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A Unified Compartmental Modeling Framework for Non-Substance Addictions

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Authors:

Auni Aslah MAT DAUD¹
Noor Ilyani Izzati NORDIN¹
Nyuk Sian CHONG¹
Salilah SAIDUN²

¹ Universiti Malaysia
Terengganu, Kuala Nerus,
Malaysia
² Independent researcher

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Abstract

Non-substance addictions, including gaming [1], gambling [2], online shopping, and social media addiction [3], represent an escalating global public health challenge. Mathematical modeling has been increasingly employed to investigate the dynamics of the non-substance addictions [4]. In this study, we review 45 existing compartmental models formulated using ordinary differential equations, comprising 18 gaming, 8 gambling, 5 online shopping, and 14 social media addiction models. We compare and contrast these models in terms of subpopulations considered, underlying assumptions, nonlinear interaction terms, and scope of study. Based on this review, a unified compartmental modeling framework is developed, within which the reviewed models arise as special cases, providing a structural template to guide future model development. The qualitative properties of the generalized model, including existence, uniqueness, positivity, and boundedness of solutions, are established. As a particular realization of the unified framework, a new compartmental model is proposed. All its feasible equilibrium points are determined, and the local stability analysis is conducted using the Lienard-Chipart criterion [5].

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