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The Scientific Basis for Law as a Public Health Tool

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Systematic reviews are generating valuable scientific knowledge about the impact of public health laws, but this knowledge is not readily accessible to policy makers. We identified 65 systematic reviews of studies on the effectiveness of 52 public health laws: 27 of those laws were found effective, 23 had insufficient evidence to judge effectiveness, 1 was harmful, and 1 was found to be ineffective. This is a valuable, scientific foundation—that uses the highest relevant standard of evidence—for the role of law as a public health tool.

Additional primary studies and systematic reviews are needed to address significant gaps in knowledge about the laws' public health impact, as are energetic, sustained initiatives to make the findings available to public policy makers. (*Am J Public Health*. 2009;99:17–24. doi:10.2105/AJPH.2007.130278)

LAW IS A TRADITIONAL PUBLIC health tool that has made vital contributions to the major public health achievements of the 20th century. Examples include school immunization laws that helped reduce the rates of infectious disease and tobacco control laws that helped reduce the rates of chronic disease.¹ Indeed, many, if not all, government public health endeavors rely on laws crafted to address specific health conditions or risk factors ("interventional" public health laws), laws that create and empower public health agencies and jurisdictions ("infrastructural" public health laws), or the general police powers of state governments. In addition, many laws not designed principally for public health objectives nonetheless have public health consequences (e.g., taxation and education laws). While potentially powerful legal tools for public health, these latter laws are not considered here.

Policy makers weigh many factors as they consider adopting and promoting public health laws. A central question—especially in this

time of emphasis on evidence-based practice and policy—is whether there is sound scientific evidence that a given public health law is effective. The number of peer-reviewed publications reporting on the impact of interventional public health laws is growing, as is the number of systematic reviews and meta-analyses of such primary studies.² However, this body of scientific knowledge, although potentially of great value, to date has not been summarized and made readily accessible to policy makers. We begin to address this gap.

Systematic reviews and meta-analyses apply the most sophisticated methodologies currently available to assess the findings of multiple primary studies focused on a given intervention.³ Systematic reviews have been defined as

review[s] of a clearly formulated question that use[s] systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review.⁴

Often considered a subset of systematic reviews, meta-analyses are

quantitative statistical analyses . . . applied to separate but similar experiments of different and usually independent researchers and that involve[s] pooling the data and using the pooled data to test the effectiveness of the results.⁵

For the sake of simplicity, we use the term "systematic review" for both.

We report on a survey of systematic reviews of peer-reviewed primary studies of individual interventional public health laws. It is thus a report on the highest-quality scientific evidence currently available on the effectiveness of such laws. In addition, we identified recommendations contained in those reviews for future research on interventional public health laws.

METHODS

We defined interventional public health laws as constitutional or statutory measures, regulations,



rules, ordinances, or other official policies adopted by a government body (e.g., a public health department, a city council, or a public school board) and intended to improve the health of a defined population through specific preventive interventions. For this initial attempt to gauge the scientific basis for public health law, we focused only on physical health and excluded the domain of mental health. We adopted the definitions of effectiveness used by the authors of the systematic reviews that we located; the authors considered interventions effective if they resulted in reduced rates of morbidity or mortality, or in some cases, in reduced exposure to known risk factors. In this they were consistent with the definitions of effectiveness offered by 2 organizations that sponsor systematic reviews of public health interventions: “The degree to which an intervention achieves a desired outcome in practice,”^{6(p479)} and “The extent to which a specific intervention, when used under ordinary circumstances, does what it is intended to do.”⁴

We used a 2-part search strategy to locate systematic reviews of peer-reviewed studies of interventional public health laws published beginning in the early 1990s. We selected this period based on the knowledge and experience of 4 authors who have conducted, directed, and published systematic reviews beginning in that time period. They estimated that there would be few available, relevant systematic reviews from before that time. First, we conducted Internet searches to identify organizations that sponsor

or publish information about systematic reviews of primary studies of public health interventions. We used broadly framed search terms to maximize the probability of identifying all organizations active in public health systematic reviews. We identified 19 organizations that appeared to sponsor, publish, or compile information about such reviews. We reviewed their printed and electronic publications to identify systematic reviews of interventional public health laws published before June 2007. A.D.M and M.L.T. conducted independent searches for relevant systematic reviews, compiled the reviews so located, and reconciled our independent scoring of the findings (as effective, ineffective or harmful, or lacking sufficient evidence of effectiveness) based on our consensus reading of the reviewers’ findings. Second, we conducted database searches in PubMed as a sensitivity analysis to determine whether such searches identified the same, fewer, or more systematic reviews. In May to June 2007, we searched PubMed for systematic reviews by using the terms “systematic reviews,” “meta-analysis,” and “prevention,” and these limits: English language, published in last 5 years, review, and human.

To categorize the findings of the reviews that we located, we adapted the classification of evidence used by the Task Force on Community Preventive Services (Community Guide): strong evidence of effectiveness, sufficient evidence of effectiveness, insufficient evidence to assess effectiveness, sufficient or strong evidence of ineffectiveness, and sufficient or strong evidence of

harmful impact.⁶ We assigned the findings of other systematic reviews to these categories based on our reading of their abstracts and full texts. We then merged the first 2 categories and renamed the 3 resulting categories as “found to be effective,” “found to be harmful,” and “insufficient evidence found to determine effectiveness.”

RESULTS

In overview, our 2-part search identified 65 systematic reviews of primary studies of 52 interventional public health laws (some of the systematic reviews dealt with the same public health laws). We found no systematic reviews of primary studies on infrastructural public health laws.

Our search for organizations active in this field located 3 that had conducted or sponsored systematic reviews of interventional public health laws, and 1 that maintained an online database of a wide range of public health systematic reviews—among them, reviews of interventional public health laws:

1. The Community Guide, housed at the US Centers for Disease Control and Prevention, conducts systematic reviews of the effectiveness and economic efficiency of public health interventions. It also identifies gaps in original research. The independent Task Force on Community Preventive Services examines the findings and makes recommendations for policy and practice based on them. As of May 2007, the Community Guide had published recommen-

dations based on systematic reviews of research on 148 public health interventions.^{7,8} Of these, 38 related to interventional public health laws, of which 18 were found to be effective, 1 was found to be harmful (transferring juveniles arrested for crimes to the adult justice system), and insufficient evidence was found to determine the effectiveness of 19.

2. The Cochrane Collaboration (“Cochrane”) is a global network of researchers who conduct systematic reviews of health interventions with agreed-upon methods.⁴ The vast majority of the more than 5000 Cochrane systematic reviews published as of February 2007 dealt with clinical and therapeutic medical interventions. We reviewed the titles of all the located 51 systematic reviews of primary studies of public health interventions: 8 focused on interventional public health laws, of which 5 were found to be effective; 1 was found to be ineffective; and 2 lacked sufficient evidence to determine effectiveness.
3. The Centre for Reviews and Dissemination, sponsored by the UK National Health Service and based at the University of York, had published 19 systematic reviews of public health interventions by May 2007, of which 3 focused on interventional public health laws. All 3 were determined to be effective.⁹

In addition to these 3 organizations, we also located the online Health-Evidence database of



published systematic reviews on the effectiveness of public health and health promotion interventions. The Health-Evidence database is maintained by researchers and policy and practice experts who search for published systematic reviews across 21 public health domains, assess their methodological quality, and publish the reviews and summaries.¹⁰ Health-Evidence is supported by the Canadian Institutes of Health Research, the Public Health Agency of Canada, and other organizations. We reviewed the titles of all 835 systematic reviews accessible on the Web site as of May 2007, and reviewed the abstracts of all that appeared to deal with interventional public health laws. We located 14 relevant systematic reviews (none duplicated systematic reviews located elsewhere). Twelve of the studied interventions were found to be effective; insufficient evidence existed to determine the effectiveness of 2.

In the second part of our search strategy, a PubMed search provided citations of 5101 articles. We reviewed the titles of the 1000 most recently published citations (those published between November 2006 and May 2007) and identified none related to public

health law. Given this null finding, we did not review earlier titles. Review of all the citations identified through similar searches for relevant meta-analyses identified only 2 focused on interventional public health laws; both laws were found to be effective.

Based on these searches, Table 1 shows, for each of the 5 sources of the systematic reviews that we located, the number of public health interventions reviewed and the number of findings related to interventional public health laws (the great volume of studies cited by PubMed precluded attempts to determine the number of public health interventions reviewed there). Of the 52 interventional public health laws addressed in these 65 studies, a majority ($n=27$, or 52%) were determined to have positive public health effects (i.e., to be effective), 1 (2%) was found to be harmful, 1 was found to be ineffective, and insufficient evidence was found to determine the effectiveness of 23 (44%).

Table 2 lists the 52 public health laws and the 65 findings regarding their effectiveness, organized by 9 public health domains: injury, oral health, physical activity, housing, tobacco use, vaccination, violence associated

with firearms and juveniles, food safety, and skin cancer. This survey of public health laws also points to gaps in the scope of research that has been conducted on the effectiveness of interventional public health laws. In each of its published systematic reviews, as of the time of our analysis, the Community Guide included recommendations for research to improve the understanding of interventions effective in addressing public health needs in specified areas. By contrast, relatively few Cochrane or other reviews appear to include such recommendations. Of the 422 recommendations that the Community Guide had made for future research as of February 2007, one quarter ($n=105$) was for research on interventional public health laws, clearly suggesting that the Community Guide recognizes a key role for such laws. These recommendations were for research in the fields of tobacco control, vaccination, physical activity, motor vehicle injury, oral health, housing, and juvenile justice.

DISCUSSION

A substantial number of systematic reviews have been

conducted on studies of the effectiveness of interventional public health laws. Most of those studies were of public health laws in North America, Western Europe, and Australia. Interventional public health laws account for a significant proportion—approximately one quarter—of all the public health interventions the Community Guide and Cochrane examined and, for smaller proportions of all the public health interventions, identified by Centre for Reviews and Dissemination and through Health-Evidence.

Many of the systematic reviews that we located went beyond simple yes or no findings to estimate the magnitude of their effects. For example, one Community Guide systematic review concluded that adoption of 0.08% blood alcohol content laws resulted in a 7% reduction in drunk-driving deaths.⁶ Some reviews commented on factors that intervene, in important ways, between the adoption of an interventional public health law and its effectiveness. A Cochrane systematic review on interventions to prevent tobacco sales to minors, for example, concluded that “Legislation alone is not sufficient to prevent sales to minors. Both enforcement and community policies improve compliance by retailers.”^{11(p9)}

When considering additional research in public health law, as in other public health areas, a number of alternative approaches can be taken to set research priorities. One can be to focus on the principal preventable causes of morbidity and mortality. Mokdad et al.

TABLE 1—Summary of 65 Systematic Reviews of Primary Studies of Public Health Laws Published from 1994 to May 2007

	Cochrane		Health-Evidence		PubMed	Total
	Community Guide	Collaboration	CRD	Database		
Public health interventions reviewed	148	73	19	835	...	...
Reviews related to interventional public health laws	38	8	3	14	2	65

Note. CRD = Centre for Research and Dissemination. Ellipses indicate that results were indeterminate (see “Results” section).



TABLE 2—Findings of 65 Systematic Reviews of the Effectiveness of 52 Public Health Laws Published From 1994 to May 2007

Public Health Laws	Systematic Reviews		
	Effective	Ineffective or Harmful	Not Determined
Injury			
Child safety seat laws	Community Guide; CRD	...	...
Safety belt laws	Community Guide	...	...
Safety belt primary-enforcement laws	Community Guide; Health-Evidence database	...	...
Safety belt-enhanced enforcement	Community Guide	...	...
0.08% blood alcohol concentration laws	Community Guide; PubMed	...	...
Minimum legal drinking age laws	Community Guide; Health-Evidence database	...	...
Sobriety checkpoints	Community Guide	...	...
Lower blood alcohol concentration for young or inexperienced drivers	Community Guide	...	...
Alcohol ignition interlock programs for reducing drunk driving recidivism	Cochrane Collaboration	...	...
Remedial interventions with drivers with alcohol offenses	Health-Evidence database	...	...
Graduated driver licensing to reduce motor vehicle crashes among youth	Cochrane Collaboration	...	...
Helmet laws to prevent head and facial injury among bicyclists	Cochrane Collaboration CRD; Health-Evidence database (2)	...	...
Red-light cameras to prevent road traffic crashes	Cochrane Collaboration Health-Evidence database	...	...
Speed enforcement detection devices to prevent road traffic injury	Cochrane Collaboration	...	...
Driver license suspension to reduce crashes	PubMed	...	...
Interventions to reduce pesticide overexposure and poisoning	...	...	Health-Evidence database
Oral health			
Drinking water fluoridation to prevent dental caries	Community Guide; CRD; Health-Evidence database	...	...
Fluoridation of milk to prevent dental caries	...	...	Cochrane Collaboration
Physical activity and obesity			
Street-scale urban design and land-use policies and practices	Community Guide	...	...
Community-scale urban design and land-use policies and practices	Community Guide	...	...
Transportation and travel policies and practices	...	...	Community Guide
Excise tax and other macrolevel environmental interventions for obesity prevention	...	...	Health-Evidence database
Housing			
Tenant-based rental assistance or voucher programs to			
Improve household safety, i.e., to reduce exposure to crime	Community Guide	...	...
Improve substandard housing conditions that pose health and safety risks	...	...	Community Guide
Improve youth risk behaviors.	...	...	Community Guide
Increase self-rated health status as good or excellent compared with fair or poor	...	...	Community Guide
Reduce children's need for medical attention for injuries, asthma, or preventive services	...	...	Community Guide
Mixed-income housing developments	...	...	Community Guide

Continued



TABLE 2—Continued

Tobacco			
Increasing the unit price for tobacco products to reduce tobacco use initiation	Community Guide	...	...
Community mobilization, when combined with additional interventions (e.g., stronger local laws)	Community Guide	...	...
Laws directed at retailers and active enforcement of retailer sales laws to restrict minors' access to tobacco products	...	Cochrane Collaboration (ineffective)	...
Sales laws directed at tobacco retailers to reduce illegal sales to minors when implemented alone	...	...	Community Guide
Laws directed at minors' purchase, possession, or use of tobacco products	...	...	Community Guide
Active enforcement of sales laws directed at retailers when implemented alone	...	...	Community Guide
Increasing the unit price for tobacco products for tobacco use cessation	Community Guide	...	...
Smoking bans and restrictions	Community Guide; Health-Evidence database	...	...
Comprehensive US tobacco control programs to reduce adolescent smoking	Health-Evidence database	...	...
Vaccination			
Vaccination requirements for childcare, school, and college attendance	Community Guide	...	...
Vaccination requirements for high-risk adults when used alone	...	...	Community Guide
Violence			
Bans on specific firearms or ammunition	...	...	Community Guide
Firearms acquisition restrictions	...	...	Community Guide
Waiting periods for firearms acquisition	...	...	Community Guide
Firearm registration and licensing of firearms owners	...	...	Community Guide
"Shall issue" concealed weapon carry laws	...	...	Community Guide
Prevention of child access to firearms	...	...	Community Guide
Zero tolerance of firearms in schools	...	...	Community Guide
Combinations of firearms laws	...	...	Community Guide
Court-ordered, prerelease drug testing and sanctions	...	...	Cochrane Collaboration
Juvenile violence			
Transfer of juveniles to adult corrections facilities	...	Community Guide (harmful)	...
Food safety			
Routine restaurant inspection	Health-Evidence database (3)	...	...
Preventing skin cancer			
Educational and policy interventions in primary schools	Community Guide	...	...
Educational and policy interventions in secondary schools and colleges	...	...	Community Guide

Note. CRD = Centre for Reviews and Dissemination. "Not determined" means there was insufficient evidence to determine effectiveness.

have presented the 9 leading "actual" or "underlying" causes of death in the United States,¹² as

shown in Table 3 (alternative measures of burden that also could be used in setting research priorities

are summarized in Thacker et al.¹³). Overall, the systematic reviews identified in our survey focused

substantially on public health law interventions related to these 9 causes: 14 of the 20 effective



TABLE 3—Systematic Reviews of and Recommendations for Research on Interventional Public Health Laws Published From 1994 to May 2007, by Underlying Cause of Preventable Mortality

Actual or Underlying Causes of Preventable Mortality ^a	Community Guide Findings of Effective Interventional Public Health Laws	Cochrane Collaboration Findings of Effective Interventional Public Health Laws	Community Guide Recommendations for Research on Law-Based Interventions Related to the Actual Causes
Tobacco	4	1	40
Poor diet and physical inactivity	1	0	4
Alcohol consumption	0	0	13
Microbial agents	1	...	3
Toxic agents	...	...	0
Motor vehicle	8	4	28
Firearms	0	...	0
Sexual behavior	...	0	0
Illicit drug use	...	...	0
Total	14	5	88

Note. With respect to columns 2 and 3, the number 0 indicates that the Community Guide or Cochrane Collaboration conducted a systematic review of an interventional public health law relevant to a given underlying cause but did not find it to be effective. The number 1 indicates that 1 such review was conducted and that that interventional public health law examined was found to be effective. The number 4 indicates that 4 such reviews were conducted and that all 4 interventional public health laws examined were found to be effective, and so forth. With respect to column 4, the Community Guide recommends research on the impact that 40 different types of public health laws have on tobacco use, that 4 types of public health laws have on diet and physical activity, and so forth. Ellipses indicate that no systematic review was conducted.

^aIn declining order of importance.

interventional public health laws that the Community Guide identified are related to them, as are 5 of the positive public health law interventions identified by Cochrane (Table 3). Moreover, 88 of the Community Guide's total of 105 recommendations for research on interventional public health laws focus on these causes.

In its recommendations, the Community Guide has urged that research be conducted on interventional public health laws related to 5 of the leading underlying causes of death: tobacco use, poor diet and physical inactivity, alcohol consumption, microbial agents, and motor vehicle injury. In light of the important role played by the Community Guide and Cochrane document for interventional public health laws, it is likely that such recommendations will be made in additional

public health domains, as well, as the work of these groups proceeds.

The systematic reviews that we found address only a fraction of all public health fields and interventional public health laws. Two (on tenant-based rental assistance programs and mixed-income housing developments) belonged to the class of laws adopted for reasons nominally unrelated to public health that, nonetheless, may have important implications for the public's health. Among the threats and risk factors that appear not to have been the subject of such systematic reviews to date are public health emergencies (e.g., disease pandemics and natural disasters); cancer not related to tobacco or to skin cancer; diabetes; unsafe water; HIV/AIDS; sexually transmitted diseases; use of illegal drugs; unintentional injuries not related to motor vehicles,

bicycles, or pool drownings; intentional injuries not related to firearms; reproductive health; and occupational health. Two of the 9 underlying causes— toxic agents and illegal drugs— appear to have been the focus of no systematic reviews; most of the 7 other leading causes have been addressed only in part. For example, tobacco control legal interventions not yet addressed in systematic reviews include labeling restrictions, limitations on access to sales outlets through zoning, and mandated inclusion of smoking cessation in services covered by health care plans, among others.

Many of the systematic reviews that we located examined the effectiveness of laws without probing the mechanisms through which they operate, although the Community Guide uses logic

models to identify potential mediating variables and to direct searches for evidence about them. At least 2 typologies have been offered of modal ways in which public health laws may influence health outcomes. Mensah et al. list 7 broad types of behavioral influences that flow from public health laws. For example, smoking bans “require behavioral change to change the environment,”^{14(p8)} whereas a motor vehicle safety belt law “directly requires behavioral change.”^{14(p8)} Gostin offers another taxonomy of mechanisms, including incentives through taxation and spending; changes in the “informational environment”; changes in the “built environment”; “direct regulation” of individuals, professionals, and businesses; and “indirect regulation” through tort litigation.¹⁵



Three peer-reviewed studies illustrate some of the many factors that may mediate between the adoption of a public health law and its health impact. One investigated the relationship between states' adoption of laws that require reporting of elder abuse and the actual reporting of elder abuse. Researchers found that variations in implementing regulations and in the training of elder abuse investigative staff directly influenced the effectiveness of the statutes.¹⁶ Another study found that a state regulation mandating that hospitals offer influenza and pneumococcal vaccination to all hospital in-patients 65 years and older did not change preexisting practice significantly. Among the responsible factors identified were the failure of hospitals to adopt standing orders to implement the mandate, the absence of enforcement mechanisms, and physician opposition to the mandate.¹⁷ Finally, a recent study on the effect of higher cigarette prices on smoker behavior found that 3 economic factors undercut the expected reduction in smoking: manufacturers increased the supply of discount or generic cigarettes and of discount coupons, tax-exempt retailers—such as American Indian-owned businesses—expanded sales, and smokers shifted to generic and other cheaper cigarettes.¹⁸

We believe that expanding research into mechanisms and the importance of enforcement, including acting on recommendations for future research issued by the Community Guide and others, could illuminate factors that facilitate or impede the beneficial impact of interventional public health laws. In addition, this

research could generate information for policy makers and advocates to use in framing public health laws to incorporate mechanisms that have the greatest potential for success.

Limitations

Our findings are subject to several limitations. First, our survey is not a systematic review, and was not designed to maximize sensitivity (i.e., to identify every possible systematic review of primary studies of the effectiveness of interventional public health laws), although we believe that we located most of those published. Instead, the survey was intended to identify systematic reviews readily available in the current, scientific literature and to characterize their findings in ways useful to public health policy makers. Second, the systematic reviews that we located were published over a period of nearly a decade; some could require updating to encompass newly published primary studies.

Third, the findings of effectiveness of the 46 studied interventions cannot be assumed to represent the universe of interventional public health laws, many of which appear not to have been the subject of systematic reviews. The Community Guide, under the direction of the Task Force on Community Preventive Services, reviews interventions in various public health domains in a purposive manner, with such criteria as the perceived preventable burden of a given health condition.⁶

Fourth, the prevailing approaches employed in systematic reviews continue to evolve, responding, in part, to critiques of

methods and of the quality of the primary studies that they treat.¹⁹ Fifth, our findings may be subject to publication bias—that is, “the greater likelihood of research with statistically significant results to be submitted and published compared with nonsignificant and null results.”^{20(p58)} Most of the systematic reviews that we located included studies of interventional public health laws in political systems based on the English common law tradition. Further research could investigate whether different findings would surface in legal systems based on the civil or Roman legal heritage, or in other traditions, and that bring to bear differently framed legal concepts of liberty, property, and procedure. In addition, reviews of laws not directed toward public health objectives, such as housing and transportation laws, will add greatly to the armamentarium of knowledge on effective legal approaches to improving the health of the public.

Conclusions

Policy makers cannot be faulted for making decisions about public health laws on a nonscientific basis when the necessary scientific work has not been done, or if scientific findings have not been made readily available. Our survey of systematic reviews found that many interventional public health laws have beneficial health impacts, even when held up against widely accepted, rigorous standards of scientific evidence. Thus, an important beginning has been made—with the highest relevant standard of evidence—in

establishing the scientific basis for law as a public health tool. Much remains to be done, however, to address large gaps through more primary studies of the effectiveness of public health laws, systematic reviews of those studies, and initiatives to make the results available to public policy makers.

Policy makers can adopt the laws found to be effective in the systematic reviews that we reviewed with a high degree of confidence that they will promote improved health. Policy makers should apply a more critical perspective to the public health laws, the effectiveness of which cannot be determined at present for lack of sufficient evidence, and generally should avoid using those that have been found to be harmful or ineffective.

Our findings also argue for expanding research on interventional public health laws and for involving those who make, implement, and adjudicate those laws (i.e., members of the legislative, executive, and judicial branches at the local, state, and national levels) in setting research questions and priorities. Research is needed on the effectiveness of interventional public health laws in more public health areas; systematic reviews are needed in areas not yet addressed, and those completed should be revisited periodically. Furthermore, research is needed on the mechanisms through which public health laws operate, clarifying the strengths and weaknesses of specific mechanisms, and deepening understanding of *how* interventional public health laws work. This composite research agenda can generate valuable



new information for policy makers, practitioners, and advocates to use in shaping public health laws that rest on a sound evidence base, have the best chance of adoption and implementation, and have the greatest practical likelihood of advancing the health of the public. ■

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Contributors

A.D. Moulton conceptualized the study and prepared the original article. A.D. Moulton and M.L. Thombly conducted searches and analyses. S.L. Mercer, T.

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Requiring Influenza Vaccination for Health Care Workers

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Annual influenza vaccination for health care workers has the potential to benefit health care professionals, their patients, and their families by reducing the transmission of influenza in the health care setting. Furthermore, staff vaccination programs are cost-effective for health care insti-

tutions because of reduced staff illness and absenteeism.

Despite international recommendations and strong ethical arguments for annual influenza immunization for health care professionals, staff utilization of vaccination remains low. We have analyzed the ethical implications of a variety

of efforts to increase vaccination rates, including mandatory influenza vaccination.

A program of incentives and sanctions may increase health care worker compliance with fewer ethical impediments than mandatory vaccination. (*Am J Public Health*. 2009;99:

24–29. doi:10.2105/AJPH.2008.136440)

IT IS GENERALLY ACCEPTED

that vaccinating health care workers against influenza reduces the transmission of the virus in health care settings, decreases staff illness and absenteeism, and