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Stochasticity of the respiratory mechanics during mechanical ventilation treatment
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Abstract
Stochastic models have been used to predict dynamic intra-patient respiratory system elastance (Ers) in mechanically ventilated (MV) patients. However, existing Ers stochastic models were developed using small cohorts, potentially showing bias and overestimation during prediction. Thus, there is a need to improve the stochastic model's performance. This research investigates the effect of the kernel density estimator (KDE) parameter tuned with a constant, c on the performance of a 30-min interval Ers stochastic model. Thirteen variations of a stochastic model were developed using varying KDE parameters. Model bias and overestimation were evaluated by the percentage of actual data captured within the 25th – 75th and 5th – 95th percentile lines (Pass50 and Pass90). The optimum range of c was chosen to tune the KDE parameter and minimise the temporal variations of model-predicted 25th – 75th and 5th – 95th percentile values of Ers (ΔRange50 and ΔRange90) in an independent retrospective clinical cohort of 14 patients. In this cohort, the values of ΔRange50 and ΔRange90 exhibit a converging behaviour, resulting in a cohort-optimised value of c = 0.4. Compared to c = 1.0 (benchmark study model), c = 0.4 significantly reduces model overestimation by up to 25.08% in the 25th – 75th percentile values of Ers. Overall, c = 0.3–1.0 presents as a generalised range of optimum c values, considering the trade-off between data overfitting and model overestimation. Optimisation of the KDE parameter enables more accurate and robust Ers stochastic models in cases of limited training data availability. © 2023 The Authors

Author Keywords
Kernel density estimator; Optimisation; Respiratory system elastance; Stochastic model

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