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Population Health Science: Fulfilling the Mission of Public Health

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27 The United States is failing in population health. Life expectancy in the United States is falling
28 for the first time since reliable mortality records have been available, and health equity has been on a
29 downward trend for decades.¹

30 Why is the United States, among the richest countries in the world, failing to protect the health of
31 its residents? A dysfunctional medical system that pays for sickness rather than wellness is certainly a
32 part of the problem, but so is confusion about the role of public health in the United States.

33

34 **The Mission of Public Health**

35 In 1988, an Institute of Medicine commission defined the mission of public health as “assuring
36 the conditions in which people can be healthy.”² Yet much of public health continues to focus not on the
37 conditions in which people can be healthy but rather on individual health.

38 Several forces have combined to push public health away from its historical mission.

39

40 *The Cognitive Straightjacket of Randomization*

41 First, science has been increasingly narrowly construed as the business of conducting randomized
42 controlled trials (RCTs). The emphasis on RCTs took hold in the field of medicine as a useful antidote to
43 expert opinion about the effectiveness and appropriateness of care. The resulting turn to evidence-based
44 medicine has the potential—as yet only partially realized—to improve the quality of medical education
45 and clinical care.³⁻⁶ However, to say that RCTs can lead to an evidence base that improves clinical care is
46 not to say that RCTs are the only avenue to improving health. This point seems to have been lost on
47 prominent gatekeepers of science. To take one example, the *JAMA* family of journals prohibits the use of
48 causal language except where an RCT has been involved. This means that, in the pages of one of the
49 most prominent medical journals, it is not permissible to discuss cigarette smoking as a cause of cancer,
50 colonoscopy screening as a cause of reduced all-cause mortality, global climate change as a cause of
51 increasing heat stress or even greenhouse gas emissions as a cause of climate change. As one wry

52 observer remarks, by this standard there is no evidence that injury in falls from airplanes can be prevented
53 by parachutes.⁷

54 This policy places *JAMA* (and other journals with similar policies) in the company of some pretty
55 severe science-deniers. But more problematically, the *exclusive* faith in RCTs generates a strong bias
56 against the contextual determinants of health that are supposed to be at the core of the public health
57 mission. It may be the mission of public health to ensure the conditions in which people can be healthy,
58 but since conditions can only rarely be randomized—and then with great difficulty—much of public
59 health is accordingly beyond the pale of science, at least as so defined.

60 The cult of randomization has an insidious effect on the development of public health. It is more
61 difficult to fund, conduct, and publish research that uses statistical techniques to make subtle causal
62 inferences about observational data than it is to randomize patients to different arms of a trial. As those
63 difficulties accumulate, the science of health moves in the direction of the pills and procedures of medical
64 service delivery rather than the context and conditions of health.

65 There is no question that randomized controlled trials make for an easier pathway to causal
66 inference, even allowing for their documented problems of replicability and external validity.⁸⁻¹¹ But
67 there are also many situations in which randomization is not feasible or ethical. In these situations, to not
68 acknowledge the legitimacy of other forms of causal inference is flatly unscientific. Medical journals like
69 *JAMA* and others in the cult of randomization should be called out for their anti-science bias.

70 The narrow focus on medical interventions as causes of health might be less meaningful if, in
71 fact, medical care were a major determinant of health. It is not. Studies have shown that only one-tenth
72 to one-quarter of the variation in health within developed countries can be attributed to variations in
73 medical care.^{12,13} But the other causes—worker protections, family income, the built environment,
74 structural racism—are precisely the kinds of contextual factors that are difficult or impossible to
75 randomize. The cult of randomization, therefore, leaves the great majority of the causes of health entirely
76 outside the concern of many major funders and journals. Those things that cannot be easily randomized

77 can be discussed only in a smaller circle of academia than can pills and procedures. Those things that can
78 be randomized, but whose effects are visible only over a long period, such as early-childhood education or
79 food advertising, are similarly disadvantaged. And structural factors such as poor housing affordability,
80 exploitative working conditions, or structural racism are the least likely to be taken seriously as objects of
81 scientific inquiry. Yet these are precisely the factors that create the conditions in which people can—or
82 cannot without great difficulty—be healthy. The mission of public health is accordingly at a structural
83 disadvantage in the hierarchy of what counts as serious research. It is no wonder that public health tends
84 to wander away from its mission in favor of a narrower focus on individual health behavior change.

85

86 *The Limitations of Empiricism*

87 A second factor pushing public health away from its mission of assuring the conditions in which
88 people can be healthy are the limits of our theoretical models. Public health can be proud of a long
89 tradition of interdisciplinary collaboration, with economic, sociological, psychological, and other
90 theoretical currents enriching the flow of public health research. But theoretical developments have often
91 remained anchored in their home fields without ever creating a coherent theoretical base within public
92 health. Within public health, our two methodological subfields—epidemiology and biostatistics—are
93 empirical, not theoretical, fields.

94 Of course, there are many useful conceptual models in public health. But they tend to be
95 descriptions of *what*, rather than of *why* or *how*. They speak a language of nouns without verbs. This is
96 very different than most scientific fields, in which an overarching theoretical frame creates an established
97 body of knowledge about *how* things happen.

98 Theory is essential to science for several reasons. It creates a foundation of shared understanding
99 that is used to advance the field—a set of facts that are no longer in dispute. All economists believe that
100 incentives matter to behavior and that the demand curve is downward-sloping. Sociologists believe that
101 social norms constrain and shape behavior. Anthropologists believe that cultural practices are adaptive to

102 their environments. All of these theoretical commitments are supported by strong empirical evidence,
103 ant although none of them is empirically unassailable, they are generally both widely endorsed and valid.
104 Their value is not that they are always and everywhere empirically true, but rather that they are true
105 enough, enough of the time, that they are valuable starting points for further empirical and theoretical
106 investigation.

107 Theory also informs empirical models, identifying directions of causality and separating
108 endogenous from exogenous variation. And, as thorny empirical issues like collider bias^{14,15} and the
109 stable-unit treatment value assumption^{16,17} become more widely understood, the pressure will grow to
110 have strong theoretical models that can help better identify empirical models. Collider bias is an analogue
111 of omitted variables bias, which is the familiar problem of an unmeasured variable that influences both X
112 and Y. In collider bias, an included variable that is caused by both X and Y similarly induces a spurious
113 correlation between them even if none would otherwise exist. A classic example is the correlation
114 between a broken starter and a dead battery in a car. These are unrelated events, but if we condition on
115 the car not starting, the finding of a dead battery and that of a broken starter are inversely associated. The
116 stable-unit treatment value assumption is also called the “no interference” or “no interaction between
117 subjects” assumption.¹⁷ A randomized-control trial found that children whose parents were assigned to
118 receive payment for their school attendance were indeed more likely to attend school; what it missed is
119 that their siblings, for whom no payment was received, had poorer nutritional status than siblings in the
120 control group.¹⁸

121 Population health science starts with its own theoretical commitments: that the health and health
122 equity of a population are different from and determined differently than the health of individuals. This is
123 a point that was made long ago by Virchow and Durkheim and repeatedly since.¹⁹⁻²¹ While individual
124 health may be determined by health behaviors or toxic exposures, progress on population health requires
125 understanding why those behaviors and exposures happen. Population health science is invested in the
126 population causes of incidence and not only the individual causes of susceptibility.²¹

127

128 *Attempting Policy While Fearing Politics*

129 Finally, public health has naturally not wanted to engage in overtly political advocacy. This
130 aversion to wading into the morass of politics is a healthy instinct. If public health becomes politicized, it
131 will lose the trust of a large fraction of the population. Avoiding political fights is accordingly sound
132 advice for anyone wishing to preserve the respect that our public health successes have earned us. Yet
133 this strategy has significant disadvantages.

134 If the goal is to avoid inflaming political passions, it is much easier to focus on individual health
135 behavior change than on structural factors. To the extent that the context is addressed at all, it is safest to
136 construe the conditions in which people can be healthy in the narrowest and most literal sense: restaurant
137 inspections and contagious disease containment. Even when systemic changes are proposed, they are
138 oriented around individual health behavior: bicycle helmet laws, cigarette taxes, sugar-sweetened
139 beverage taxes. Although these changes may face political headwinds, there is rarely a storm of protest at
140 new impositions on the behavior of the most marginalized.

141 Of course, public health does sometimes attempt to engage the structure in ways that are
142 unambiguously designed to improve the context, rather than just punish unhealthy behavior. Asthma
143 home remediation, school-based health centers, and nurse home-visiting programs are all bright spots, all
144 too small and too underfunded.

145 And why are such programs underfunded? Because public health must fund such programs out
146 of budgets that are designed for much narrower purposes. Public health, unfortunately, has an impossible
147 task: create a culture of health but without displacing any vested interests in the current culture.

148 It is a Faustian bargain: maintain funding by avoiding offense to any political interest, thereby
149 abandoning attempts at wider structural change, or jeopardize funding by using public health methods and
150 evidence to advance an agenda for creating a society in which people can be healthy. Such a society
151 would involve substantial changes in how income and power are distributed, how cities and suburbs are

152 built, and whose voice is heard and how. Creating the conditions in which people can be healthy, in other
153 words, requires politics.

154 Public health once was more open to engaging in political fights. Delivering clean water to
155 growing cities was one of the great public health triumphs and led to huge increases in life expectancy.
156 But publicly financed sewers came only after a huge—and very political—struggle.^{22,23} Quarantine laws
157 and food inspections similarly came about as a result of political struggle.²⁴ It might be nice to imagine
158 that progress in public health occurs whenever public health simply presents its science to dispassionate
159 decision-makers. Never has it been so.

160 While decades of hiding from politics has been a reasonable if sometimes uncomfortable
161 accommodation, it is now no longer working. The allies won through the scrupulous non-political
162 approach to public health—if they were ever really with us—have now definitively abandoned us.

163 The definitive breakdown has occurred around an issue that is not inherently political or even
164 controversial: the wearing of face masks during a pandemic. This and the broader response to the
165 pandemic—closing restaurants, asking for physical distancing, bans on large gatherings, evidence-based
166 vaccine development, and adequate safety trials for vaccines once developed—have been politically
167 controversial.

168 The problem for public health is clear: notwithstanding decades of assiduously avoiding politics,
169 politics has come to us. What's worse, public health is now being turned to overtly political ends. For
170 example, the Trump Administration has coopted public health guidance from the Centers for Disease
171 Control and Prevention (CDC) to illegally deny hearings to asylum applicants.²⁵ And, as a SARS-CoV-2
172 vaccine is developed at warp speed in the United States by an administration that is known for its self-
173 dealing and lying, public health is finding that the lines between politics and science have been harmfully
174 blurred as vaccine skepticism grows.²⁶ If we continue to ignore politics, we will be crushed.

175 As the terms of the Faustian bargain have changed, the only way to now preserve the public
176 health mission is to engage politically. Where once it may have been defensible to argue that

177 dramatically narrowing the scope of public health was worth the price of preserving what the rest of the
178 field does, that case can no longer be made. We are in no danger of alienating highly political
179 Republicans, not because this danger is not here, but because it has already happened. Across the
180 country, public health officials have been fired or have quit under duress for implementing the most
181 anodyne public health actions in the face of an enormous threat to the public's health.²⁷ If our good
182 graces do not protect us now, they were never worth sacrificing for.

183

184 **The Emergence of a Population Health Perspective**

185 In reaction to these forces in the field of public health, population health science is emerging to
186 bring back an emphasis on structural and contextual factors.

187 Population health science requires scientists from different disciplinary backgrounds to combine
188 their knowledge and expertise to answer questions that individual disciplines alone cannot. It requires
189 syncretic practice focused not on individual health, but on the mean and variation—the health equity—of
190 outcomes in a population.

191 Each of the three barriers to engagement with the traditional mission of public health identified
192 above is addressed in some way by population health science.

193 Population health science starts with one very strong claim, but a well-evidenced one: that
194 science without randomization is not only possible, but essential. The natural sciences understand this
195 intuitively. From Galileo's observations of pendulums to Einstein's observation of light bending around
196 the sun during an eclipse, science makes bold claims that it then tries to falsify. No randomization
197 required. The example of macroeconomics is impressive. Here is a field in which there is never any
198 chance of randomization and in which there are many potential confounders and often very small
199 numbers. And yet the field progresses.

200 The physicist Lee Smolin has written, “Science has succeeded because scientists comprise a
201 community that is defined and maintained by adherence to a shared ethic,”^{28, p.301} and he defines this ethic
202 as having three parts:

- 203 • If an issue can be decided by [professionally competent] people of good faith applying rational
204 argument to publicly available evidence, then it must be regarded as so decided.
- 205 • If, on the other hand, rational argument from the publicly available evidence does not succeed in
206 bringing people of good faith to agreement on an issue, society must allow and even encourage
207 people to draw diverse conclusions.
- 208 • Science progresses. We will know more later than we know now. As a result, what we know
209 now is necessarily incomplete.^{27(p303)}

210 Causal inference using observational methods are not only consistent with this definition, but
211 have been an essential means of advancing science in many fields with particular relevance to public
212 health, including epidemiology, toxicology, economics, sociology, and psychology.²⁹⁻³⁶

213 Science accordingly has nothing inherently to do with randomization, but rather with agreement
214 on an ever-growing body of knowledge, produced sometimes by experimentation and sometimes by
215 careful observation. When this body of knowledge is organized in a way that makes it memorable, it is
216 theory.

217 Population health has several theoretical models capable of making testable predictions. Two
218 models, the fundamental causes model³⁷ and multi-level theory,³⁸ include concrete explanations of specific
219 causal pathways. These are promising developments, because the more concretely population health can
220 develop ideas of how population health happens, the more rapidly the field will advance. Theoretical
221 development is an urgent need within the field. Both models are capable of generating predictions that
222 would not be otherwise obvious. For example, neo-materialist theory suggests that poor health arises
223 from a failure to adequately achieve the material conditions that secure health.³⁹ One might expect that,
224 as a society becomes richer, more and more people are lifted above the threshold of necessities, and

225 health accordingly improves. If, as seems intuitive, there are diminishing marginal health returns to
226 increased living standards—that an extra \$10,000 a year matters more to the man under the bridge than to
227 the woman in the McMansion—then rising living standards should also compress the distribution of
228 health, reducing health disparities. The fundamental causes model proposes that access to society’s
229 resources is so inflected by social position, that even if additional resources have a higher marginal health
230 return for lower-income people than for higher-income people, health disparities nonetheless can widen
231 when average standards of living are increasing. This claim is bold and surprising when taken piece-by-
232 piece, yet consistent with an abundance of evidence on health disparities. The capacity to make a
233 counterintuitive prediction that cannot be falsified is the hallmark of a strong scientific theory. It also
234 generates important other theoretical implications: in this case, that average health and health equity are
235 theoretically independent and driven by different processes. This theoretical finding would come as a
236 surprise to many methodological individualists.

237

238 The engagement of population health science with politics starts with a clear-eyed understanding
239 that politics matters. To be clear, population health science should be used to inform political judgments,
240 never to support political ends. Public health accordingly has two tasks: it must resist the use of
241 population health science for the objectives of politics, and it must simultaneously engage the tools of
242 politics to pursue the population health objectives identified by science.

243 One example of using politics to pursue population health science is offered in a recent paper in
244 this journal showing a high and positive correlation, which persists when adjusting for potential
245 confounders, between a state becoming more liberal over time and increasing life expectancy.⁴⁰ The
246 magnitude is large: The five states with the greatest movement toward more liberal policies from 1970 to
247 2014 saw life expectancy increase by about one year associated with this policy shift. The five states with
248 greatest movement toward conservative policies saw life expectancy decrease by about one year
249 associated with this policy shift. This difference is on a par with the life expectancy between the

250 Netherlands and Puerto Rico. There is no way to embrace science and to deny the import of results such
251 as these. Public policy matters to population health outcomes, and for that reason politicians must be held
252 accountable to population health science to the best of our abilities.

253 Another strand of population health science seeks to expand our abilities to influence political
254 outcomes—or more precisely, outcomes of policy debates. There is increasing recognition that how we
255 talk about our research is as important as what we say. A large body of research in political science
256 suggests that voters are typically not swayed by facts about policy issues.⁴¹ Instead, recent research on
257 message framing suggests promising strategies to make population health interventions more widely
258 acceptable. For example, political conservatives become more open to government actions to prevent
259 obesity when the rationale is presented in terms of military readiness or consumer sovereignty.^{42,43}
260 Evoking themes of fairness can increase support for universal health insurance.⁴⁴ Stories have been
261 shown to be effective in shifting public opinion about policy options to improve the context in which
262 health happens.⁴⁵

263

264 **Population Health Science on the Ground**

265 Population health takes two distinct but interacting forms: population health management and
266 population health research.

267 Population health management is pursued in the United States by medical groups, accountable
268 care organizations, managed care organizations, and insurance companies. It involves the tracking of
269 outcomes of the entire membership, whether or not individuals present for treatment.⁴⁶

270 The emphasis in population health management is on proactively ensuring genuine access to
271 needed care, on management of chronic conditions, and on disease and injury prevention. Because most
272 medical care in the United States is compensated on a fee-for-service basis, population health
273 management remains a relatively small part of what US medicine does, but it is rapidly growing. Most of
274 the top medical schools now have departments of population health. One of the priorities of the field is to

275 develop shared definitions and systems of benchmarks that can be used to assess progress on population
276 health and communicate among actors.⁴⁶ While many OECD countries have some kind of shared health
277 records that are accessible to—and used by—all health care providers, the United States lags severely in
278 implementing interoperable electronic health records.

279 On the academic side, research in population health has increased dramatically in the United
280 States, partly in response to the evolving policy context of medical care delivery and partly because of
281 growing recognition of the importance of upstream factors to health outcomes. It has long been
282 recognized in public health that medical care delivery accounts for a very small portion of the
283 determinants of health.^{12,13,47,48} Increasingly, though, it is seen as inadequate to simply ascribe differences
284 in health to differences in behavior. Instead, research is revealing the role of the political, social, and
285 economic context, operating through forces such as structural racism, environmental injustice, and labor
286 exploitation in the patterns of behavior that are observed within a population. Given this understanding,
287 public health then becomes more a matter of changing this context by changing policy than of exhorting
288 individuals to change their behavior.

289 While this perspective has been within public health at least since Rudolf Virchow, it has gained
290 increasing salience and theoretical coherence in the past several years.

291 The Interdisciplinary Association for Population Health Science (IAPHS) was founded in 2015 to
292 bring scholars of population health together and to build the science of how some populations are able to
293 achieve high levels of health, with strong health equity. Also in 2015, the CDC initiated a Population
294 Health Training in Place Program to build capacity in policy analysis and population health improvement.

295 These institutional changes are the early signs in the United States of a growing commitment in
296 population health science to bring scientific tools to the historic mission of public health to assure the
297 conditions in which people can be healthy.

298

299 **Conclusion**

300 Creating the conditions for health is difficult work: far more difficult, for example, than
301 admonishing people to act more healthfully. It is more difficult for medical delivery systems to take
302 responsibility for keeping people healthy than to treat them when ill. It is more difficult to engage in
303 politics with scientific integrity than to avoid political controversy altogether. And it is more difficult to
304 think critically about the theoretical basis of what causes health in populations than to conduct
305 randomized trials of clinical interventions. But with declining health and eroding health equity in the
306 United States, it is clear that the conditions in which health can happen have not been fostered. It has
307 become urgent to do the harder work to assure population health. Fortunately, the perspective of
308 population health science has engendered several institutional changes that support this hard work.
309 Whether health and health equity in the United States improves or not will depend on how well these
310 institutions are supported.

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