\ \rangle} \sum (\ ) I\ _0 .$$

The final size with vaccination

If accina ion follo a nifo m imm ni a ion a eg , e ha e

$$\ln \frac{\ (0)}{\ (\infty)} = \frac{(1 - \ ) l_1}{\langle\ \rangle} \sum (\ ) \bar{A} + \frac{(1 - \ ) l_2}{\langle\ \rangle} \sum (\ ) \bar{I}$$

$$= (1 - \ ) \ _0 \frac{}{\langle\ \rangle} \qquad \frac{}{\langle\ \rangle} \quad E$$

$$\frac{}{\langle\ \rangle}$$

Conclusions

Ne o k model can ca e he main fea e of he ead of he H1N1. In hi a e , ing a ne o k e i-demic model fo infl en a A (H1N1) in China, e cal-c la ed he ba ic e od c ion n mbe R_0 and di c ed he local and global d namical beha io of he di ea e-f ee e ilib i m. The effec of a io imm ni a ion cheme e e died and com a ed. A final i e ela ion a de i ed fo he ne o k e idemic model . The de i a ion de end on an e lici fo m la fo he ba ic e od c ion n mbe of ne o k di ea e an mi ion model . The an mi ion coefficien a e e ima ed h o gh lea - a e fi ing of he model o ob e ed da a of he c m la i e n mbe of ho i al no ifica ion . We al o ga e he e ima ed al e fo he e od c ion n mbe fo infl en a A (H1N1) in China a $R_0 = 1.6809$.

Pa ame e e e e ima ed d ing he e iod hen he accina ion a no a lied. Fo he e a ame e , e fo nd ha $\gamma = 0.85$, hich mean ha 15% of he e o ed become infec ed d ing he ea l co e of he endemic. Al ho gh accina ion commenced in China in No embe 2009, e e e no able o com a e he eal da a i h he model ojec ion d e o lack of da a.

List of abbreviations used

Acknowledgements

BMC Public Health

Author details

Authors' contributions

Competing interests

P : 25 F 2011

References

(H1N1) 2009 - 82.
H1N1 P F
R A M
P 2009-2010
H1N1 (F
J. R. Soc. Interface, 2(4)
P A(H1N1): E F Science, 324
A(H1N1) Eurosurveillance, 14
E A (H1N1) H N J New Zealand Medical Association, 122
E N A/H1N1 M PLoS Curr Influenza, 11
A/H1N1 E A Vaccine
E -F N Phys Rev Lett, 86
E Phys Rev Lett, 63
E Eur Phys J B, 26
Eur Phys J B, 38
E Phys Lett A, 364
IR J Math Biol, 56
PNAS, 105
Rev Mod Phys, 74
N AR J Theor Biol, 232
R Math Bios, 180
O New York: Wiley-Interscience
Q Phys Life Rev, 5
1918 G A J Theor Biol, 241
K 1918 Theor Biol Med Model