

# Weekly Presentation: Review

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1 August 2025



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# Background

- **Facts:** Smoking remains one of the leading causes of premature death and preventable disease worldwide: c. 1.3 billion current users of tobacco products, over 7 million deaths (including c. 1.6 million second-hand smoke deaths) each year.
- Comprehensive tobacco control measures have been implemented.
- The drastic surge in vaping has further complicated the situation.
- Agent-based modelling has been proved a feasible approach for modelling smoking behaviour contagion driven by effects of social contagion and underlying network topology of the complex system.
- However, current models fail to characterise the complexity of smoking behaviour contagion in multiple aspects.



# Motivations

Complexity of smoking behaviour contagion includes the following aspects (mostly regarding heterogeneity):

- **Social Ties**: Heterogeneous social ties lead to characterisation of different social and smoking norms, as well as underlying network structure with higher resolution (e.g., multi-layer networks).
- **Smoking Norms**: The emergence of vaping further calls on the needs of model complexity: finer characterisation of smoking states and state change processes (e.g., association between smoking and e-cigarette use, East, Katherine, et al., 2018)
- **Social Norms**: Multiple social norms suggest finer characterisation of multiple smoking contagion dynamics driven by social influences: social norms towards smoking and vaping (East, Katherine, et al., 2019 & 2021), social influence characterisation (opinion dynamics approaches, physics-informed approaches, etc).



# Motivations: Social Ties and Social Norms

**Social Norms** can be classified into two domains:

- Descriptive Norms: perceptions of how others behave.
- Injunctive Norms: perceptions of what others think people should or should not do.

For example, empirical research have found evidence of social norms in shaping smoking behaviour:

- **Descriptive Norms associated with S/V Initiation:**
  - Smoking: among parents; among closed friends.
  - Vaping: among closed friends (almost doubled than smoking).
- **Injunctive Norms associated with S/V Initiation:**
  - Smoking: among parents; among the public.
  - Vaping: among peers and closed friends.



# Motivations: Social Norms and Opinion Dynamics

- Social norms are shaped by perceptions of how people behave and how people think they should behave.
- Perceptions can be interpreted as opinions or beliefs.
- In this case, social norms can be described as the emergence of beliefs at a social group level.
- The interplay between individual-level and social-level beliefs needs to be considered as integrative, i.e., social-level beliefs are shaped by individual-level beliefs, while individual-level beliefs are regulated by social-level beliefs.
- Therefore, it leads to the opinion dynamics approaches (or physics-informed approaches).



# Objectives

We will focus on youth in Scotland and the UK because of their relatively simple interpersonal relationships and the fact that they are the main driving force of the drastic surge in the vaping trend across the UK. This coincides well with the ambition of the Scottish and British governments to shape a smoking-free future for the next generation.

- Provide a robust model concerning smoking contagion driven by realistic social influences to governments and the public.
- Explore the hierarchy among heterogeneous social influences on smoking contagion.
- Explore the time-varying effects of social influences and the system's underlying network topology on smoking contagion.



We will develop an enhanced agent-based model based on the Adarsh model by:

- differentiating influential social ties in the underlying network structure;
- considering vaping state in the state change processes.
- improving state change dynamics by considering both social influences and smoking norms;
- calibrating and validating the model with higher-resolution data and machine learning techniques.





# Smoking Toolkit Study (STS) Research Proposal

Despite significant efforts over the past 30-40 years to combat it, smoking remains one of the leading causes of premature death and preventable disease worldwide. However, current models fail to accurately represent how smoking behaviour spreads through social networks, which is the primary reason people start smoking. With the rise of vaping further complicating the situation, this project aims to develop realistic mathematical and computational models (statistical physics approach and agent-based modelling approach) of both smoking and vaping behaviours and how they interact, enabling the Scottish and British governments to design simple and targeted smoking intervention strategies to achieve their tobacco endgame goals.



# The End

Thank you very much for your time!



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