age (including in nursing homes). In addition, integrated NCD dental strategies can provide advantages in terms of intersectoral patient care (e.g., dietary counseling, smoking cessation, integrated diabetes and periodontitis management, avoidance of contraindicated medications).

TOWARD MORE EVIDENCE-INFORMED POLICYMAKING

The literature on dental disparities has focused extensively on describing the nature and extent of the problem and relatively little on evaluating the impact of interventions. Rational policymaking requires more decisive evidence on the usefulness of interventions. First, because of the limited applicability of randomized controlled trials in this context, program evaluation via quasiexperimental methods appears sensible. Methods such as regression discontinuity designs, instrumental variables, difference-in-differences analyses, and fixed effects models using panel data are becoming increasingly relevant in health policy and public health research.[6]

Second, various studies on dental disparities have used diverse dental health outcome variables and different inequality measures. A more harmonized reporting of dental disparities might facilitate better comparability across different studies and settings.

Third, because of resource scarcity, careful choices need to be made about investments into public health and clinical interventions. Therefore, the impact of any examined intervention to reduce (dental) disparities should also be weighed against associated costs. Not least, comprehensive information about the social and economic impacts of dental diseases is important for raising policymakers' awareness of the relevance of addressing these diseases. AJPH

Stefan Listl, DDS, PhD

REFERENCES

1. Listl S, Galloway J, Mossey PA, Marcenes W. Global economic impact of dental diseases. *J Dent Res*. 2015;94(10):1355–1361.

2. Watt RG, Heilmann A, Listl S, Peres MA. London Charter on Oral Health Inequalities. *J Dent Res*. 2016;95(3):245–247.

3. Birch S, Listl S. *The Economics of Oral Health and Health Care*. Munich, Germany; May 2015. Max Planck Institute for Social Law and Social Policy Discussion Paper no. 07–2015.

4. Niederman R, Huang SS, Trescher AL, Listl S. Getting the incentives right: improving oral health equity with universal school-based caries prevention. *Am J Public Health*. 2017;107(S1):S50–S55.

5. Watt RG, Sheiham A. Integrating the common risk factor approach into a social determinants framework. *Community Dent Oral Epidemiol*. 2012;40(4):289–296.

6. Listl S, Jürges H, Watt RG. Causal inference from observational data. *Community Dent Oral Epidemiol*. 2016;44(5):409–415.

Causes and Causes of Causes of Population Health: A Public Health of Consequence, March 2018

See also Christopher et al., p. 351.

In her classic 1994 article, Nancy Krieger suggested that an ecosocial framework can be useful to integrate our understanding of how biological and social factors influence health and may therefore be an important framework to guide epidemiological theory.[1] That article, in turn, rested on earlier work suggesting the importance of multiple causes of health, and subsequently it has been followed by a substantial, and growing, body of work that has grappled with the observation that the causes of health are not singular but rather include a broad range of factors at multiple levels of influence.

This thinking has also led to the adoption of methods within quantitative population health science that can more readily embrace multiple causes at different levels of influence[2] and interacting in a complex dynamic manner.[3] Insofar as this thinking and these approaches bring us closer to understanding the causal structures that influence population health, this, to our thinking, is all to the good. Ecosocial frameworks and methodological approaches that loosen the constraints of modeling aimed at isolating individual causes can provide us with an approach that tackles the complex causes that produce health and the causes of these causes. Recognizing that multiple causes all matter in the production of health, however, introduces a particular challenge: how can we choose where to intervene to improve the public's health? We have often commented in these pages about our view of population health as a pragmatic discipline and our collective need to conduct scholarship of consequence. But what direction does such scholarship point to?

ILLUSTRATIVE EXAMPLE

One article in this issue of *AJPH* illustrate well how we can grapple with multiple causes and what this work can teach us about how we can positively inflect the trajectory of population health.

Christopher et al. (p. 351) analyzed data from the 2010 to 2014 versions of the Current Population Survey and found that medical outlays redistributed about 1.4% of total income from poorer to richer individuals; put another way, these outlays reduced the median income of the poorest decile by 47.6% as compared with 2.7% in the wealthiest decile, pushing more than seven million people into poverty. Importantly, this article shows that these changes were relatively minimally affected by the Patient Protection and Affordable Care Act (ACA), the signature effort of the Obama

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administration to improve population health.

The article provides us with insight about multiple causes from a different perspective. The relationship between income, assets, and health is perhaps the best documented relationship in decades of population health science; a vicious causal cycle traps populations whereby poor health results in fewer resources, more subsequent poor health, and so on.

Coming back, again, to our question of interest: what does this tell us about the potential focus of our interventions? The relatively minimal impact of the ACA on this vicious cycle is both disappointing and nonsurprising. Provision of limited health coverage without any action on the foundational causes that are producing poor health to begin with ultimately does little to stem the tide that results in poor population health.

BACK TO THE CAUSES OF CAUSES

We fear that the implications of this month's reflection are a bit more radical than usual. Drawing insight from the literature about multiple causes of health and building on this interesting article in this issue of *AJPH*, we suggest that the production of health simply cannot be understood by focusing only on isolated causes and that efforts to intervene only on those isolated causes will inevitably fall short. One might even argue that such an effort may be a distraction from the effort that is needed, a focus on the bigger picture, on the causes of causes, absent which we will fail to do more than nudge population health negligibly forward. This is sobering on many levels, not least when one reflects that the United States' entire "health" conversation over the past decade has focused on the introduction (and attempted repeal) of the ACA, which at core probably does little for the generation of health, even as it provides a minimal level of curative care—long overdue—to millions more Americans.

This does encourage us to reflect on the fact that the United States spends far less as a country on the social conditions that promote health than many other peer nations,[4] that perhaps these social conditions are the causes of causes, and that somehow a public health of consequence needs to turn its lens on these conditions. Not doing so would be missing the fundamental lesson lurking in the web of causation. AJPH

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REFERENCES

1. Krieger N. Epidemiology and the web of causation: has anyone seen the spider? *Soc Sci Med*. 1994;39(7):887–903.

2. Diez-Roux AV. Multilevel analysis in public health research. *Annu Rev Public Health*. 2000;21:171–192.

3. Marshall BD, Galea S. Formalizing the role of agent-based modeling in causal inference and epidemiology. *Am J Epidemiol*. 2015;181(2):92–99.

4. Bradley EH, Elkins BR, Herrin J, Elbel B. Health and social services expenditures: associations with health outcomes. *BMJ Qual Saf*. 2011;20(10):826–831.