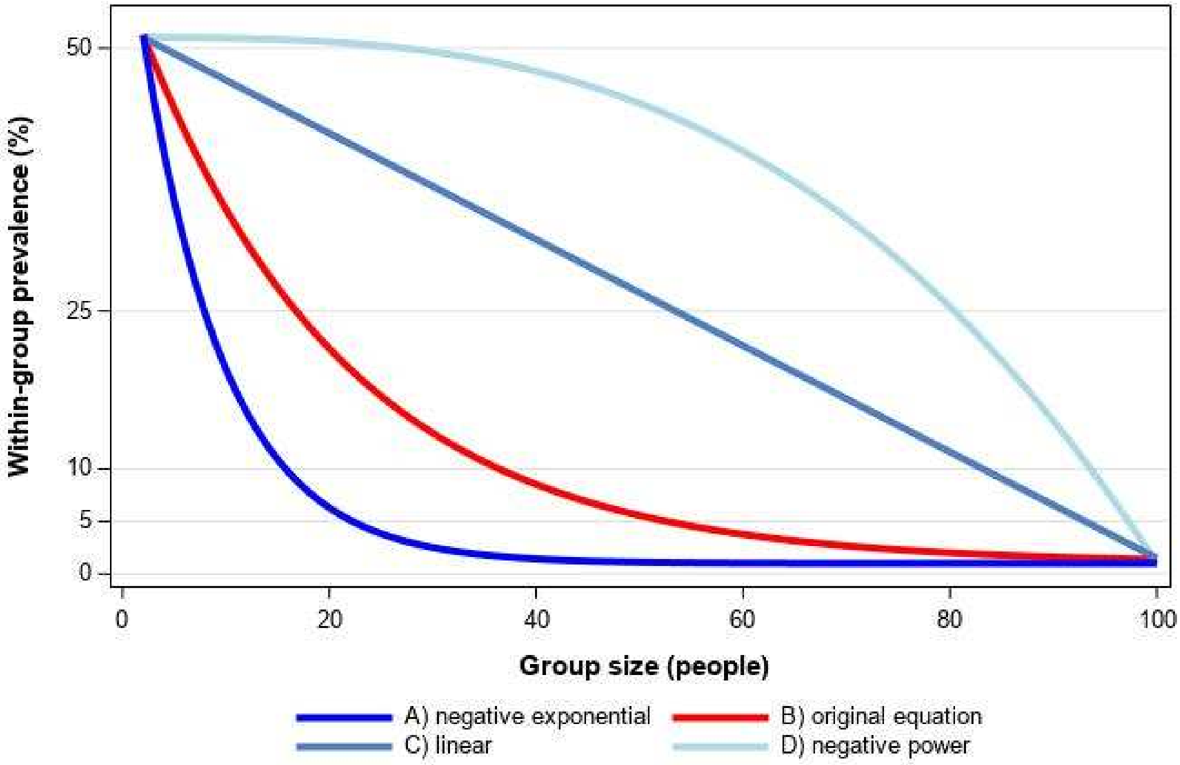
Appendix

1) Sensitivity analysis: variations of the shape of the curve of the 'within-group' prevalence

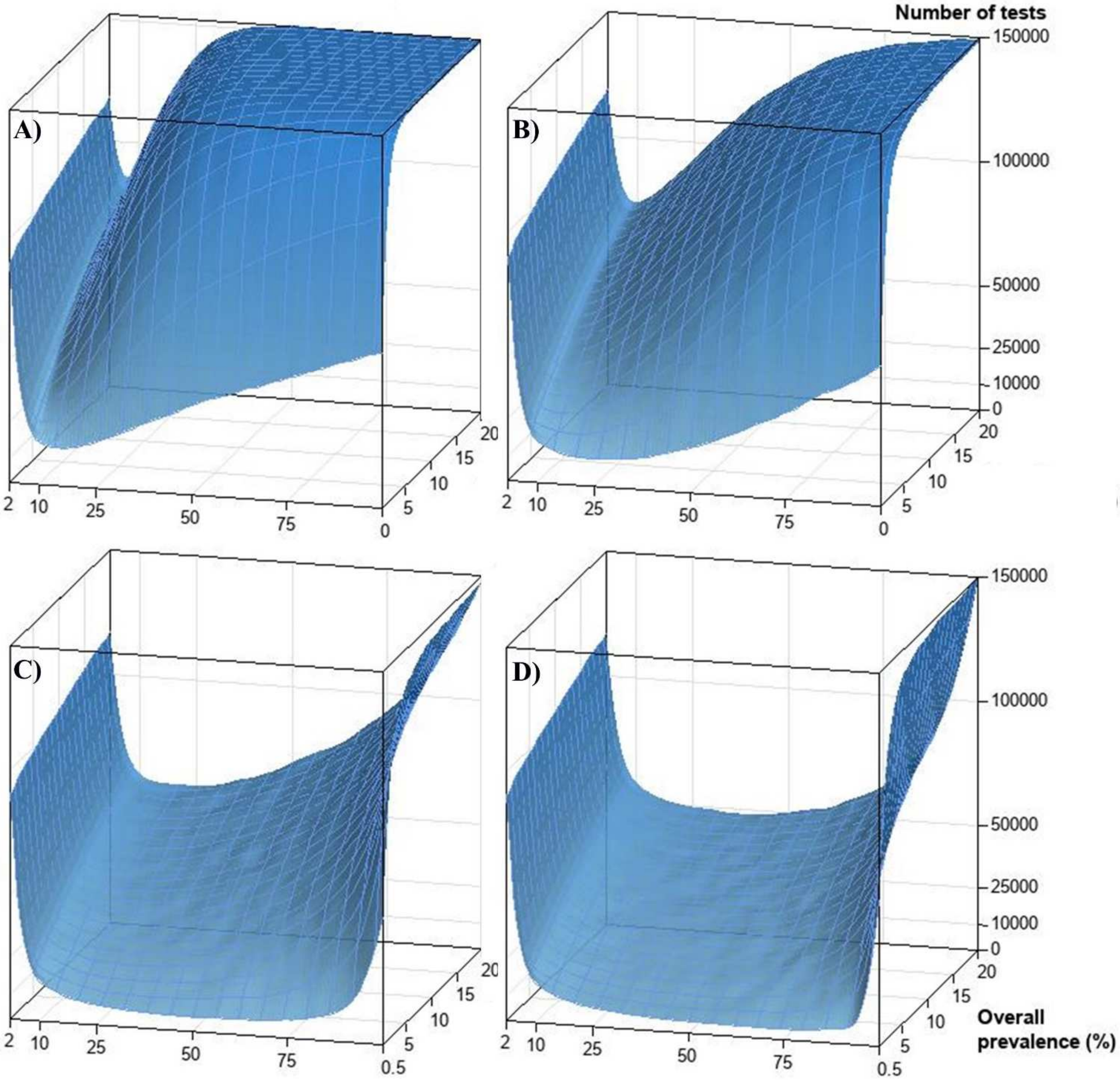
So far, data on the prevalence within homogeneous groups is scarce. An exponetial decrease of the 'within-group' prevalence related to the size of homogeneous groups in the 'context-sensitive approach', as taken as basis for our initial curve, is supported by a study conducted in Heinsberg in Germany. Among other things, this study investigated the infection risk in households in which one person was already infected. They found, that the risk for a second infection in a two-person household was 44%, in a three-person household the risk was 36%, and in a four-person household the risk was 18% [1]. However, in Germany the average household size is 2 persons and the available square meters per person are large compared to many other countries with very dense living conditions and bigger household sizes. Additionally, the study most probably is not representative due to its localized character. Furthermore, different forms of the relationship between 'within-group' prevalence and groups size could exist, for example linear. Hence, in our sensitivity analysis we investigated a negative exponential curve which is closer to the Heinsberg scenario (see curve A in figure 1). Additionally, we covered all functional forms and considered a linear relationship (see curve C in figure 1) and a negative power function (see curve D). Curve B displays the original equation as used in the paper.



Sensitivity analysis: exemplary functions of the relation between the size of homogeneous groups and the 'within-group' prevalence: A) negative exponential function, B) shape of curve as used for the original simulation, C) linear relation, D) negative power function (all exemplary for an overall prevalence of 1%)

Figure 1: Four different scenarios of the relationship between 'within-group' prevalence and the size of the homogeneous groups

For each 'within-group' prevalence relationship, we repeated the simulation of the number of tests required, as described in the paper. Figure 2 depicts the simulation results (in contrast to the paper here displayed up to group sizes of 100). For comparison reasons we added the simulation results of the randomly composed heterogeneous groups ('routine high-throughput approach', see surface plot E in figure 2).



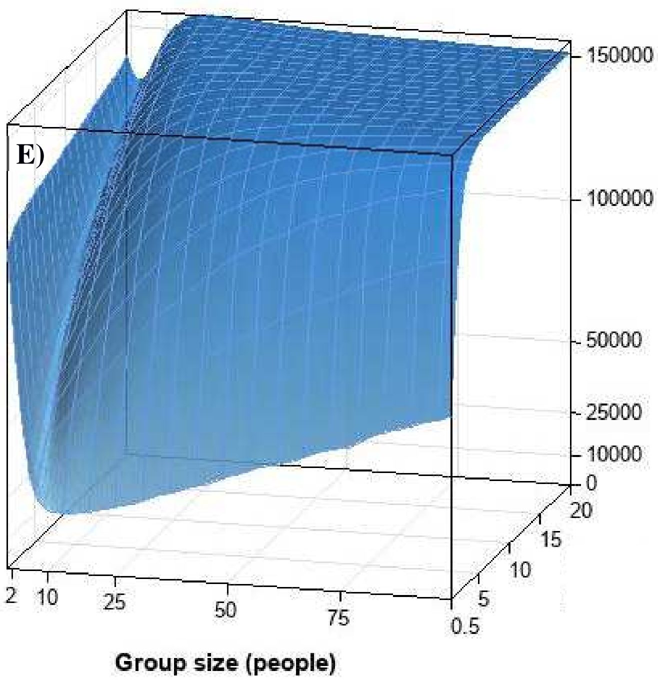


Figure 2: Surface plots of the relationship between the number of tests required and the size of the groups, conditioned on the overall prevalence

A) Surface plot of the number of tests required with the 'within-group' prevalence in homogeneous groups modeled by a negative exponential function (see also figure A1)

B) Surface plot of the number of tests required with the 'within-group' prevalence in homogeneous groups modeled by the equation used in the original simulation

C) Surface plot of the number of tests required with the 'within-group' prevalence in homogeneous groups modeled by a linear function

D) Surface plot of the number of tests required with the 'within-group' prevalence in homogeneous groups modeled by a negative power function

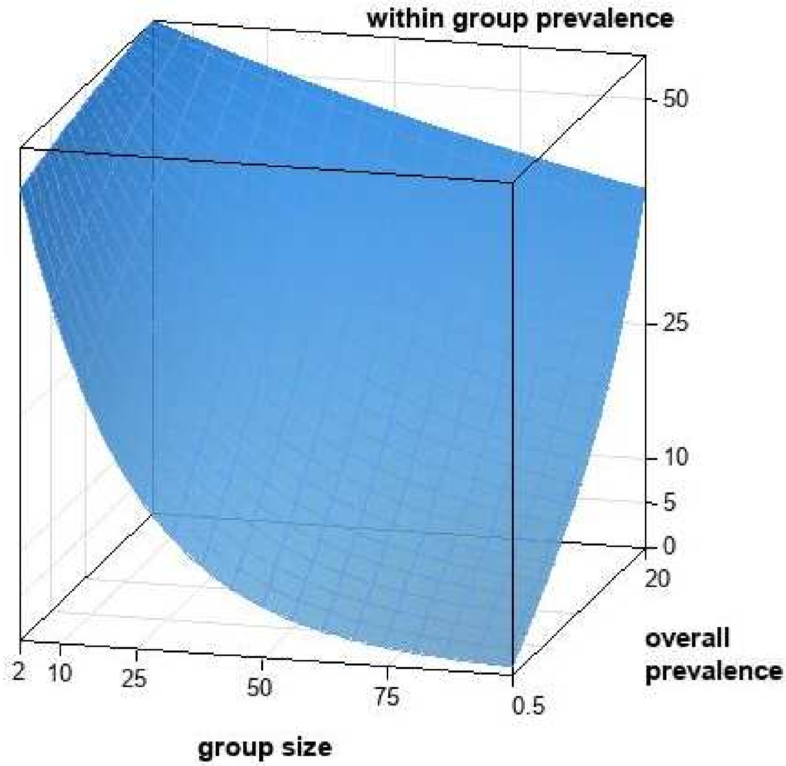
E) Surface plot of the number of tests required with randomly composed heterogeneous groups ('routine high-throughput approach')

As can be seen, the ‘context-sensitive approach’ is always superior to the ‘routine high-throughput approach’. In particular, with increasing prevalence and group sizes a plateau is reached much faster in the ‘routine high-throughput approach’ where the number of tests equals or even exceeds the number required for individual testing. Comparing the optimal group sizes for both scenarios we find, that they are similar for low prevalence but differ in high prevalence settings. Additionally, our initial equation (curve B) is conservative compared to other possible functional forms of the relationship between the ‘within-group’ prevalence and the size of the groups.

2) Sensitivity analysis: shape of the ‘within-group’ prevalence depending on the overall prevalence

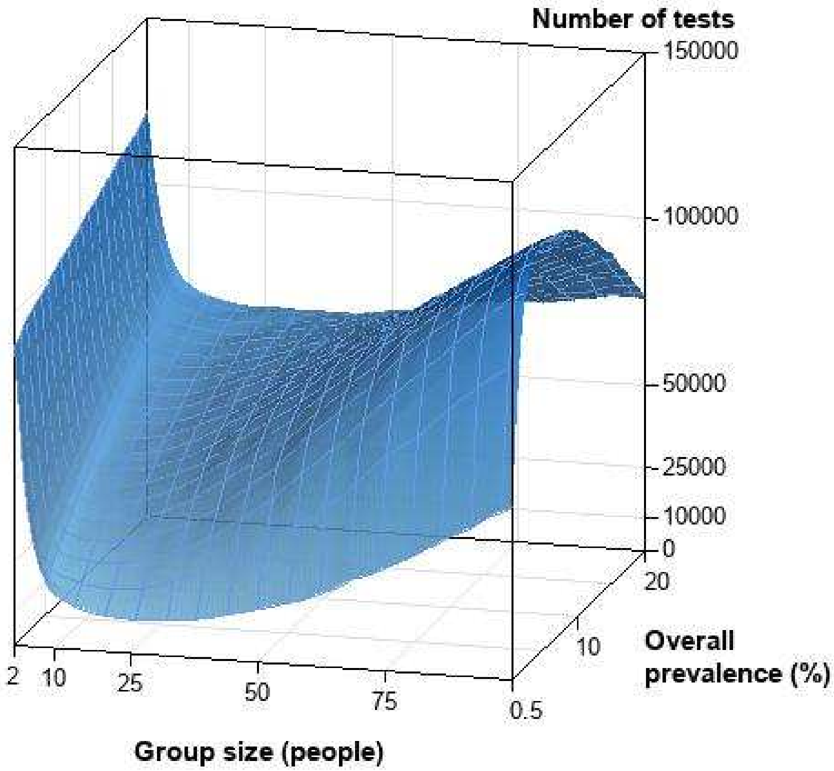
In our scenario in the paper and above the shape of the ‘within-group’ prevalence relationship in the ‘context-sensitive approach’ does not change with changing overall prevalence, the overall prevalence was added as an absolute term only. However, in reality there could be an interaction between the ‘within-group’ prevalence and the overall prevalence. For example, at the beginning of an outbreak rather smaller groups could contain a high ‘within-group’ prevalence, whereas in a later stage with a more balanced spread of the virus the ‘within-group’ prevalence could be closer to the overall prevalence but also larger groups could have a slightly higher ‘within-group’ prevalence. Figure 3 displays such an interaction of the relationship of ‘within-group’ prevalence and the group size with the overall prevalence.

We repeated the simulation of the number of tests required, as described in the paper, and considered the interaction between ‘within-group’ prevalence and overall prevalence as shown in figure 3. Figure 4 depicts the simulation results. As can be seen, the number of tests required with the ‘context-sensitive approach’ is always lower than with the ‘routine high-throughput approach’. Additionally, the window of effective group sizes remains wide in the ‘context-sensitive approach’, even for high overall prevalence.



Functional form of the relationship between the size of homogeneous groups and the 'within-group' prevalence: negative exponential function additionally conditioned on the overall prevalence

Figure 3: Relationship between ‘within-group’ prevalence and the size of the homogeneous groups



Surface plot showing the relationship between the number of tests required depending on the size of the homogeneous groups and conditioned on the overall prevalence

Figure 4: Surface plot of the relationship between the number of tests required and the size of the homogeneous groups in the 'context-sensitive approach'

References:

[1] Streeck H, Schulte B, Kuemmerer B, Richter E, Höller T, Fuhrmann C, Bartok E, Dolscheid R, Berger M, Wessendorf L, Eschbach-Bludau M. Infection fatality rate of SARS-CoV-2 infection in a German community with a super-spreading event. medRxiv. 2020 Jan 1.