COVID-19 pandemic Simulation Modeling in Anesthesia residency training to predict delays and workforce deficiencies for contingency planning

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Abstract:

Background:
COVID-19 is the worst pandemic this century resulting in a myriad of disruptions, impacting education and residency training. This study aimed to develop a model predicting effects of COVID-19 on the residency training pipeline, with predicted movement restrictions resulting in delayed graduation of in-flight residents and a potential future shortage of specialists. Based on the effects of the Covid-19 measures implemented in early 2020 on anesthesia residency training, a simulation model was devised.

Method:
A Delphi study was conducted to determine key ACGME-I training variables affected by Covid-19. Quantitative datasets on these variables from 2018-2021 were extracted. The average delay on training was used as the key input to a novel system dynamics simulation model to study the impact of Covid-19 on residency training. The model was calibrated and validated against historical data. 5 scenarios were applied to simulate the length of the pandemic period from best case (no pandemic) to worst case (4 years of ongoing pandemic). A user-friendly web application was developed to evaluate the outcomes of different scenarios for practical use.

Results:
The model predicts the number of residents and graduates for each accredited year, cumulative numbers of specialists and times of backlog clearance under different scenarios. Data from the anesthesia residency training programme predicts the longer the pandemic lasts, the higher the likelihood that cumulative numbers of graduates will decrease, from 62 (best-case scenario) to 53.8 (worst-case scenario). The time to recover to “business as usual” was as long as 9 years in the worst-case scenario.

Conclusion:
Systems dynamic modeling can be used to predict delays in residency training programs during pandemics, enabling stakeholders to implement mitigating measures early to minimize potential shortages of specialists. The model developed in this study is generalisable with different scenarios included and model framework adaptability to different programmes. The model has application in future pandemics.