EDITORIAL

Forecasting the opioid epidemic

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Since 2000, almost half a million Americans have died from drug overdoses. This modern plague—largely driven by opioid addiction—degrades health, saps productivity, spawns crime, and devastates families, all at enormous societal cost. How did we get here, and what do we do now?

About 20 years ago, compassionate advocacy for better treatment of chronic pain, combined with aggressive marketing of high-dose opioid formulations, led to a sharp increase in the prescribing of legal opioids by physicians in the United States. An unintended consequence of this well-meaning movement was that millions of Americans became dependent on opioids. Drug cartels seized the opportunity to sell heroin as a cheaper alternative to this ready-made consumer base. As users switched from high-quality pharmaceuticals to street drugs of unreliable composition and quality, deaths mounted. Mortality rates surged further as potent illicit synthetic drugs—such as fentanyl—were mixed in with heroin.

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Law enforcement officials have realized that "we can't arrest our way out of the epidemic" and that a new, public health–oriented approach is needed. How can a new approach be designed? Better understanding of the underlying system dynamics may prove critical. Computational models are routinely used by engineers to understand the dynamics of physical systems, and models and simulations are increasingly being used in public health to understand the dynamics of contagious disease epidemics in human populations. Today, every major public health agency has access to a modeling unit that provides policy decision support for epidemics such as HIV/AIDS, influenza, Ebola, and Zika.

The opioid epidemic can be approached as a dynamical system, composed of networks of interacting individuals including nonusers, users, legal prescribers, illicit suppliers, treatment providers, supporters (family and friends), law enforcement officials, and others. Data on the frequency of opioid drug prescribing, illicit drug availability, the natural history of substance use disorder, treatment effectiveness, availability of support services, and other key factors can then be used to construct and parameterize models. Borrowing from methods used to model contagious diseases, these dynamical models can be employed to forecast the likely future trajectory of the opioid epidemic in the population (not a single path, but a range of possible paths as bounded by uncertainty) and then to evaluate—in silico—interventions designed to alter the trajectory. Policy-makers could estimate the likely effectiveness—and cost-effectiveness—of possible public health interventions such as increasing the availability of naloxone (medication used to block the effects of opioids), decreasing prescriptions, expanding treatment, and widening education, as well as concurrent deployment of two or more of these interventions. Computational modeling can also be used to explore synergies between public health and law enforcement.

Increased data openness will be needed. Each country will have its own data access issues. In the United States, overdose deaths are available from public death records, but these are compiled slowly, and are not readily available at detailed geographic specificity. Prescription data can be obtained from commercial vendors and from state monitoring programs, but these are either not publicly available or are available only at exorbitant cost. Illicit drug seizure data are collected, but these are not readily shared outside law enforcement. Self-reported drug use patterns are available from national surveys, but these do not provide regional or local data. Urine drug testing data are collected, but are held as proprietary. Finding creative ways to open up and analyze these and other data sources can lead to valuable insights into the dynamics of the opioid epidemic.

The opioid epidemic is a complex, dynamical process, and it should be approached as such in the development and evaluation of policy. A coordinated national opioid epidemic modeling program could help solve this difficult problem.

–Donald S. Burke

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