

Coupled agent-based model of COVID-19 and major depressive disorder spread in Moscow

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Motivation and Aim: During the first year of COVID-19 pandemic the prevalence of major depressive disorder (MDD) in some populations reportedly increased by 29.4 %, the increase is believed to be associated with the lack of personal communications caused by lockdowns, distant work and education [1]. Using agent-based modeling approach for COVID-19 and MDD spread in Moscow population we investigate the effect of epidemic containment measures on physical and mental health.

Methods and Algorithms: We developed an agent-based coupled COVID-19 – MDD spread model, designed for Moscow population. The COVID-19 submodel is based on realistic age-sex composition of Moscow households, correlated chronic diseases, and statistic-based description of places of study and work. Modeling of MDD is based on the psychological stress concept; high level of stress leads to increased risk of getting depression. We considered mobility and a number of infected relatives as predictors of stress level. Modified (considering the stochastic nature of agent-based model and integer-valued parameters) multistart gradient descent optimization was used to fit the model to Moscow COVID-19 statistics data [2].

Results: The modeling results reveal that human toll in terms of quality adjusted life years related to mental disorders (MDD and additionally anxiety disorder) is as large as 48 % of COVID-related human toll. Model-based analysis shows that lockdowns despite the significant mobility decrease lead to better outcome both for physical and mental health.

Conclusion: The results obtained using the model show that mental disorders associated with epidemic containment measures leads to considerable human toll. Therefore, further cost-benefit analyses should consider both the estimates of economic loss related to lockdowns and mental disorders caused by mobility restrictions.

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References

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