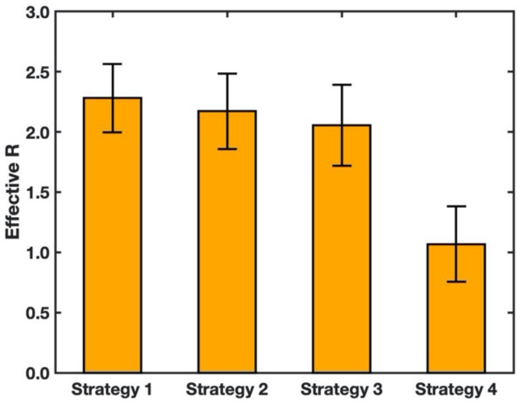
Structured testing of larger households reduces contagion in Norway

The NTNU COVID-19 Taskforce has developed a high-fidelity epidemiological computer model for COVID-19 spread that includes all municipalities in Norway. Using the model, we have investigated a wide variety of approaches for large-scale testing for COVID-19 cases in Norwegian cities and suburban regions. Focusing on the region of Oslo to assess the effect of testing in connection with the re-opening of day care centers and primary school grades 1.-4., we find that a structured testing regime targeting larger households will have the added value of reducing contagion. In contrast to random testing approaches, this structured testing approach may even serve as a cost-efficient intervention strategy to control societal infection levels.

The interdisciplinary group at NTNU consists of scientists from several faculties and departments, bringing together expertise in medicine, biotechnology, engineering cybernetics, statistics and economics. The group has developed an individual-based model that imports high-resolution demographic data, such as number and age composition of households, and number of schools and day care facilities, to develop complex contact networks on the level of each municipality. This network model is used to study COVID-19 spread and test different intervention strategies. In the current analysis for Oslo, we have assumed that 50.000 tests are available every week, and the simulations begin in March, with the re-opening of day care facilities on April 20th, primary school grades 1.-4. on April 27th, and simulation end on June 20th, 2020. We have investigated 4 possible procedures for testing: (1) No testing; (2) Testing of randomly chosen individuals; (3) Pooled testing of randomly chosen households; (4) Pooled testing of all households with 4 or more members. Here, pooled testing means that samples from all members of a household are combined before running the analysis for presence of SARS-Cov2 virus. If a test returns a positive result, we have assumed that individuals (strategy 2) or the whole household (strategies 3 & 4) will quarantine.



As a deliberate conservative choice, we have assumed that implemented social distancing measures have little effect on spread to ensure a wide safety margin in our prognosis of societal contagion. Since the 4 scenarios are studied under the same conditions, we can directly compare their potential effectiveness as intervention strategies.

We find that strategy 4, consisting of a systematic testing of households with 4 or more members, is the approach with the strongest added value as a contagion-inhibiting intervention. For our choice of simulation parameters, this strategy will keep R < 1. Strategies 1 and 2 show no significant difference, and hence, randomized testing of individuals cannot be expected to confer the added value of inhibiting spread. Strategy 3 demonstrates only a modest effect, with approximately 50% reduction in infections at the end of the computer simulations as compared to the approach of no testing.

Based on these results, we propose that extensive testing of larger households should be considered as part of all governmental testing strategies. We are currently conducting systematic evaluations of a wide range of interventions to identify optimal strategies for controlling the COVID-19 epidemic.

More information about our modelling framework and the team is available at https://www.ntnu.edu/biotechnology/ntnu-covid-19

NTNU COVID-19 Taskforce