STOCHASTIC EPIDEMIC MODELS FOR ESTIMATING TRANSMISSION RATES OF PATHOGENS.

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We consider development and adaptation of the susceptible-infected-removed (SIR) stochastic epidemic model to infer transmission rates of asymptomatic communicable pathogens within a hospital ward. Inference is complicated by partial observation of the epidemic process which, within the hospital setting, is observed by routine swab tests for the presence of the pathogen on patients (and sometimes health care workers), so-called colonization. Transmission between patients via health care worker contact is the focus of the modeling and the methods are applied to estimate the transmission of golden staph or methicillin-resistant staphyloccus Aureus (MRSA) within an intensive care unit. We consider a continuous-time model which allows for fixed known times for swab tests and inferred times for colonization. Arrivals and departures are considered deterministic. Modeling is in a Bayesian framework using Markov chain Monte Carlo (MCMC). The model can be extended to allow for false negative test outcomes and requires colonization times to be inferred using a reversible jump MCMC approach as some patients are considered colonized even though they have returned negative swab results. The model requires an informative prior for the sensitivity of the test otherwise additional data are required compared with the original model.