

Estimating the Size of the Methamphetamine-Using Population in New York City Using Network Sampling Techniques

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As part of a recent study of the dynamics of the retail market for methamphetamine use in New York City, we used network sampling methods to estimate the size of the total networked population. This process involved sampling from respondents' list of co-use contacts, which in turn became the basis for capture-recapture estimation. Recapture sampling was based on links to other respondents derived from demographic and "telefunken" matching procedures—the latter being an anonymized version of telephone number matching. This paper describes the matching process used to discover the links between the solicited contacts and project respondents, the capture-recapture calculation, the estimation of "false matches", and the development of confidence intervals for the final population estimates. A final population of 12,229 was estimated, with a range of 8235 - 23,750. The techniques described here have the special virtue of deriving an estimate for a hidden population while retaining respondent anonymity and the anonymity of network alters, but likely require larger sample size than the 132 persons interviewed to attain acceptable confidence levels for the estimate.

Keywords: Population Estimation; Network Methods; Methamphetamine; Anonymous Sampling

Introduction

Statistics such as the size of hard-to-enumerate populations are both important and difficult challenges for social science: important in that they represent one area where sociological results impact the allocation of public funds for both law enforcement and public health resources (Aceijas et al., 2006, Dengenhardt & Hall, 2012), yet difficult because they often require estimation procedures that pit ideal methods against the difficulties of research implementation. Such questions lie at the heart of applied sociology. In particular, estimates of the size of hidden populations often hinge on data drawn from a single source, such as arrests or hospital admissions, whose relationship to overall population levels remains largely unknown, leaving both policy makers and researchers unsatisfied with results. Recent modeling work notwithstanding (Simeone et al., 2003; Zhao, 2011; see Berchenko & Frost, 2011 for discussion) this represents a less than ideal situation, a point aptly summed up in the titled of a recent article: "The numbers game: Let's all guess the size of the illegal drug industry!" (Thoumi, 2005). As noted by Thoumi, such problems are particularly true for drug using populations, where limited data from disparate sources often indicates countervailing trends, yet population estimates and overall community dynamics continue to occupy important policy decisions. In these situations, research confronts hidden populations whose illegal behaviors invoke the need for anonymous sampling, further exacerbating an already difficult research scenario.

New York City methamphetamine users represent such a population. Indeed, meth-users in NYC have received little

attention until recently when concern about growing levels of methamphetamine use were associated HIV risk behaviors in the MSM (men who have sex with men)/gay community (Hirshfield et al., 2004; Morin et al., 2005). Methamphetamine has actually been available in New York City for decades (Drug Enforcement Administration (DEA) 2004, 2006, National Drug Intelligence Center (NDIC) 2008). Yet New York's methamphetamine markets have remained mostly inaccessible to researchers, and the small body of literature that is currently available on methamphetamine use in New York City focuses mainly on use among MSM while offering little information about market size, numbers of users, or distribution in general; nor about use outside of MSM communities, and what effect this has on the total number of users in the area. Local data such as these are important. While DAWN (2009: pp. 18-19) reports that the national estimate of methamphetamine-related emergency room visits in the US dropped from 132,576 in 2004 to 66,308 in 2008, and ADAM II (2009) data show significant declines in those testing positive for methamphetamine upon arrest, the NDIC (2008) notes that "the number of amphetamine-related (including methamphetamine-related) admissions to publicly funded treatment facilities in the New York/New Jersey Region increased 15 percent overall from 2002 (685) to 2006 (787)".

Network-Based Population Estimates

Estimation techniques for hidden population sizes using social network techniques have grown as sociological exposure to social network analysis has exploded over the last two decades. Among the most popular of these techniques is Respondent

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- Hope, V., Hickman, M., & Tilling, K. (2005). Capturing crack cocaine use: Estimating the prevalence of crack cocaine use in London using capture-recapture with covariates. *Addiction*, 100, 1701-1708. doi: 10.1111/j.1360-0443.2005.01244.x
- Hook, E. B., & Regal, R. R. (1995). Capture-recapture methods in epidemiology: Methods and limitations. *Epidemiology Review*, 17, 243-264.
- Johnston, L. G., Malekinejad, M., Kendall, C., Iuppa, I. M., & Rutherford, G. W. (2008). Implementation challenges to using respondent-driven sampling methodology for HIV biological and behavioral surveillance: Field experiences in international settings. *AIDS and Behavior*, 12, 131-141.
- Kadushin, C., Killworth, P. D., Bernard, H. R., & Beveridge, A. A. (2006). Scale-up methods as applied to estimates of heroin use. *Journal of Drug Issues*, 36, 417-440. doi:10.1177/002204260603600209
- Kruse, N., Behets, F., Vaovola, G., Burkhardt, G., Barivelo, T., Amida, X., & Dallabetta, G. (2003). Participatory mapping of sex trade and enumeration of sex workers using capture-recapture methodology in Diego-Suarez, Madagascar. *Sexually Transmitted Diseases*, 30, 664-670.
- Laska, E. M., & Meisner, M. A. (1993). A plant-capture method for estimating the size of a population from a single sample. *Biometrics*, 49, 209-220. http://www.jstor.org/stable/2532614
- Maxwell, J., & Rutkowski, B. (2008). The prevalence of methamphetamine and amphetamine abuse in North America: A review of the indicators, 1992-2007. *Drug and Alcohol Review*, 27, 229-235.
- McCormick, T. H., Salganik, M. J., & Zheng, T. (2010). How many people do you know? Efficiently estimating personal network size. *Journal of the American Statistical Association*, 105, 59-70. doi:10.1198/jasa.2009.ap08518
- Morin, S., Steward, W., Charlebois, E., Remien, R., Pinkerton, S., Johnson, M., Rotheram-Borus, M., Lightfoot, M., Goldstein, R., Kitel, L., Samimy-Muzaffar, F., Weinhardt, L., Kelly, J., & Chesney, M., (2005). Predicting HIV transmission risk among HIV-infected men who have sex with men: Findings from the healthy living project. *Journal of Acquired Immune Deficiency Syndromes*, 40, 226-235.
- National Drug Intelligence Center (2008). *Methamphetamine Threat Assessment 2009*. Washington DC: US Department of Justice.
- Paz-Bailey, G., Jacobson, J. O., Guardado, M. E., Hernandez, F. M., Nieto, A. I., Estrada, M., & Creswell, J. (2011). How many men who have sex with men and female sex workers live in El Salvador? Using respondent-driven sampling and capture-recapture to estimate population sizes. *Sexually Transmitted Infections*, 87, 279-282.
- Salganik, M. J., Fazito, D., Bertoni, N., Abdo, A. H., Mello, M. B., & Bastos, F. I. (2011). Assessing network scale-up estimates for groups most at risk of HIV/AIDS: Evidence from a multiple-method study of heavy drug users in Curitiba, Brazil. *American Journal of Epidemiology*, 174, 1190-1196. doi: 10.1093/aje/kwr246
- Schoeneberger, M., Leukefeld, C., Hiller, M., & Godlaski, T. (2006). Substance abuse among rural and very rural drug users at treatment entry. *American Journal of Drug and Alcohol Abuse*, 32, 87-110.
- Simeone, R., Holland, L., & Viveros-Aquilero, R. (2003). Estimating the size of an illicit-drug-using population. *Statistics in Medicine*, 22, 2969-2993. doi: 10.1002/sim.1528
- Thoumi, T. (2005). The numbers game: Let's all guess the size of the illegal drug industry! *Journal of Drug Issues*, 35, 185-200. doi:10.1177/002204260503500109
- Vuylsteke, B., Vandenhoude, H., Langat, L., le Semde, G., Menten, J., Odongo, F., Anapapa, A., Sika, L., Buve, A., & Laga, M. (2010). Capture-recapture for estimating the size of the female sex worker population in three cities in Cote d'Ivoire and in Kisumu, western Kenya. *Tropical Medicine and International Health*, 15, 1537-1543.
- Wendel, T., Khan, B., Dombrowski, K., Curtis, R., McLean, K., Mishula, E., Riggs, R., & Marshall IV, D. M. (2011). *Dynamics of retail methamphetamine markets in New York City. Final report to the National Institute of Justice, office of justice programs*. Washington DC: US Department of Justice.
- Zhao, Y. (2011). Estimating the size of an injecting drug user population. *World Journal of AIDS*, 1, 88-93. doi:10.4236/wja.2011.13013