otherwise obtain commercial tobacco products.

6. Given the many fully ethical tobacco control measures available, it is not ethical for governments to allow the enormous harms caused by smoking to continue, especially the many harms to youths and nonusers.

By themselves, these considerations indicate that almost any effective measure to reduce smoking harms directed solely at the tobacco industry would not excessively or unethically infringe on individual liberty. But Morain and Malek suggest that it might be ethically inappropriate to seriously impede the ability of people already addicted to smoking to obtain the smoked tobacco products they desire to feed their addictions (e.g., by abruptly increasing the minimum sales age instead of phasing it in). This ethical concern should largely disappear, however, if the antismoking measures leave smokers with other readily available legal ways to obtain and consume the nicotine they crave that are attractive or at least acceptable to smokers (e.g., via e-cigarettes or other products for inhaling nicotine).

The article also states that a tobacco control measure that restricts individual liberty might not be ethically appropriate if there is "a less restrictive alternative that could achieve a similar public health benefit."[1(p1404)] This standard works well to the extent that it means that the measures should be modified to minimize any liberty restrictions whenever that can be done without significantly reducing the health gains they secure. But its broader literal application could be unethical. For example, if an otherwise ethical tobacco control measure that restricted individual liberty would reduce smoking harms by 10%, and a different, less-restrictive measure would also secure a 10% reduction, it would not be ethical to replace the first with the second. The most ethical approach would be to implement both measures to maximize overall health gains. It would be ethical to substitute the less–liberty-restricting tobacco control measure for the other only if implementing both were not necessary to minimize smoking harms as quickly as possible.

GOVERNMENT INACTION

Currently, very few, if any, governments worldwide are actively considering new tobacco control measures that would quickly minimize smoking harms. Consequently, any antismoking intervention that qualifies as ethically appropriate under the previously discussed considerations should satisfy any ethically valid less-restrictive alternative test as well.

Even if understandable for political reasons, the failure of governments to implement more aggressive, ethically appropriate measures to reduce the enormous harms caused by smoking is itself unethical. To date, however, ethical analyses have primarily focused on the ethics of different tobacco control interventions. Although these analyses are important, they are largely defensive. Tobacco control ethics should also go on the offensive and provide new ethical critiques of government inaction.

THE TOBACCO INDUSTRY

New ethical analyses of the tobacco industry are also needed. So far, tobacco industry product development, marketing, and sales practices have rarely been held to any ethical standards. By detailing how tobacco companies continue to act unethically, thereby causing enormous amounts of preventable death and destruction, new ethical analyses could increase support for more active tobacco control efforts. They could also prompt the development of new strategies and proposals designed to make the companies act more responsibly and comply with the same ethical standards that have been inaccurately used to attack minimum age increases and other effective tobacco control measures. AJPH

Eric N. Lindblom, JD

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Successes and Continued Challenges of Electronic Health Records for Chronic Disease Surveillance

See also Klompas et al., p. 1406.

For many years, the Behavioral Risk Factor Surveillance System (BRFSS) has been a mainstay of public health surveillance for chronic diseases. This telephone survey generates national and state-specific estimates of the prevalence of the major chronic diseases and risk factors, including behaviors, that make up many indicators in *Healthy People 2020* and state and local public health improvement plans. Recent innovations in BRFSS methods have been responses to evolving surveillance needs: adding mobile telephone numbers to the sample, imputing measures for the 500 largest cities,[1] and fielding follow-up surveys to gather clinical care information for conditions such as asthma. However, BRFSS is limited by the number of questions that can be asked, the self-reported nature of the data, the lack of clinical data, declining response rates, and reductions in funding.

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CHRONIC DISEASE SURVEILLANCE

Electronic health records (EHRs) are an important potential source of public health surveillance data. EHRs are used by nearly 90% of ambulatory care providers and contain data on large numbers of people. Their development has been driven by the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act that provides incentive payments for "meaningful use" of EHRs, including public health reporting. However, despite the billions of dollars disbursed through the program, the development of EHR-based chronic disease surveillance systems has been slow, with few published reports.[2]

Two recent articles in *AJPH* show significant progress in using EHRs for chronic disease surveillance. In the June 2017 issue, Perlman et al.[3] described the New York City Macroscope, a distributed network of more than 700 providers with a single EHR system that contains records on about 1.5 million people, about one in six New York City residents.[3] In the current issue, Klompas et al.[4] discuss the Massachusetts MDPHnet system, which is installed on multiple EHRs in three large provider groups covering 1.5 million people, or about one in five state residents. The approaches taken by these two groups have many similarities that illustrate not only the steps necessary to build successful EHR-based surveillance systems, but also the challenges to be dealt with going forward.

ALGORITHM DEFINITION

A critical factor in the development of both projects is that they are collaborations among public health departments, academic centers, and clinicians. Both projects started by selecting the EHR systems to be used and developing algorithms based on the available EHR data elements to define the chronic diseases for surveillance, for example, disease-specific diagnosis codes, laboratory values indicating diseases such as diabetes or hypercholesterolemia, and smoking history. Chart reviews were done to validate some of the disease algorithms at the individual patient level. The algorithms and extraction tools were made available by both projects to the clinical sites to enable them to analyze their own data, an important benefit of the cooperative relationship.

VALIDATION

Both groups also took the important step of comparing their EHR-based surveillance results with known standards. The New York City Macroscope citywide prevalence data for selected diseases were compared with the gold standards of the New York City Health and Nutrition Examination Survey, which collects clinical data directly from a statistical sample of city residents, and of the New York City Community Health Survey, which is equivalent to the BRFSS. Several of the Macroscope measures correlated well with those from the standard data sources. Other measures such as depression prevalence and influenza vaccination agreed less well, possibly because the clinical settings did not have standardized depression assessments and vaccinations given in locations such as pharmacies were not documented in the EHR. The MDPHnet data were examined at the state level and for 13 cities for which comparison data were available from the BRFSS 500 Cities Project. They found good agreement for statewide prevalence measures for diabetes, asthma, smoking, hypertension, and obesity but some variation at the city level, particularly in smaller cities with poorer coverage by the EHR data.

LIMITATIONS

The New York City Macroscope and MDPHnet projects demonstrate the great potential for EHR-based chronic disease surveillance. EHR-based surveillance can access large populations with clinical information including provider diagnosis and laboratory and pharmacy data. The data are available in electronic form, facilitating computer analysis in near real time. However, EHR data are limited to people receiving health care, which may differ from those people not receiving health care. Because the proportion of a population receiving care may depend in part on health insurance coverage, EHR-based surveillance may perform less well in areas with lower insurance coverage rates than New York City or Massachusetts. In addition, MDPHnet data suggest that the validity of small-area estimates may vary depending on the proportion of the local population covered by the EHR and the number of participating providers. Small-area estimates may be affected if the participating EHRs cover only a small portion of the population. Ultimately, this concern should be mitigated as more EHRs are added to surveillance systems, increasing the proportion of the population under surveillance. Further work is necessary to determine the impact of these factors and also to validate EHR-based estimates for racial/ethnic subgroups. Finally, EHR-based surveillance will not replace BRFSS, which gathers data on health behaviors and self-perceived health status not typically available in EHRs and on people not in care. BRFSS will continue to serve a complementary function to EHR-based surveillance.

REPLICATION

How adaptable are the New York City and Massachusetts methods to other jurisdictions? Certainly the algorithm definition and validation process will help guide efforts elsewhere. However, jurisdictions implementing EHR-based chronic disease surveillance will likely have to customize their surveillance algorithms to the varying EHRs available for surveillance and analyze their sensitivity and specificity through chart review. This burden can, one hopes, be reduced in the future as broadly applicable algorithms are validated and become available. This goal should be advanced by a provision of the 21st Century Cures Act that calls for the development and use of Application Programming Interfaces (APIs).[5] Developing public health surveillance APIs will be a critical step in helping health departments access data from EHRs. Similarly, jurisdictions with regional health information organizations linking together EHRs may be able to use these networks for surveillance purposes.[6]

Health departments undertaking EHR-based chronic disease surveillance will also need to compare the resulting disease and risk factor prevalence estimates with standards such as BRFSS. This may present a challenge for local jurisdictions outside the 500 Cities data, which encompass only one third of the US population. Expanded county-level BRFSS

can provide standards for comparison in some states.

CONTINUED CHALLENGES

The foundational steps described in the two articles mentioned previously are necessary but not sufficient to establish EHR-based surveillance systems at this time when public health resources are under stress. Both author groups note that their EHR-based surveillance systems are cost effective. That may be true after the systems are set up and validated, but many jurisdictions may have difficulty finding the resources to replicate this work. State and local health departments have received only a fraction of the resources that the clinical sector received under the HITECH meaningful use program. More resources will be needed to fully establish EHR-based surveillance systems.[7] Continued collaboration between public health and clinical settings, which can access HITECH resources, will also be critical.

EHR-based surveillance is still in its infancy. Perlman et al.[3] and Klompas et al.[4] show the way forward. However, replicating their models across the country will be challenging. Standardizing methods and algorithms and sharing technological solutions will certainly be helpful. However, for EHR-based surveillance to become a reality, the public health community must stay involved and must advocate for crucial resources. AJPH

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Complexity in Public Health Research: A Public Health of Consequence, September 2017

See also Marshall, p. 1385; Acquah et al., p. 1477; Winter and Sampson, p. 1496; Yimgang et al., p. 1455; and Light et al., p. 1448.

In this issue of *AJPH*, Marshall considers the application of systems science approaches to population health.[1] Consideration of these models for population health rests on the recognition that populations are complex, dynamic systems characterized by long-tail effects, reciprocities, discontinuities, and emergent properties.[2] Marshall suggests that systems science approaches can help a public health of consequence in pushing scientific boundaries, nudging forward the questions we ask, and grappling with the multifactorial and multisectoral processes that produce many public health challenges. We agree and see Marshall's editorial as an important reminder of the potential of analytic methods that have largely been outside the mainstream of population health science analysis. Saliently, this editorial coincides in this issue with four articles that very much reinforce Marshall's point about the importance of considering population health through a complex systems lens.

LONG-TAIL EFFECTS

Two articles in this issue illustrate the long-term consequences of particular exposures, reminding us that too narrow a focus on the immediate could allow us to miss important factors and consequences that shape population health. Acquah et al. consider a long-ago exposure indeed: in utero exposure to the 1918 flu pandemic.[3] Using data from the Asset and Health Dynamics survey, a nationally representative sample of persons born in 1923 or earlier, they found that in utero exposure to the deadly wave of the 1918 influenza pandemic increased the number of hospital visits for persons older than 70 years by 9.9 per 100 persons. For those exposed in utero to the deadliest wave of the influenza pandemic, high rates of activities of daily living limitations were related to

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