sterilization, hand hygiene requirements, and vaccination requirements as a means of mitigating nosocomial infections. However, in most hospitals, hand hygiene and vaccination are still voluntary and both suffer from non-compliance. Aside from non-compliance, there are occasional vaccination shortages, notably in 2004 with influenza vaccinations [67] and, more recently, in 2009 with H1N1 vaccinations.

One way to deal with non-compliance and vaccination shortages is to "target" the right subset of HCWs for vaccination to protect the entire population. It has been shown that vaccinating the right subset of a population can ultimately lead to protection for the entire population, a phenomenon known as "herd immunity" [41, 6, 18]. As we will show, the problem of determining the "right" people to vaccinate can be modeled as an optimization problem. But solving optimization problems for mitigating hospital acquired infections requires that we first have an understanding of how disease spreads within the hospital environment.

1.2 Contact Network Epidemiology

The earliest models used to understand the diffusion of disease within a population were *compartmental* mathematical models such as SIR and its close relatives SEIR, MSEIR, and more recently SZR [50, 77]. These models track the size of compartments that divide the population by their "state": being either *susceptible* (S), *infected* (I), or *recovered* (R). Compartmental models are based on the *mass-action principle* where the number of cases is proportional to the product of the number of infected and susceptible hosts. Recent research has shown that the mass-action