# Letters to the Editor

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## A COMPLEX-SYSTEMS PARADIGM CAN LEAD TO EVIDENCE-BASED POLICYMAKING AND IMPACTFUL ACTION IN SUBSTANCE MISUSE PREVENTION—A REJOINDER TO PURSHOUSE *ET AL.* (2018)

We recently advocated for a paradigm shift in alcohol prevention research grounded in complex systems and dynamic modeling methodologies [1,2]. In response, Purshouse and colleagues [3] acknowledged that complex simulation modeling holds promise, and echoed our call for its application while emphasizing the importance of methodological care to ensure that such initiatives are useful. We agree that advanced computational capabilities, as well as policymakers' increased use of evidence, make this the right time to invest in complex simulation modeling. That said, our manuscripts were intended to introduce a programmatic discourse in alcohol prevention that surpasses complex simulation modeling. We hope etiological research, evidence-based policymaking and action planning will embrace a complex-systems-grounded paradigmatic overhaul in alcohol prevention in the context of population health [4,5].

Empirical observations suggest that the prevailing paradigm in alcohol prevention offers an incomplete representation of how alcohol misuse develops over time and leads ultimately to inconsequential population-level interventions [1,2,6]. Thus, traditional research and prevention approaches are not designed to capture the complex nature of alcohol misuse. As a complex system, alcohol misuse is: determined by interconnected, heterogeneous, self-organizing and evolving subsystems [1,2]; marked by dynamic complexity, non-linear feedbacks, phase transitions and emergence across temporal scales [1,2]; defined by the presence of mutual and adversely reinforcing risks [6]; and exacerbated by risk disparities associated with social, economic and geographic milieux in which populations at-risk are immersed [6]. As with other complex systems [7,8], alcohol misuse is particularly difficult to control because it often switches from manageable to uncontrollable or irreversible states [6]. While complex simulation modeling can provide useful insights, it unfortunately falls short of capturing the wide array of dynamic properties that determine systemic failures in alcohol misuse. The untapped potential of integrative, transdisciplinary complex-systems-grounded epistemological, methodological and analytical frameworks offers a path to illuminating the mechanisms that determine stability, resilience and predictability in protracted population health challenges and support more impactful action [5].

The foundational blocks of the comprehensive complex-systems-grounded paradigmatic shift in alcohol prevention we are advocating include: (a) architectural mapping of the system (e.g. component configuration and interactions) [6]; (b) delineation of the controllability and control principles of the system (e.g. dynamic laws governing the temporal behavior of system components) [6]; (c) development of an integrative theory base grounded in substance prevention (e.g. social networks [7]), population health (e.g. syndemics [8]) and complex systems (e.g. phase transitions) theoretical frameworks; and (d) synergistic methodological and analytical frameworks and techniques based on mathematical [9] (e.g. stochastic dynamical systems) and simulation [10] (e.g. agent-based) modeling, statistical physics and mechanics [11,12] (e.g. stability and bifurcation of system attractors) and machine learning and data mining (e.g. supervised, unsupervised and reinforcement learning) [13].

Understanding, predicting, anticipating and preventing alcohol misuse remain challenging tasks that have eluded scientists and policymakers for too long. The development and proliferation of an integrative, transdisciplinary complex-systems-grounded paradigm, which goes beyond complex systems modeling and simulation, has the potential to revolutionize prevention research with far-reaching ramifications for policymaking and action.

## Declaration of interests

None.

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## CALL TO ACTION FOR GAMBLING DISORDER IN THE UNITED STATES

The 1 October 2017 mass shooting event in Las Vegas was perpetrated by a man who, according to media reports, exhibited behaviors suggestive of a significant gambling problem [1]. While it is not unequivocally clear that the man had a gambling disorder, this tragedy raises important questions about gambling and its potential role in this particular disaster. Feelings of isolation, despondency and suicidality, mixed with (1) a perceived injustice, (2) a disregard for and violation of the rights of others and (3) the availability of lethal means to kill and injure a great number of individuals in a short amount of time can result in disastrous events. A tragedy of this magnitude is rare, but human suffering is not. The relationship between suffering and gambling disorder is complex, because suffering can lead to maladaptive gambling and vice versa. We must learn more about gambling and its potential role in human suffering.

We are writing this letter as a call for action in the United States. American society does little to help those suffering from gambling disorder. Resources for gambling-related prevention, treatment and research are sparse. The American Psychiatric Association classifies gambling disorder as an addiction, and estimates that it affects up to 1% of individuals from all walks of life [2]. Harms include financial ruin for individuals and families, significant guilt and shame, disrupted social relationships, engagement in illegal behaviors, occupational impairment, despair and suicide. The impact of these harms is greater than the harms associated with many well-researched medical and psychiatric conditions [3] and, unfortunately, few with the disorder seek treatment [4].

Our call is to the gambling industry, state authorities and the federal government to take a proactive role in mitigating the harms associated with gambling products and to invest in research that leads to better understanding of gambling disorder and its prevention and treatment. We call for all stakeholders to step forward.

The paradigm of using a small portion of gambling-related revenues to fund state-level gambling-related prevention and treatment in the absence of a systematic approach to gambling-related problems diffuses responsibility and is a passive patchwork response to the harms associated with gambling. However, unlike other commercial products with a propensity for addiction (e.g. tobacco), the gambling industry includes many and diverse stakeholders: private industry, Native American tribes and state governments that run lotteries ($n = 45$). Moreover, the federal government collects approximately $8 billion dollars annually via taxation of gambling winnings [5]. Thus, each stakeholder benefits financially from gambling. We call for each stakeholder group to step forward and address gambling disorder.

First, responsible gambling initiatives by the gambling industry are critical and need greater support and examination of efficacy to ensure that patrons use their product safely as a form of entertainment and recreation. This step probably requires regulatory oversight. Secondly, the gambling industry and all levels of government need to improve access to prevention, treatment and recovery services for gambling disorder; and finally, the federal government, as the largest funder of biomedical and public health research, needs to fund research programmatically, focus on gambling disorder and monitor the impact of gambling activities on society.

Overall, more could and should be done to understand, prevent and treat this condition by the American gambling industry and by state and federal governments. We note that many of the points raised here may also apply to other countries around the world.

We call for three primary initiatives.

1. For the gambling industry to make greater investment in identifying and validating responsible gambling initiatives.