Reviewer's report

**Title:** Social Networks of Children and Teenagers: Characterization and Application for the Spread of Pandemic Influenza

**Version:** 1  **Date:** 17 September 2007

**Reviewer:** Cecile Viboud

**Reviewer's report:**

This paper presents interesting and novel data on the social contact networks of middle and high-school students, based on surveys of 249 students between grades 5 and 12 in Albuquerque, NM (presumably between the ages of 10 and 18 years). The authors then discuss at length the implications of their findings in the context of social distancing measures for control of pandemic influenza. I find the survey data very interesting and worthy of publication, but the application to pandemic flu is more questionable and should be shortened. Specific comments follow.

**MAJOR COMMENTS:**

1) There is a lack of statistical analysis of the survey data. The authors do not conduct any statistical tests, in particular to compare social networks between age groups or between activities, and use vague descriptive terms such as “a bit higher…” Tests would be useful to improve the analysis of Figures 1-2.

2) The authors create an index integrating the number of contacts, the strength of these contacts (based on a categorical scale ranging from 1 to 4), and the duration of the contact, as a measure of probability of influenza transmission (referred to as “contact-level-hour”). Without calibrating this index with real disease transmission patterns (as in Wallinga et al, AJE, 2006), the analysis seems rather theoretical. It is possible that there is a threshold for the number (or strength) of contacts, above which transmission between a susceptible and infected will occur no matter what. Hence it may be good the present the results and discussion on pandemic flu mitigation using the integrated index as well as the raw data on the number of contacts.

3) More details could be given on the surveys conducted. For instance, are the children asked to report on a specific day, week, or month of their life? Is there any difference in the demographics of the respondents whose surveys were used for analysis and those who had to be discarded? A copy of the survey questionnaire could be provided in the Appendix.

4) This paper follows two recent studies of social contact networks by Wallinga et al. in the Netherlands and Edmunds et al. in the UK (ref 16 and 17). A detailed comparison of the contact matrix between these 3 studies would be useful. In particular, it appears that 60% of conversational contacts in people 13-19 yo occur with peers in Wallinga et al’s study, while 77-83% of primary links in grades 9-12 occur with peers in the present study. This comparison suggests stronger
patterns of assortativity in the Albuquerque data than in the two previous studies. Are these differences statistically significant and can the authors comment on the possible reasons for these differences?

5) The authors devote nearly the entire discussion to predictions of the impact of social distancing measures for control of pandemic influenza. There are many uncertainties in these predictions (some listed below), and accurate pandemic flu predictions do not simply depend on having more data on social contacts. This part should be shortened and caveats should be highlighted. In addition, it would be better to present this section as a true “discussion” rather than “evaluation of social distancing measures”. Indeed, the impact of school closure interventions is not fully evaluated here.

a. The authors have focused their surveys on children between grades 5 and 12, disregarding contacts initiated by younger children and working adults, two population age groups who are deemed essential for the local and national spread of influenza (eg, Monto, CID, 2000; Brownstein et al, AJE, 2005, Viboud et al, Science, 2006). Hence simply reducing contacts in older children may not be enough to decrease transmission in all age groups and mitigate disease burden. In addition, the probability of transmission is not just a function of the number (and strength) of contacts but also depends on the proportion of susceptible hosts in specific age groups. Even for pandemics, there seems to be a general pattern of decreasing attack rates with age.

b. Past influenza pandemics have had a diversity of epidemiological patterns; in particular the 1918 pandemic had unusually high mortality impact in young adults, as compared with other pandemic and interpandemic seasons. In addition, it is estimated that the transmissibility of past pandemics ranged between 1.3 and 3.8, depending on the specific pandemic wave and geographical location considered (see a nice summary table for the 1918 pandemic in Nishiura, Theor Biol and Med Model, 2007). Such important variability in past pandemic patterns, both spatially and temporally, makes it extremely difficult to predict the spread of future pandemics, even with great data on social contacts.

c. The authors estimate in the discussion that school closure would decrease contacts to ~67%-88% of their original values in children >=10 yo, which would be enough to stop transmission of an influenza pandemic. However children would then spend more time at home. The authors make additional assumptions on the amount of extra time spent at home and the levels of household contacts. These assumptions seem arbitrary in the absence of additional data and no sensitivity analysis is presented.

d. It is unclear how social networks change when an individual become sick (and infectious) with influenza.

MINOR COMMENTS:
- abstract: flu is thought to spread by coughs *and* sneezes.
- last sentence of intro p. 5: the authors do not “evaluate” social distancing strategies, rather they “discuss” these strategies in light of their results (cf
- It would be useful to provide some data on the demographics (age, gender) of the children in the different grades.
- Was there any difference in social network between genders?
- The index measuring the strength of the contact is categorical (4 categories described p. 7); however the results are analyzed as if the index was continuous (cf “contact-level” columns in Table 1 and 2). In consequence, there is artificially little dispersion in these data. Can the authors present the proportion in each category instead (perhaps in Appendix)?
- Figure 5a(c)e): box plots would be more informative than crude data points.
- Discussion: 1957 pandemic (not 1958 pandemic!)

**What next?:** Unable to decide on acceptance or rejection until the authors have responded to the major compulsory revisions

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**

I declare that I have no competing interests