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There is a wide range of pathogens which are both horizontally and vertically transmitted. We present some mathematical analysis on two simple models without latency or recovery: one model with a single strain of pathogens and another model with two strains of pathogens when the second strain is only vertically transmitting and there is complete cross-protection between the two strains.

For the single strain model, we show that the pathogen can persist when the coefficient of horizontal transmission is large enough. For the two strains model, we show that the vertically transmitted strain, which cannot persist by itself, can otherwise coexist with the horizontally transmitted strain. We show the uniform persistence of (the host and) the two strains of pathogen when the (unique) coexistence equilibrium exists. Depending on further conditions, the coexistence equilibrium can be either locally asymptotically stable or unstable. Numerical simulations show that there can be attracting periodic orbits when the coexistence equilibrium is unstable. (Received February 26, 2007)