MODELING PARTNERSHIP OF COMMUNITY AND LAW ENFORCEMENT TO CURB THE PREVALENCE OF DRUG ADDICTION: AN AGENT-BASED MODEL

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ABSTRACT

Drug addiction is a global problem that costs many millions of lives each year and causes innumerable suffering. To curb this global problem, the study was conducted to generate a model on the partnership of community and law enforcement to address the prevalence of drug addiction through the use of an agent-based model, particularly by modifying the AIDS model of Rand and Wilensky (2007). Based on the result, the community, law enforcement and their interaction have significant effects to curb the prevalence of drug addiction. However, the law enforcement showed the greatest effect among them. It implies that drug addiction can be best curbed through law enforcement. Therefore, government must consider this result to strengthen the law enforcement in terms of regular police patrol and investigative units that are constantly attacking the drug trafficking, use, and related violence.

***Keywords**: drug addiction, agent-based model, methamphetamine hydrochloride, law enforcement, community vigilance*

1.0 Introduction

Drug abuse is a widespread problem that makes individual drug users the prime victims. The highest *shabu* (methamphetamine hydrochloride) abuse rate in South-East Asia is in the Philippines, according to the United Nations World Drug Report 2012 as cited by Esplanada (2012) from his news article. Moreover, factors that influence an individual to drug abuse are related to behavior, such as stress and depression (Quello, *et al*., 2005), curiosity (Racz, 2008), and low self-esteem (Alavi, 2011). In the Philippines, the population configuration from the early 1970s to the present has dramatically shifted towards the younger and more vulnerable groups. Hence, the rise in drug abuse in the country can be largely explained by population demographics and which drug abuse problem can be curbed through efficient partnership between the local communities and law enforcement. This

study aimed to generate a model of partnership of community and law enforcement to curb the prevalence of drug addiction.

Research studies show that drug problems targeted by the police vary across a range of characteristics (Weisburd and Mazerolle, 2000; Mazerolle *et al*., 2004). Environmental characteristics like small places largely influence opportunities for drug use and dealing and also influence the type of interventions and relative effectiveness of police activity (Mazerolle *et al*., 2004). Before, drug dealers typically locate their operations close to main roads (Weisburd *et al*., 1994; Green, 1996), they choose places that maximize communication with customers and minimize the risk of apprehension (Rengert and Wasilchick, 1990), and they prefer places with weak place management to minimize the risk of interference (Eck, 1994; Green, 1996). However, due to the advent of technology nowadays, cryptomarkets represent an important drug market innovation by bringing buyers and sellers of illegal drugs together in a 'hidden' yet public online marketplace (Aldrige and Askew, 2016). In this case, regular patrol and investigative units should be engaged to inevitably attack drug trafficking, use, and also to related violence. In addition to the enforcement effort, law enforcement agencies have been working with the community through schools, using programs to educate people on the dangers of drug use and involvement in drug activity (Levesque, 2012). However, in some areas, drug dealers cannot gain a foothold. There are too few users to make dealing profitable and too many vigilant people ready to expose and resist the enterprise. In a community where the will and capacity for self-defense are strong, a little official policing goes a long way to keep the neighborhood free of drugs. Otherwise, if it is weak, even heavy doses of official policing will not get the job done. Exactly what communities do to defend themselves varies greatly according to their character and resources (Cleaver and Katsiaficas, 2014). Thus, the importance of partnership of local community and law enforcement is evident in a review of the spatial distribution of drug dealing across a specific area. Police strategists must consider that the assets available to attack the drug problem are not limited to the distinction between supply and demand-reduction strategies. The law enforcement must find a way of accommodating, regulating, and using citizen indignation to help them manage the drug problem.

The complex problem of drug abuse and drug-related crimes in communities cannot be studied in isolation, but through the system they are embedded in, according to Nyabadza and Coetzee (2017). Based on their study, a theoretical model to evaluate the syndemic of substance abuse and drug-related crimes within the Western Cape province of South Africa was constructed and explored. Results indicated that the different key players (political actors, funders, program implementers, researchers, and the public) need to collaborate to counterforce the synergistic epidemic. However, results are only general insights that can be used as a tool to quantify and improve the understanding of the dynamics of the substance abuse and drug-related crime syndemic over time. Thus, this study aimed to generate a model to measure the efficiency of partnership between the most important key players in the community; the law enforcement and

the public. The factors considered in the study to curb the prevalence of drug addiction are the initial number of citizens, average time spent in healthy recreation activities, average number of socio-civic activities in the community and average police operation frequency on drug addiction in the specific area.

The model of the study was generated from the software called NetLogo (version 5.2.1), an agent-based programming language and integrated modeling environment (Kornhauser *et al*., 2007). This study provided the optimum partnership of community and law enforcement to curb the prevalence of drug addiction.

2.0 Model Definition

The rates of transition into and out of addiction on the part of individuals within a group or population are a function of the social connections between individuals who are and are not promoters of addiction or non-addiction, and the nature of those connections.

The study had looked into diffusion theory, which describes how "innovations" spread through social networks; in the case of addiction, this may mean the use of an addictive product or method to help overcome the addiction (Ferrence, 1996, 2001). Most studies examined support the application of the diffusion model in the study of drug use. The model is particularly valuable when new substances are introduced to a population or subgroup.

The model relies on the following basic assumptions:

- Addictive behaviors occur in clusters at multiple levels, from families, through local area groups, to subcultures and ultimately whole populations (Valente *et al*., 2003; Rosenquist *et al*., 2010).
- Changes in prevalence of addictive behaviors appear to show patterns similar to contagion in infectious diseases (West, 2013; White and Comiskey, 2007).

This social network theory implies that interventions to combat uptake of addictive behaviors should focus on weakening social connections that promote such uptake or develop effective connections to counter that uptake. This provides potentially useful information on the mobilization of law enforcement to develop and implement effective interventions to counter addiction.

A community oriented policing is proposed, which recognizes that crime problems are best addressed when the police and the community work together to identify and solve problems. This is to strengthen the partnership between civilians and police forces working together within communities in order to successfully curb the prevalence of drug addiction.

Figure 1 shows the Conceptual framework of the study. It clearly shows on how pushers can influence the public to use drugs and the role of partnership of community and law enforcement in order to control this scenario.

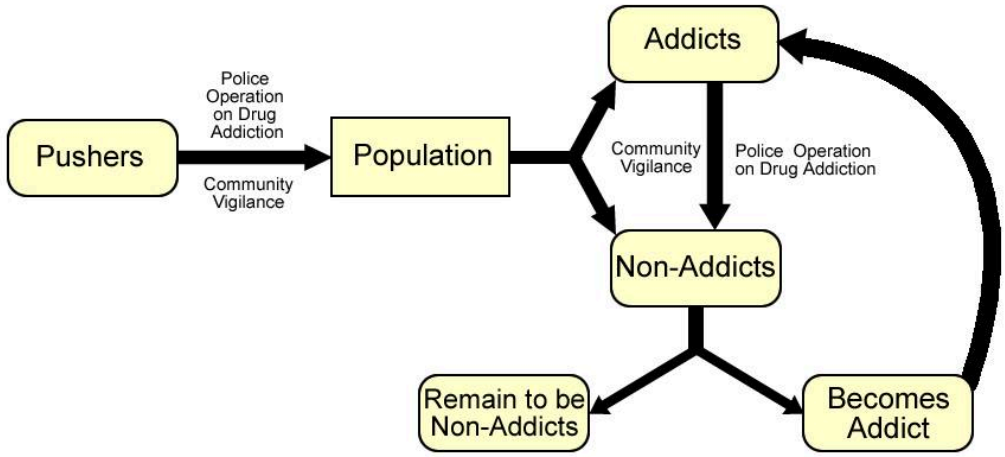

Figure 1. Conceptual Framework of the Study

PARAMETERS

The present scenario of drug prevalence in a certain community is represented through the model which is subject of the algorithm that will be coded based on the following parameters of the study. These are:

1. Initial People
2. Average Number of Drug User Friends
3. Average Time Spent to Mingle New Friends
4. Average Number of Socio Civic Activities in the Community
5. Average Police Operation Frequency on Drug Addiction

This study made use of the existing AIDS model of Rand and Wilensky (2007), found in the net logo model library with the following changes in the parameter definition, which is shown in Table 1. The AIDS model by modification was used to create the model on the prevalence of drug addiction, since the addictive behaviors appear to show patterns similar to contagion in infectious diseases. Indeed, with regard to the research by Skinner *et al*. (2011), deviant friends of drug using parents was one predictor of continued drug use. One such example of research exploring familial influence on childcare and drug use was conducted by Barnard (2003), where she sampled 62 drug using parents. Analysis revealed mixed findings in terms of the positive and negative aspects to extended family involvement in such protection. Feelings of responsibility and obligation to the child influenced family members to become involved, with a mix of practical and social concerns reported.

Table 1. Sensitivity Analysis on the Parameters Used from Different Models

Parameters in AIDS Model	**Parameters in the Prevalence of Drug Addiction Model**
Initial-People (1 – 500)	Initial-People (1 – 500)
Average Coupling Tendency (1 – 10)	Average Number of Drug User Friends (1 – 10)
Average Commitment (weeks)	Average Time to Mingle New Friends (Maximum of 200 weeks)
Average Condom Use (1–10)	Average Number of Socio Civic Activities in the Community (1–10)
Average Test Frequency (0.00 times/year)	Average Police Operation Frequency on Drug Addiction (0.00 times/year)

The initial people in the prevalence of drug addiction model used the same number of people from the model of AIDS, which has a total number of 500 people. The average coupling tendency was modified as the average number of drug user friends, this parameter leads the exposure of people from countering drug addiction as the same with a coupling tendency towards the infection of AIDS. The average time to mingle new friends is another parameter in replaced with the average commitment (in weeks) found in AIDS model, both parameters reduced the incidence of AIDS infection and Drug addiction respectively when increment of these parameters have been observed. The average number of socio civic activities indulges the community to divert their attention out of drug addiction, which reduces its rate. This parameter is in parallel to the estimated effect of 80% reduction in the incidence of HIV infection when using condom (Wilkinson, 2002). Lastly, in this current model the average police operation frequency on drug addiction minimizes the incidence in a certain community with the same function as the average test frequency applied in AIDS model. Thus, these parameters of the current model have been changed logically considering its function from the AIDS model.

3.0 Research Design and Methods

The study used the computer experimental research design, specifically the 3x3 two factorial design. In this study there are two considered factors (Average Number of Socio Civic Activities in the Community and Average Police Operation Frequency on Drug Addiction), having three respective levels (Low, Average and High). This Experimental Computer Science is the mathematical modeling of the behavior of computer systems that involves the evaluation of computer systems, but using the standard methodologies of the natural sciences (Feitelson, 2006).

The data were gathered from the created agent based model on the partnership of law enforcement and community vigilance, which had been observed for about 40 replications on each type level of partnership with a total of 360 simulated samples. The parameter on the average number of socio civic activities in the community was categorized into three different levels. These levels indicated an equal distribution of corresponding range; namely, Low (1–3.33), Average (3.34–6.66) and High (6.67–10). This consideration is similar to the parameter of average police operation frequency on drug addiction, which was categorized into the same three different levels. Further, the prevalence rate of drug addiction for every simulation was recorded as the outcome of the study.

4.0 Results and Discussion

The prevalence rate of drug addiction within 240 weeks, where other parameters (Average Number of Drug User Friends and Average Time to Mingle New Friends) held constant, was recorded and shown in Table 2 below.

Table 2. Data Collected from the Agent-based Model on the Rate of Drug Addiction (%)

		Average Number of Socio Civic Activities in the Community		
		Low	Average	High
Average Police Operation Frequency on Drug Addiction	Low	27.80, 32.80, 22.00, 26.60 29.80, 24.00, 15.80, 26.40 31.20, 20.80, 23.60, 29.00 25.20, 24.00, 18.60, 30.20 31.00, 25.80, 23.60, 35.60 23.60, 18.20, 34.00, 25.40 26.60, 25.60, 32.20, 22.00 27.60, 20.20, 29.40, 29.00 19.40, 27.60, 25.20, 23.80 31.20, 31.20, 31.20, 34.00	27.20, 31.60, 18.80, 24.40 21.00, 28.20, 27.00, 28.00 27.80, 33.20, 28.40, 18.20 20.80, 28.40, 12.80, 21.20 15.60, 20.40, 22.00, 15.40 23.00, 32.60, 34.00, 20.00 21.40, 28.00, 28.00, 31.20 27.60, 27.40, 28.00, 31.40 19.60, 29.20, 21.80, 21.80 25.60, 31.40, 21.60, 27.60	16.80, 13.00, 21.60, 29.80 19.40, 26.80, 24.60, 32.00 21.00, 21.00, 24.60, 18.80 25.40, 26.00, 18.60, 26.40 18.00, 28.60, 23.40, 18.80 17.80, 27.20, 24.20, 29.60 25.40, 18.60, 16.40, 29.40 21.80, 23.80, 13.40, 22.00 17.80, 19.40, 21.40, 15.40 28.80, 14.40, 23.60, 19.00
	Average	6.20, 10.80, 9.80, 8.60 10.00, 7.80, 8.00, 8.20 6.20, 9.20, 7.40, 9.00 9.00, 9.80, 9.00, 8.00 10.40, 6.60, 9.40, 6.80 7.40, 6.40, 7.40, 11.00 11.00, 8.60, 8.20, 8.20 6.00, 10.60, 7.20, 8.60 12.20, 12.80, 7.80, 8.80 5.20, 8.80, 6.60, 7.40	5.20, 8.20, 6.00, 7.80 13.00, 8.20, 10.20, 7.60 8.80, 6.80, 10.20, 11.20 5.00, 7.00, 7.00, 6.40 9.80, 7.40, 6.60, 6.80 9.80, 10.60, 9.60, 6.00 5.80, 7.20, 6.40, 8.40 9.40, 7.20, 12.40, 7.60 9.60, 6.80, 7.60, 8.60 11.20, 6.80, 7.60, 8.60	9.20, 5.40, 6.20, 9.60 11.60, 6.00, 4.00, 11.40 7.00, 8.80, 9.60, 5.00 6.20, 8.80, 6.80, 5.00 5.00, 9.20, 8.40, 7.60 5.80, 12.60, 5.40, 9.40 10.80, 6.60, 12.00, 5.20 6.00, 9.60, 9.60, 7.40 5.20, 8.80, 8.60, 8.80 8.00, 7.60, 8.60, 9.60
	High	8.00, 3.80, 5.20, 6.80 5.00, 5.80, 5.20, 5.60 6.40, 7.00, 6.20, 6.60 5.40, 6.00, 6.20, 7.60 4.20, 4.40, 6.40, 5.00 4.80, 5.00, 4.40, 5.40 5.20, 9.00, 6.60, 6.20 5.60, 5.20, 6.00, 5.60 6.00, 5.80, 6.60, 4.80 4.60, 4.80, 6.80, 8.20	5.80, 4.00, 5.40, 5.60 6.20, 5.80, 4.40, 4.00 4.00, 4.60, 4.60, 6.60 4.00, 4.20, 6.40, 5.40 5.20, 5.60, 4.00, 3.80 6.00, 3.60, 4.20, 4.60 6.80, 8.00, 5.00, 5.00 7.00, 4.60, 5.00, 4.80 5.60, 5.40, 4.80, 5.40 4.60, 4.00, 3.60, 4.80	5.00, 4.00, 3.80, 5.40 4.80, 5.80, 4.20, 5.80 5.20, 4.40, 4.00, 3.80 5.20, 6.20, 5.80, 5.40 4.40, 6.20, 4.20, 4.00 3.80, 5.20, 5.80, 4.20 4.00, 4.80, 4.80, 4.40 4.60, 5.40, 3.40, 5.40 5.40, 4.80, 4.60, 4.00 5.60, 7.00, 5.60, 4.20

The Analysis of Variance (ANOVA) for the rate prevalence of drug addiction is presented in Table 3. The table shows that *p*-value of main effects of the community vigilance and law enforcement is much less than the $\alpha = 0.05$ significance level. Thus, the main effects of community vigilance, as well as the law enforcement, have significant effect in curbing the prevalence of drug addiction. Moreover, the interaction of these variables has obtained also a *p*-value that is lower than the $\alpha = 0.05$ significance level, which implies that the interaction of community vigilance and law enforcement has significant effect in curbing the prevalence of drug addiction.

The importance of community vigilance is evident in a review of the spatial distribution of drug dealing across certain city, especially citizens voice their outrage toward open-air drug dealing, and they became dynamic in calling police to report illicit activity (Thomas, *et al*., 2008). Further, several studies also claimed that partnership between the law enforcement and community vigilance is more effective in addressing drug addiction. In fact, prevention efforts are most successful when it involves multiple sectors of a community, such as schools, health & social service systems, and law enforcement. However, in the current study, comparing the main effects of community vigilance, law enforcement and its interaction, the result shows that law enforcement has the greatest impact in curbing the prevalence of drug addiction that obtained the highest mean square of 12980.42. The result is clearly manifested in a real situation where many citizens are afraid of the drug use in the community. Thus, it implies that to curb the prevalence of drug addiction in a community, the law enforcement must be strengthened where police should redeem the citizens' faith in their ability to bring positive change to their neighborhoods, and narrowed the schism between law enforcement and community.

Table 3. Two-way ANOVA for the Rate Prevalence of Drug Addiction

Sources	*d*f	SS	MS	*F*	*p* -value
Main Effects					
Community Vigilance (A)	2	241.32	120.66	12.21	**0.000**
Law Enforcement (B)	2	25960.84	12980.42	1313.81	**0.000**
Interaction Effects					
Treatment A x B	4	193.52	48.38	4.90	**0.001**
Error	351	3467.87	9.88		
Total	359	29863.55			

5.0 Conclusions and Policy Recommendation

In curbing the prevalence of drug addiction, the government may consider the factors of strengthening the partnership of law enforcement and promoting community vigilance. However, based on the result of this study, the law

enforcement has the greatest effect in curbing the prevalence of drug addiction compared to the effects of community vigilance and the partnership of both factors. Therefore, government must consider this result to strengthen the law enforcement in terms of regular police patrol and investigative units that are constantly attacking the drug trafficking, use, and related violence.

References

Alavi, H. R. (2011). *The Role of Self-esteem in Tendency towards Drugs, Theft and Prostitution*. Addiction & Health, 3(3-4), 119–124. Last retrieved on January 25, 2018 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3905528/

Aldridge, J. and Askew, R. (2016). *Delivery Dilemmas: How Drug Cryptomarket Users Identify and Seek to Reduce Their Risk of Detection by Law Enforcement*. International Journal of Drug Policy, Vol. 41, Pp. 101-109. Last retrieved on January 25, 2018 from https:// www.sciencedirect.com/science/article/pii/S0955395916303140

Barnard, M. (2003). *Between a Rock and a Hard Place: The Role of Relatives in Protecting Children from the Effects of Parental Drug Problems.* Child and Family Social Work, 8(4), 291-299.

Cleaver, K. and Katsiaficas, G. (2014). *Liberation, Imagination and the Black Panther Party: A New Look at the Panthers and Their Legacy*. Last retrieved on January 26, 2018 from https://books.google.com.ph/books?isbn=1135298327

Eck, J. (1994). *Drug Markets and Drug Places: A Case Control Study of the Spatial Structure of Illicit Drug Dealing*. University of Maryland.

Esplanada, J. (2012, March 27). *UN Drug Report: Philippines has Highest Rate of Shabu Use in East Asia*. Philippine Daily Inquirer. Last retrieved on January 25, 2018 from http://newsinfo.inquirer.net/168143/un-drug-report-philippines-has-highest-rate-of-shabu-use-in-east-asia

Feitelson, D. (2006). *Experimental Computer Science: The Need for a Cultural Change*. School of Computer Science and Engineering. Hebrew University of Jerusalem, Jerusalem, Israel. Last retrieved on January 25, 2018 from http://www.cs.huji. ac.il/~feit/papers/exp05.pdf

Ferrence, R. (1996). *Using Diffusion Theory in Health Promotion: The Case of Tobacco*. Canadian Journal of Public Health 87 (Suppl. 2), Pp. S24-S27. Last retrieved on January 26, 2018 from https://www.ncbi.nlm.nih.gov/pubmed/9002339

Ferrence, R. (2001). *Diffusion Theory and Drug Use*. Addiction 96 (1), Pp. 165-173. Last retrieved on January 26, 2018 from https://www.ncbi.nlm.nih.gov/pubmed/11177527

Green, L. (1996). *Policing Places with Drug Problems*. Thousand Oaks, CA: Sage Publications.

Kornhauser, D., Rand, W., and Wilensky, U. (2007). *Visualization Tools for Agent-Based Modeling in NetLogo*. Agent 2007. Chicago, IL. Last retrieved on October 4, 2012 from https://ccl.northwestern.edu/2007/Kornhauser-Agent-2007.pdf.

Levesque, N. (2012). *Fighting Narcoterrorism: A Counter Narcotic Approach to Homeland Security*. Master in Management for Public Safety and Homeland Security Professionals Master's Projects. Paper 8. Last retrieved on January 26, 2018 from http://digitalcommons.pace.edu/homelandsecurity/8

Mazerolle, L., Kadleck, C. and Roehl, J. (2004). *Differential Police Control at Drug Dealing Places*. Security Journal Vol. 17, No. 1, Pp. 61-69. Last retrieved on January 25, 2018 from https://link.springer.com/article/10.1057/palgrave.sj.8340162

Nyabadza, F. and Coetzee, L. (2017). *A Systems Dynamic Model for Drug Abuse and Drug-Related Crime in the Western Cape Province of South Africa*. Computational and Mathematical Methods in Medicine, Vol. 2017, Article ID 4074197, 13 pages, 2017. doi:10.1155/2017/4074197

Quello, S. B., Brady, K. T., and Sonne, S. C. (2005). *Mood Disorders and Substance Use Disorder: A Complex Comorbidity*. Science & Practice Perspectives, 3(1), 13–21. Last retrieved on January 25, 2018 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC 2851027/

Racz, J. (2008). *The Role of the Curiosity in Interviews with Drug Users*. Forum Qualitative Sozialforschung/ Forum: Qualitative Social Research. Vol 9, No 2. Last retrieved on January 25, 2018 from http://www.qualitative-research.net/index.php/fqs/rt/printer Friendly/423/916

Rand, W., and Wilensky, U. (2007). *NetLogo El Farol Model*. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL. Last retrieved on January 25, 2018 from http://ccl.northwestern.edu/netlogo/models/ElFarol

Rengert, G. and Wasilchick, J. (1990). *Space, Time and Crime: Ethnographic Insights into Residential Burglary; Final Report*. Department of Criminal Justice. Philadelphia, PA: Temple University.

Rosenquist, J.N., Murabito, J., Fowler, J.H. and Christakis, N.A. (2010). *The Spread of Alcohol Consumption Behavior in a Large Social Network.* Annals of Internal Medicine, 152(7), 426–W141. Last retrieved on January 26, 2018 from http://doi.org/10.1059/0003-4819-152-7-201004060-00007

Skinner, M.L. Haggerty, K.P., Fleming, C.B., Catalano, R.F. and Gainey, R.R. (2011). *Opiate-addicted Parents in Methadone Treatment: Long-term Recovery, Health, and Family Relationships*. Journal of Addictive Diseases, 30(1), 17-26. Last retrieved on January 26, 2018 from http://doi.org/10.1080/10550887.2010.531670

Thomas, Y., Richardson, D., and Cheung, I. (2008). *Geography and Drug Addiction*. Science. Pp. 411. Last retrieved on January 26, 2018 from https://books.google.com.ph/books? isbn=1402085095

Valente, T.W., Hoffman, B.R., Ritt-Olson, A. Lichtman, K. and Johnson, C.A. (2003). *Effects of a Social-Network Method for Group Assignment Strategies on Peer-led Tobacco Prevention Programs in Schools.* American Journal of Public Health 93, Pp. 1837-1843. Last retrieved on January 26, 2018 from https://www.ncbi.nlm.nih.gov/pmc/ articles/PMC1448060/

Weisburd, D. and Eck, J.E. (2004). *What Can Police Do to Reduce Crime, Disorder, and Fear?* The ANNALS of the American Academy of Political and Social Science, 593, 42-65. Last retrieved on January 25, 2018 from http://doi.org/10.1177/0002716203262548

Weisburd, D. and Mazerolle, L.G. (2000). *Crime and Disorder in Drug Hot Spots: Implications for Theory and Practice in Policing*. Police Quarterly. Vol. 3, No. 3. Pp. 331-349. Last retrieved on January 25, 2018 from http://journals.sagepub.com/doi/abs/10.1177/ 1098611100003003006

West, R. (2013). *Models of Addiction*. Lisbon, Portugal: European Monitoring Centre for Drugs and Drug Addiction.

White, E., and Comiskey, C.M. (2007). *Modelling Treatment Pathways and the Drug Using Career*. Mathematical Biosciences, 208, 312-324.

Wilkinson, D. (2002). *Condom Effectiveness in Reducing Heterosexual HIV Transmission: RHL Commentary*. The WHO Reproductive Health Library; Geneva: World Health Organization. Last retrieved on January 26, 2018 from http://cms.kcn.unima.mw:8002/ moodle/downloads/Department%20of%20Maternal%20&%20Child%20Health/who%20videos/apps.who.int/rhl/hiv_aids/dwcom/en/index.html