Modeling the Effect of Antibiotic Exposure on the Transmission of Methicillin-resistant *Staphylococcus aureus* in Hospitals with Environmental Contamination

Qimin Huang[1] **Mary Ann Horn**[1] **Shigui Ruan**[2]

[1] *Case Western Reserve University, Cleveland, OH, US, 44106*
[2] *University of Miami, Miami, FL, US, 33146*

Both deterministic and stochastic mathematical models are developed to explore the roles that antibiotic exposure and environmental contamination play in the transmission dynamics of nosocomial infections in hospitals. Uncolonized patients without or with antibiotic exposure, colonized patients without or with antibiotic exposure, uncontaminated or contaminated healthcare workers, and free-living bacteria are included in the models. Under the assumption that there is no admission of the colonized patients, the basic reproduction number R_0 is calculated. It is shown that when $R_0 < 1$, the infection-free equilibrium is globally asymptotically stable; when $R_0 > 1$, the infection is uniformly persistent. Numerical simulations and sensitivity analysis show that environmental cleaning is a critical intervention, and hospitals should use antibiotics properly and as little as possible. The rapid and efficient treatment of colonized patients, especially those with antibiotic exposure, is key in controlling MRSA infections. Screening and isolating colonized patients at admission, and improving compliance with hand hygiene are also important control strategies.

References

[1] Q. Huang, X, Huo, D. Miller and S. Ruan, Modeling the seasonality of Methicillin-resistant *Staphylococcus aureus* infections in hospitals with environmental contamination, *Journal of Biological Dynamics* 2018, 1-24. doi:10.1080/17513758.2018.1510049.

[2] Q. Huang, X, Huo and S. Ruan, Optimal control of environmental cleaning and antibiotic prescription in an epidemiological model of Methicillin-resistant

---

*Mini-Symposium: Disease Modelling – from Within-Host to Population

Staphylococcus aureus infections in hospitals, *Mathematical Biosciences* (accepted).

[3] Q. Huang, M. A. Horn, and S. Ruan, Modeling the Effect of Antibiotic Exposure on the Transmission of Methicillin-resistant *Staphylococcus aureus* in Hospitals with Environmental Contamination, (submitted)