ABSTRACT

Social networks encode important information about the relationships between individuals. The structure of social networks has important implications for how ideas, information, and even diseases spread within a population. Data on online social networks is becoming increasingly available, but fine-grained data from which physical proximity networks can be inferred is still a largely elusive goal. We address this problem by using nearly 20 million anonymized login records from University of Iowa Hospitals and Clinics to construct healthcare worker (HCW) contact networks. These networks serve as proxies for potentially disease-spreading contact patterns among HCWs. We show that these networks exhibit properties similar to social networks arising in other contexts (e.g., scientific collaboration, friendship, etc.) such as the "Six Degrees of Kevin Bacon" (i.e., small-world) phenomenon. In order to develop a theoretic framework for analyzing these HCW contact networks we consider a number of random graph models and show that models which only pay attention to local structure may not adequately model disease spread. We then consider the best known approximation algorithms for a number of optimization problems that model the problem of determining an optimal set of HCWs to vaccinate in order to minimize the spread of disease. Our results show that, in general, the quality of solutions produced by these approximations is highly dependent on the dynamics of disease spread. However, experiments show that simple policies, like vaccinating the most well-connected or most mobile individuals, perform much better than a random