Perspective

J Prev Med Public Health 2023;56:481-484 • https://doi.org/10.3961/jpmph.23.239

pISSN 1975-8375 eISSN 2233-4521

Journal of Preventive Medicine & Public Health

Epidemiological Model for Conventional Tobacco Control Measures and Tobacco Endgame Policies

Heewon Kang[1,2], Sung-il Cho[1,3]

[1]Institute of Health and Environment, Seoul National University, Seoul, Korea; [2]NHMRC Centre of Research Excellence on Achieving the Tobacco Endgame, School of Public Health, University of Queensland, Brisbane, Australia; [3]Department of Public Health Science, Graduate School of Public Health, Seoul National University, Seoul, Korea

Epidemiological models, also known as host-agent-vector-environment models, are utilized in public health to gain insights into disease occurrence and to formulate intervention strategies. In this paper, we propose an epidemiological model that incorporates both conventional measures and tobacco endgame policies. Our model suggests that conventional measures focus on relationships among agent-vector-host-environment components, whereas endgame policies inherently aim to change or eliminate those components at a fundamental level. We also found that the vector (tobacco industry) and environment (physical and social surroundings) components were insufficiently researched or controlled by both conventional measures and tobacco endgame policies. The use of an epidemiological model for tobacco control and the tobacco endgame is recommended to identify areas that require greater effort and to develop effective intervention measures.

Key words: Tobacco endgame, Epidemiological model, Host-agent-vector-environment model, Tobacco control, Epidemiological triad

INTRODUCTION

The Framework Convention on Tobacco Control (FCTC) and its 6 demand-focused policy measures (MPOWER, *Monitor* tobacco use and policies; *Protect* from smoke; *Offer* help to quit; *Warn* about dangers; *Enforce* bans on advertising, promotion, and sponsorship; and *Raise* taxes) have significantly reduced smoking prevalence [1], but have not ended the tobacco epidemic due to the lack of a defined endpoint. The tobacco endgame initiative aims to achieve a near-zero smoking prevalence before a target date. Tobacco endgame policies have the potential to permanently change or eliminate the dynamics sustaining the tobacco epidemic. Endgame policies include product, user, market/supply, and institutional structure-focused measures [2]. Specifically, proposals including limiting nicotine in cigarettes, banning tobacco sales by birth year, and restricting the density, location, or types of tobacco retailers are under consideration [3]. Some conventional measures, such as tax increases, are also considered endgame policies when implemented at sufficient intensity (e.g., a 20% increase per year) [2].

In Korea, tobacco control efforts based on the MPOWER framework have been implemented (Supplemental Material 1), but progress in reducing smoking prevalence has been insufficient, with the target prevalence unmet (Supplemental Material 2). Given the increasing discussions on the tobacco endgame and how to accelerate prevalence reductions in Korea, one study has offered suggestions for adopting the tobacco endgame in Korea [3]. These proposals include strengthening MPOWER

Received: May 24, 2023 Accepted: September 12, 2023

Corresponding author: Sung-il Cho
Department of Public Health Science, Graduate School of Public Health, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea
E-mail: persontime@hotmail.com

measures and generating evidence on preferred endgame policies.

As number of countries seek to implement endgame policies alongside conventional MPOWER measures [3], an integrated conceptual model would be beneficial. Furthermore, generating evidence for endgame policies remains challenging due to a lack of clarity regarding the characteristics of policies with the potential to phase out smoking. Epidemiological models have long shaped public health interventions [4], and they may similarly do so for endgame policies. Here, we describe the traditional epidemiological model for tobacco control and propose an extended model that incorporates tobacco control/endgame policies. The model provides evidence to support strengthening MPOWER measures and implementing endgame measures in the Korean context and beyond.

EPIDEMIOLOGICAL MODEL

Current Epidemiological Model of Tobacco Control

An epidemiological model is a conceptual framework in public health that includes the agent (pathogens), host (organisms that are exposed to agents and spread health outcomes), and environment (physical and social surroundings where agents, vectors, and host interact). For vector-borne diseases, the vector (the organism that distributes agents to susceptible hosts) is also considered [5].

Orleans and Slade [6] were the first to use an epidemiological model for tobacco control. The model identifies tobacco products as agents; users, potential users, and those exposed to secondhand smoke as hosts, and the tobacco industry as the vector. Environmental factors such as policies, social norms, and media impact are also included [5]. Multiple measures derived from the epidemiological model, such as monitoring tobacco industry activities and implementing bans on tobacco advertising, are now included in the FCTC measures [4]. This epidemiological model also guided the development of the PhenX Toolkit [7,8], a comprehensive list of standardized measures for tobacco control research to inform effective regulatory actions. For example, the Vector framework [8] of the Toolkit suggests 13 measures for addressing tobacco industry activities (e.g., availability/placement/promotion/price in retailers) and exposure to these activities (e.g., self-reported exposure to sponsorship, advertisements).

New Epidemiological Model Encompassing the MPOWER Measures and Tobacco Endgame Policies

We extended the traditional epidemiological model for tobacco control, which focuses solely on model components, by incorporating specific MPOWER measures and key endgame policies (Figure 1). Unlike the traditional approach, which treats all policies as environmental components, we aligned each policy with its primary intervention targets to clarify the intended impact. The key endgame policies include reducing nicotine content in cigarettes, promoting tobacco-free generations, and restricting retailer availability. These measures are part of the Smokefree Aotearoa 2025 Action Plan of New Zealand, a leading country in the tobacco endgame [3]. The model also incorporates endgame policy categories that encompass these key policies.

Alignment of the MPOWER measures and endgame policies in the epidemiological model showed that MPOWER measures focus on relationships among host-agent-vector-environment components, whereas key endgame policies aim to eliminate these components. The *Monitor* measure is relevant for all model components as it aims to conduct surveillance for both use and control activities. Among the POWER measures, *Offer*, *Warn*, and *Raise* are aligned with the link between the agent (tobacco products) and the host (tobacco users, potential users, and individuals exposed to secondhand smoke). The *Enforce* and *Protect* measures correspond to the host-vector and host-environment links, respectively. Unlike the MPOWER measures, endgame policies focus on modifying the components of the model. For example, limiting the nicotine content aims to alter the agent, and the tobacco-free generation policy aims to permanently change or eliminate the host. The model includes 4 "RE" endgame interventions (Figure 1): *restrain* tobacco addictiveness and appeal, *relief* from lifelong exposure to tobacco, *restrictions* on retailers and the tobacco industry, and *reframe* tobacco products and tobacco industries as non-normal and illegitimate.

Our model and evidence from previous studies show that there are few efforts to change or eliminate the vector and environment components and to disrupt the interactions involving these components. The conventional measures concentrate on the links between agent and host components. Previous studies have shown that tobacco control research is focused on the agent (e.g., tobacco product constituents or ingredients) and host (e.g., trajectories for tobacco use) compo-

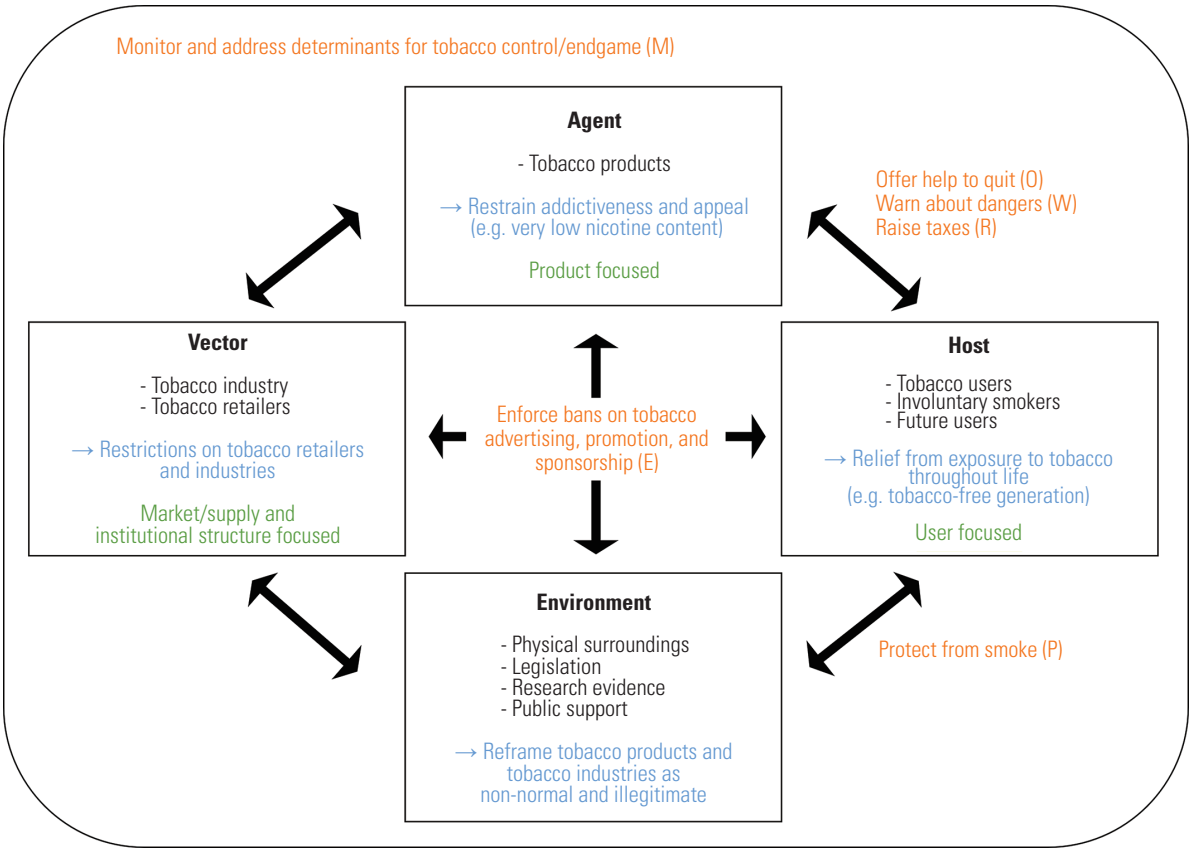

Figure 1. Epidemiological model encompassing the MPOWER measures and endgame policies. The model components (host, agent, vector, and environment) and the examples in the bullet points were originally proposed by Orleans and Slade [6] and Giovino [5]. Colored texts have been additionally included in this extended model. Green-colored text in each component indicates endgame policy categories suggested by Puljević et al. [2]. Blue-colored text indicates the description and examples of a specific endgame policy. Orange-colored text indicates the MPOWER measures.

nents, whereas research on the vector (e.g., retail characteristics or marketing) and environment (e.g., peer/family influence) components has been conducted less frequently [9,10]. Another study of endgame measures from New Zealand, Australia, Finland, and Korea found that endgame policies being implemented or under consideration focused on measures targeting the product (agent) and user (host), while only few measures focused on the market/supply and institutional structures [3]. Oversight of the vector and environment components was found to be particularly common in Korea, where the achievement levels for the *Protect* and *Enforce* measures were the lowest (Supplemental Material 1). Potential reasons for this oversight include a domestic tobacco manufacturer, inadequate industry regulations, poor compliance with existing regulations, and lack of a comprehensive tobacco control law aligned with FCTC guidelines [3].

APPLICATION AND CONCLUSIONS

The extended conceptual model can be used to evaluate whether tobacco control research and policies address all host-agent-vector-environment components, a condition to ensure effective tobacco control policies [10]. Previous studies have evaluated the volume of research relevant to each component to identify imbalances [9,10]. As our model incorporates policies relevant to each component, it allows one to determine whether a country's planned tobacco control/endgame policy set maintains a balanced portfolio. Further, our model indicates areas where indicators need to be developed or applied for policy planning, analysis, and evaluation. Some measures and indices for each component have been reported [7], including support for tobacco-related policies (environment) and tobacco industry and retailer public relations (vector). Furthermore, our model can help characterize endgame policies as those

with the potential to permanently change or eliminate host-agent-vector-environment components. As new policies continue to be proposed (e.g., health warnings on individual cigarettes), distinguishing between incremental conventional policies and those with the potential to phase-out smoking would be beneficial for determining policy priorities.

Our model extends the traditional epidemiological model of host-agent-vector-environment components by incorporating policy measures that are being implemented or considered. The alignment of the model's components with conventional and innovative tobacco control measures suggests that further efforts are needed to disrupt the interactions of the vector and environment components and permanently change or eliminate each host-agent-vector-environment component. To rapidly reduce smoking to minimal levels in Korea, establishment of an endgame goal and implementation of policies to change or eliminate the host-agent-vector-environment components is required.

SUPPLEMENTAL MATERIALS

Supplemental materials are available at https://doi.org/10.3961/jpmph.23.239.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

FUNDING

This work was supported by a National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT) (No. 2021R1C1C2094375).

ACKNOWLEDGEMENTS

None.

AUTHOR CONTRIBUTIONS

Both authors contributed equally to conceiving the study, analyzing the data, and writing this paper.

ORCID

Heewon Kang *https://orcid.org/0000-0002-1519-5678*
Sung-il Cho *https://orcid.org/0000-0003-4085-1494*

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