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Analysis of the transmission dynamics of pneumonia disease in a developing country: The effect of environment on pneumonia transmission, significance of hospital and community based care

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Pneumonia is recorded to be one of the major disease leading to serious deaths among the children aged under five and adults aged over 65. It is reported that, more than 2 million deaths occur in the developing countries due to pneumonia each year. The efforts for early detection, effective treatment and minimise the transmission of pneumonia are possible if the dynamics of the disease is well understood. In this research, a model for the transmission dynamics of pneumonia disease in a developing country to investigate the effect of environmental transmission, the significance of community and hospital based care is formulated. Basic properties of the model were computed. The basic reproduction number, $\mathcal{R}_0$ was derived. The model has the disease-free and endemic equilibria. Sensitivity analysis was performed to determine the parameters with greatest significance in the reproduction number, from which the results revealed that transmission rate through environment and contact rate through person-to-person have the greatest potential of increasing the disease burden when increased. On the other hand, rate of treatment and decay rate of virus from the environment have greatest potential of minimising the number of new infections when increased. We computed the numerical simulations to illustrate the analytical results as well as establishing the long term behaviour of the disease. It was observed that treatment interventions either in the hospital or community can eradicate pneumonia infection. However, the infection may stay long in the community which might be as a result of increased contacts through unlimited visitors and crowded homes since they are not really controlled as compared to the hospital based care. Moreover, transmission of

pneumonia is not only by person to person contact, but it can be transmitted through the environment. We therefore recommend trainings of more health workers to assist in the community on treatment and educating the individuals on transmission behaviour of pneumonia as well as ways to minimise spreading the infection. Moreover practising good hygiene, applying more control measures such as vaccination, disinfection and isolation is important to reduce the number of new infection to less than one.

Keywords: reproduction number, sensitivity analysis, hospital and community based care

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