

# The Shale Gas Boom and the Need for Rational Policy

Madelon Finkel, PhD, Jake Hays, MA, and Adam Law, MD

High-volume, slick water hydraulic fracturing of shale relies on pumping millions of gallons of surface water laced with toxic chemicals and sand under high pressure to create fractures to release the flow of gas.

The process, however, has the potential to cause serious and irreparable damage to the environment and the potential for harm to human and animal health. At issue is how society should form appropriate policy in the absence of well-designed epidemiological studies and health impact assessments.

The issue is fraught with environmental, economic, and health implications, and federal and state governments must establish detailed safeguards and ensure regulatory oversight, both of which are presently lacking in states where hydraulic fracturing is allowed. (*Am J Public Health*. 2013;103:1161–1163. doi:10.2105/AJPH.2013.301285)

**BALANCING THE NEEDS OF THE** economy and society with the protection of the environment and health is not a new issue. Countless global examples exist, such as the contamination of bodies of water as a result of oil spills, degradation of the environment resulting from coal mining or mining for metals and ore, and unregulated industrial growth contributing to air, soil, and water pollution. As the global demand for energy, be it oil, coal, nuclear, hydroelectric, wind, or solar, accelerates, the challenge to meet the demand without causing undue harm to either the environment or human health becomes more complicated and difficult.

Oil and coal combined represent nearly 60% of the world's energy supply.<sup>1</sup> Both, however, have the disadvantage of having a negative impact on the environment, including but not limited to contributing to atmospheric pollution. Natural gas is abundant around the world and is commonly viewed as a cleaner and more efficient energy source. Moreover, it is easy to transport, reasonably economical, requires comparatively quick construction timelines and low capital costs, and has the added advantage of bringing jobs to economically depressed regions where natural gas reserves are plentiful.

The search for energy alternatives has benefited substantially from advances in technology. Unconventional drilling is now the primary method used to extract natural gas from vast shale deposits by means of high-volume, horizontal hydraulic fracturing from long laterals using multi-well

pads. This extraction process relies on pumping millions of gallons of surface water laced with sand and toxic chemicals (slick water) under high pressure to open or create fractures in the shale formation, thus releasing the flow of gas to the surface. Along with the natural gas, massive quantities of waste fluids are also returned to the surface. Of the fracking fluid, 30% to 70% will resurface as flowback fluid, bringing with it toxic substances including heavy metals, volatile organic compounds including benzene, and naturally occurring radioactive materials.<sup>2</sup> The materials acquired by the flowback fluid can be equally as or more toxic than the hydraulic fracturing fluid injected into the wells. The disposal and storage of the flowback waste fluids is a significant public health issue. Presently, flowback waste fluids are held in open reserve pits or in non-airtight metallic containers, the contents of which must be disposed of safely because of the real possibility of contamination of air and soil, as well as waterways and watersheds. To date, most states do not have adequate regulations on drilling, particularly related to the disposal of these toxic fluids.

Concerns about the potential for contamination of water provided the impetus for the US Environmental Protection Agency to study the issue. In December 2011, the agency released a draft report of its investigation of groundwater contamination near Pavillion, Wyoming, and concluded that the groundwater was likely contaminated by the hydraulic fracturing activities.<sup>3</sup>

Despite this finding, current laws allow the oil and gas industry to inject hazardous materials unchecked near drinking-water supplies. Fracturing fluids are exempted from the Safe Drinking Water Act, which authorizes the Environmental Protection Agency to set national health-based standards for drinking water to protect against both naturally occurring and manmade contaminants that may be found in drinking water. The oil and gas industry was granted this exemption in the Energy Policy Act of 2005, which amended the Safe Drinking Water Act to exclude the “underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities.”<sup>4</sup>

The natural gas extraction process itself produces emissions of multiple health-hazardous air pollutants, including benzene, toluene, ethylbenzene, xylene, formaldehyde, hydrogen sulfide, acrylonitrile, and methylene chloride.<sup>2</sup> Air quality is further compromised by heavy truck traffic to and from the drilling site. One well site could require as many as 3399 one-way truck trips, according to the New York Department of Environmental Conservation's 2011 draft environmental impact statement on hydrofracking.<sup>5</sup>

Natural gas extracted from shale may also contribute substantially to global greenhouse gas emissions. Natural gas is composed largely of methane, a powerful greenhouse gas with a global warming potential far greater than that of carbon dioxide. An estimated 3.6% to 7.9% of the

methane from shale gas production escapes to the atmosphere in venting and leaking over the lifetime of a well.<sup>6</sup> These methane emissions are perhaps more than twice as great as those from conventional gas.<sup>7</sup> Recent studies by the National Oceanic and Atmospheric Administration have indicated that methane is leaking at rates even higher than previously anticipated.<sup>8</sup> Reconciling the benefits of natural gas and its potential harms to both the environment and public health is a key challenge facing policymakers.

At present, the natural gas industry operates in a world in which safety measures are self-regulated, laws are protective of the industry rather than of those living in close proximity to drilling sites, and environmental remediation is the reactionary norm. If precautions are not enforced, unconventional drilling for natural gas has the potential to cause serious and irreparable damage to the environment by having a negative impact on air, soil, and water quality as well as the climate.

The paucity of scientific evidence looking at the public health impact of natural gas extraction complicates the issue. It is difficult and potentially dangerous to formulate policy and regulations in a vacuum. Although there have been anecdotal reports of adverse health effects (e.g., severe headaches, sinus problems, nosebleeds) among those living in close proximity to shale gas drilling,<sup>9</sup> there is a paucity of objective, evidence-based epidemiological research. Witter et al.,<sup>10</sup> in their review of the available literature, showed that evidence of risk to human health ranges from the comparatively benign (e.g., psychological problems) to the more serious (e.g., cancer, cardiovascular disease, and asthma). Implicit in this review

is a lack of well-designed epidemiological studies to scientifically quantify the potential for human harm. That being said, in the absence of health impact assessments on human health, animal studies can often shed light on the potential harmful effects of drilling. Like the canary in the coal mine, cows, horses, poultry, and other wildlife can be used as sentinels to foreshadow impacts to human health.

Animals tend to suffer more direct exposure and have shorter life and reproductive cycles than humans. A recent qualitative study<sup>11</sup> published in a peer-reviewed journal focused on the impact of gas drilling on animal health (interviews conducted with animal owners in Colorado, Louisiana, New York, Ohio, Pennsylvania, and Texas). The researchers documented reproductive (e.g., irregular cycles, failure to breed, stillbirths), neurological (e.g., seizures, incoordination, ataxia), gastrointestinal (e.g., vomiting, diarrhea), and dermatological (e.g., hair and feather loss, rashes) problems among livestock. These findings need to be verified in a more quantitative study; the implications for animal health, as well as for the beef and dairy industries, could be considerable. Moreover, on the basis of the findings from this qualitative study, we argue that the need to study the potential for harm to human health is urgent.

The concern over the paucity of studies has highlighted the distinction between science-based advocacy and advocacy-based science.<sup>12</sup> Scientists who have expressed support of hydraulic fracturing have been accused of being in the industry's back pocket, and those who have come out against it have been accused of promoting their own

environmental agenda. The role of science in advocacy is important, but regardless of one's position, methodologically well-designed studies need to be conducted on which policy recommendations should be made. With regard to the public health implications of natural gas drilling, we should not conclude that an absence of data implies that no harm is being done. The burden of proof should not be the public's to bear.

In the absence of methodologically sound data, many states and countries have taken a precautionary stance and banned drilling. France and Bulgaria have banned hydraulic fracturing. The United Kingdom, however, is moving ahead with drilling despite strong protests against this decision.<sup>13</sup> Other countries with large natural gas deposits such as Poland, South Africa, and Canada are under pressure from the gas industry to allow drilling for natural gas. In the United States, New York State, in contrast to neighboring Pennsylvania, has an extended moratorium on drilling pending review of an environmental impact assessment conducted by the State Department of Environmental Conservation. Concerns about the content of the report, as well as fears of water contamination, prompted the governor to ask the state health commissioner to form a panel to determine whether the Department of Environmental Conservation adequately addressed potential impacts to the environment and to the public's health.

In his 2012 State of the Union Address, President Obama said that his administration would take every possible action to safely develop natural gas energy. He called on companies that drill for gas on public lands to disclose the chemicals that they use. The president's implied message is that

this industry needs to be developed without jeopardizing the health and safety of people and animals. The Centers for Disease Control and Prevention, in an official policy statement regarding the safety of hydraulic fracturing that was issued after the president's address, recommended that further study is warranted to better understand the potential public health impact.<sup>14</sup>

Natural gas has been in shale formations for millions of years; it is not going anywhere and will be around for generations to come. This form of energy could turn out to be an important source of energy, but in the absence of health impact assessments on both animals and humans, the rush to drill should be tempered. Given the potential for harm, we advocate precautionary measures and assert that the burden of proof for potentially harmful actions rests on the assurance of safety in areas of scientific uncertainty.<sup>15</sup> Society owes it to those living in areas with both active and planned drilling to study the potential for harm and to mandate policies and strengthen regulations to ensure that adverse effects to the public's health are not an unfortunate consequence of an industry's eagerness to capitalize on this new energy boom. ■

#### About the Authors

Madelon Finkel and Adam Law are with Weill Cornell Medical College, New York, NY. Adam Law is also with Cayuga Medical Center, Ithaca, NY. Jake Hays is with Physicians Scientists and Engineers for Healthy Energy, New York, NY.

Correspondence should be sent to Jake Hays, MA, Program Director of the Health-Energy Nexus, Physicians Scientists & Engineers for Healthy Energy, 452 West 57th Street, Apartment 3E, New York, NY 10019 (e-mail: [jake.hays@gmail.com](mailto:jake.hays@gmail.com)). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints" link.

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## Contributors

All authors contributed equally to the research and writing of this article.

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## Achieving Population Health in Accountable Care Organizations

| Karen Hacker, MD, MPH, and Deborah Klein Walker, EdD

Although “population health” is one of the Institute for Healthcare Improvement’s Triple Aim goals, its relationship to accountable care organizations (ACOs) remains ill-defined and lacks clarity as to how the clinical delivery system intersects with the public health system.

Although defining population health as “panel” management seems to be the default definition, we called for a broader “community health” definition that could improve relationships between clinical delivery and public health systems and health outcomes for communities.

We discussed this broader definition and offered recommendations for linking ACOs with the public health system toward improving health for patients and their communities. (*Am J Public Health*. 2013;103:1163–1167. doi:10.2105/AJPH.2013.301254)

**WITH THE PASSAGE OF THE Affordable Care Act (ACA),<sup>1</sup>** the United States has turned its attention to improving the quality of health care while simultaneously decreasing cost. As we move toward alternative and global payment arrangements, the need to understand the epidemiology of the patient population will become imperative. Keeping this population healthy will require enhancing our capacity to assess, monitor, and prioritize lifestyle risk factors that unduly impact individual patient health outcomes. This is especially true, given that only 10% of health outcomes are a result of the medical care system, whereas from 50% to 60% are because of health behaviors.<sup>2,3</sup> To change health behaviors, it will be necessary to engage in activities that reach beyond the clinical setting and incorporate community and public health systems.<sup>4</sup>

The Institute for Healthcare Improvement (IHI), a leading

not-for-profit organization dedicated to using quality improvement strategies to achieve safe and effective health care, has developed the Triple Aim initiative<sup>5</sup> as a rubric for health care transformation. The three linked goals of the Triple Aim include improving the experience of care, improving the health of populations, and reducing per capita costs of health care.<sup>6</sup> However, although two of the three aims—experience of care and cost reduction—are self-explanatory, there is little consensus about how to define population health. Words like “panel management,” “population medicine,” and “population health” are being used interchangeably. Berwick et al.<sup>6</sup> describe the care of a population of patients as the responsibility of the health care system and use broad-based community health indicators as evidence of improvement. Other recent publications have attempted to describe population health from the hospital,<sup>7–10</sup>

primary care,<sup>11</sup> and community health center perspectives.<sup>12</sup> The “clinical view” identifies the population as those “enrolled” in the care of a specific provider, provider or hospital system, insurer, or health care delivery network (i.e., panel population).<sup>7</sup> Alternatively, from the public health perspective,<sup>8</sup> population is defined by the geography of a community (i.e., community population) or the membership in a category of persons that share specific attributes (e.g., populations of elderly, minority population). In either case, the context of a community and the existing social determinants of health, ranging from poverty to housing, are known to have substantial impact on individual health outcomes. Thus, ensuring the health of a population is highly dependent on addressing these social determinants and requires collaborative relationships with community institutions outside the health care setting.<sup>13,14</sup>

Two key concepts that will greatly influence the definition and actualization of population health in the post-ACA era include the accountable care organization (ACO)<sup>15</sup> and the patient-centered medical home (PCMH).<sup>16</sup> The ACO represents an integrated strategy at the delivery system level to respond to payment reform.<sup>15</sup> These integrated systems of care are poised to manage a population of patients under a global payment model. The PCMH is focused on transforming primary care to better deliver “patient-centered” care and to address the whole patient, including their health and social needs.<sup>17,18</sup> Both models will need to identify, monitor, and manage their “population” of patients. However, their ability to extend their definition of population health to encompass the entire community will depend on resources, market share, and the strength and capacity of collaborating community and public health organizations. As integrated delivery systems are asked to do more than focus on their own patients, they will require additional resources. These may come from a realignment of existing programs (community benefits), a return on investment from effective preventive care, or collaborative relationships with existing community and public health organizations.

In this article, we discuss two major points regarding ACOs and their approach to population health. First, ACOs should be committed to serving the health of the people in the communities from which their population is drawn, and not just the population of patients enrolled in their care to achieve the population health goal. Second, to achieve this expanded definition of population health, ACOs will need to

engage in collaborative efforts with community agencies and the public health system. We describe a “community” definition of population health to be used in lieu of the “panel” definition and then outline the resources needed and strategies for collaboration. Finally, we offer recommendations to assist ACOs in realizing their population health goal.

## DEFINING POPULATION HEALTH

Population health connotes a high-level assessment of a group of people.<sup>9</sup> This epidemiological framework is often in direct opposition to the manner in which the health care system has cared for patients in a fee-for-service model: one individual at a time. Currently, population health is being seen in two distinct ways: (1) from a public health perspective, populations are defined by geography of a community (e.g., city, county, regional, state, or national levels); and (2) from the perspective of the delivery system (individual providers, groups of providers, insurers, and health delivery systems), population health connotes a “panel” of patients served by the organization.

In the post-ACA world, as payment models shift from fee-for-service to global payment, ACOs will necessarily reorient from a disease focus to a wellness focus to improve quality and contain costs. Although they will have an ethical and contractual obligation for the patients for which they care, their engagement in the larger community may be highly dependent on which members of the community population actually end up being part of a particular ACO or PCMH panel. The larger the overlap between an

ACO panel and the community population, the more the overall health of the community will contribute to the ACOs’ ability to keep their patients healthy. Similarly, the larger the overlap between community population and ACO panel, the more ACO health outcomes will drive community health indicators. Table 1 displays how an ACO might address a variety of characteristics, depending on the chosen definition of population health (none, panel of patients in the delivery system, all members of a community).

## Resources

As provider organizations are asked to embrace the broader community definition of population health, resources will be needed to support this role. These resources include access to data, funding, and collaborative relationships.

**Data.** With the emergence of the electronic medical records, ACOs should become more facile at viewing their population as a whole and identifying trends across their panel’s health (age, gender, race, chronic conditions). The data needed for this endeavor are largely collected at the visit level by registration and clinical staff. With adequate health information technology, systems can now examine issues such as risk for future disease, comorbidities, and quality metrics across a defined population. Using these data, the ACO can also determine the zip codes and communities where a majority of their patients reside and compare their health indicators to the community health indicators for the same geography.

Data on community health indicators (e.g., preventive services use, infectious disease rates, lead paint exposure, occupational health issues, cancer rates, births,

and deaths from vital statistics) are more accessible than ever before. The National Prevention Strategy<sup>19</sup> and the Healthy People 2020 goals for the nation<sup>20</sup> include health indicators for population health at the community level. Much of community health information resides with state and county or city health departments, some of which have online interactive data tools that are available to the public (MassCHIP-Massachusetts<sup>21</sup>). New tools, such as the County Health Rankings<sup>22</sup> and the Community Health Status Indicators,<sup>23</sup> are publicly available and allow users to obtain county-level health data. In some jurisdictions, provider organizations are identifying ways to share de-identified data with community health leaders to jointly identify priority prevention strategies.<sup>24</sup>

**Funding.** ACOs will also need to identify financial resources to achieve population health goals. The current fee-for-service structure does not support population health efforts, and although demonstration grants may help, they cannot sustain ongoing work. Today, nonprofit hospitals are required to provide some support for community programs through the recently revised community benefit in the ACA.<sup>25</sup> Realigning hospital community benefit programs with population health efforts can help support the expanded role.

Simultaneously, ACOs need to assess which preventive strategies will yield the best return on investment (ROI) for their patients. Evidence-based services that demonstrate ROI and improved health outcomes can help in this endeavor. Nationally, two sets of evidenced-based prevention services have been identified: clinical preventive services, such as mammography, immunizations, and

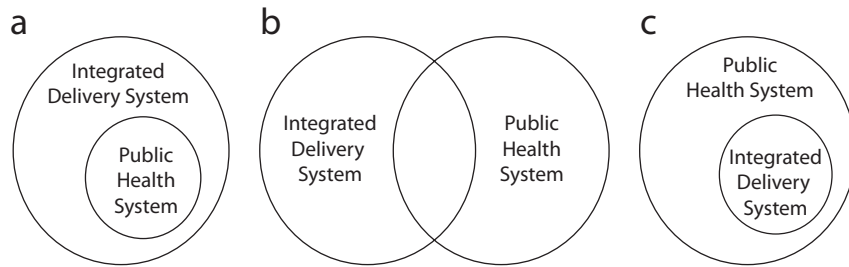
**TABLE 1—Characteristics of Various Approaches to Population Health in Accountable Care Organizations**

Approach	Focus on Individual Patients in Primary Care Settings	Panel Population = Population Health	Community <sup>a</sup> Population = Population Health
Medical home Care coordination	May or may not have medical home Focuses on coordination within primary care setting	Medical home implemented Focuses on coordination within delivery system and potentially some community resources	Medical home implemented Focuses on coordination within delivery system and all community resources
Clinical prevention services Community prevention services Health indicators monitored	Implement all clinical prevention services in primary care No implementation of community prevention services Measures for provider settings, but no alignment with delivery or community or public health systems	Implement all clinical prevention services in primary care Limited implementation of community prevention services Measures for patients in the delivery system, but no alignment with community or public health systems	Implement all clinical prevention services in primary care Full implementation of community prevention services Measures for delivery system include measures at the community population level
Needs assessment	No attention to community needs assessment—focus only on primary care settings	May have some joint needs assessment but focuses on decisions within the delivery system	Joint needs assessment related to community population outcomes and joint selection of target areas for action
Relationship to public health system	No relationship	Coordinating structure may exist with public health	Governance and coordinating structures in place with public health agencies to improve community population health
Relationship to community agencies	No relationship	Coordinating structure may exist with some agencies to promote health for patients in delivery system	Formal coordinating relationships with community agencies to share community population health goals
Use of community health workers	Use within primary care system with little link to community resources	Use to coordinate across delivery system and some community resources	Use in clinical and community settings to improve community population health for all individuals in the community.
Financing for population health initiatives	None within a fee-for-service system	Limited financing within fee-for-service system; community benefits supports limited activities with community, special grants and demonstrations but no dedicated source	Increased financing for public health entities through state or federal streams or Prevention Trusts; global fee systems for delivery systems commit 5% to community population health outcomes
Governance to promote population health	None in place in primary care setting	Limited governance structures in delivery system; might participate on community coalition or in informal partnerships	Formal governance structures in place with community and public health agency; delivery system has a designate senior lead for population health and dashboard measures on population health

<sup>a</sup>Community can also equal geographic area.

smoking cessation<sup>26</sup>; and community preventive services, such as fluoridation, lead testing, and community screening.<sup>27</sup> Many of the clinical preventive measures are considered quality measures by major accrediting systems (e.g., Healthcare Effectiveness Data and Information Set or the National Committee for Quality Assurance) and are also included in health coverage under the ACA. Assuming an ROI is realized, dollars saved can shift to support community and public health initiatives. Additionally, the federal public health trust fund provides a new revenue stream to support prevention strategies directly tied to health improvement and cost containment.<sup>28</sup> This was recently replicated in Massachusetts with the passage of Chapter 224.<sup>29</sup>

*Collaboration.* Many of these evidence-based prevention practices fall within the purview of community agencies and the public health system outside of ACO responsibility. For example, smoking bans promulgated by public health authorities have affected smoking rates and second-hand smoke exposure and have led to lower risk of hospitalization for cardiac and pulmonary conditions.<sup>30</sup> Therefore, ACOs that strive to improve population health within geography will need to develop partnerships to support prevention activities while integrating complementary efforts into clinical settings. In particular, the ACO's relationship with the local public health authority or authorities is essential. Although the public health authority is not the only organization with which an ACO will need to collaborate, it is the only agency that has legal authority and mandates to protect, promote, and assure the health for every individual in the



**FIGURE 1—Relationships between integrated delivery system and public health system.**

community.<sup>31</sup> Despite the logic of this partnership, integrating public health and the delivery system has proven difficult.<sup>32,33</sup> Today, the ACA poses an unprecedented opportunity to refocus these efforts. While ACOs are contemplating the best strategies for population health improvement, public health authorities are also recognizing their changing roles<sup>34,35</sup> and their need to effectively align with providers.<sup>36</sup> As health insurance expands, public health clinical services are likely to decrease, and core functions including surveillance, regulation, and quality assurance will be more important than ever before. States such as Massachusetts, Minnesota, Washington, and Vermont have already evolved from delivering direct services to providing “wrap around” services (e.g., outreach, care coordination) and maintaining the core public health functions. Under global payment models, ACOs will depend on public health authorities to address regulatory and policy issues that have wide-reaching health impact.<sup>37</sup>

Figure 1 presents three possible relationships between health delivery and public health systems. When a community is served by one health system and one public health authority, integration efforts may be more easily achieved. However, in

other cases, the delivery system will need to work with a number of public health authorities or the public health authority will need to work with numerous delivery systems.

### Strategies to Overcome Obstacles

To achieve alignment between provider organizations and community and public health agencies, strategies are needed to overcome multiple obstacles. For example, in highly competitive environments with multiple providers, a strategy of cooperation between clinical delivery systems and community and public health agencies is required to jointly improve population health. The Institute of Medicine report, *Improving Health in the Community*<sup>38</sup> presented a method for multiple stakeholders in a community coming together to “share accountability” for population health outcomes. Weak public health infrastructure is another obstacle, and in these cases, the delivery system may need to shore up core public health functions (assurance, assessment, policy).<sup>31</sup> In communities with strong public health systems, public health can address health from a policy and regulatory perspective while the health care system provides individual

clinical prevention and treatment.<sup>37,39</sup> ACOs may lack the appropriate skills and resources to achieve population health goals, posing another challenge. A strategy that identifies and connects an ACO to community and public health resources can enhance population health efforts. For example, many community and public health agencies have extensive experience and programs serving vulnerable populations and can assist ACOs in their outreach efforts. Overall, ACOs and public health systems can play complementary roles in improving population health goals as seen in the following examples.

1. An urban ACO serving a large city works with a local public health authority to identify geographic pockets of patients with diabetes. The ACO focuses on improved diabetes management in the clinical setting while linking to community resources for patients requesting exercise and physical activity options. Public health can lead a campaign to improve access to fresh fruits and vegetables and change policies related to menu labeling.
2. An ACO serving a number of suburban communities identifies high use of the emergency room

from alcohol-related issues in young adults as a focus for improvement. Working with the public health authority, local schools, and substance abuse agencies, the collaboration creates a safe rides program and develops policies to monitor underage liquor sales.

3. An ACO serving a large rural population has trouble providing enough access for immunizations to elders. Community-wide access to immunizations is provided by working with the public health authority and local pharmacies. Communication strategies that link pharmacies and public health to the ACO are developed, along with an immunization registry for public health population-level surveillance.

### Recommendations

It will take time for newly emerging ACOs to develop meaningful collaborative relationships with public health entities. We recommend the following steps for ACOs:

- Determine in which geographic communities patients reside and what the overlap is between the ACO panel and the community population.
- Compare the health of the population served by the ACO with that of the community.
- Decide what level of overlap in any geographic area merits collaboration. The more market share an ACO has in the area, the more investment in collaboration might be made, and the more impact that investment will have on health outcomes.
- Engage in collaboration with public health and key community agencies, including conducting a joint needs assessment.
- Collaboratively select health outcomes for focus.

- Set up a formal agreement with the public health authorities to share data and monitor progress toward goals in clinical and community settings.
- Identify population health indicators to be included on the ACO dashboard.
- Use a portion of global payment fee to support community public health activities.

## CONCLUSIONS

To fully meet the goals of the Triple Aim, including improving the health of a population, ACOs must define “population health.” We recommend that they embrace the broad community definition of population health and take steps to work collaboratively with community and public health agencies. Future financing and value-based purchasing should reward collaborations that result in population health improvements at the community level. As health care moves toward alternative and global payment arrangements, the need to understand the epidemiology of the patient population is imperative. Keeping the population healthy will require enhancing capacity to assess and to monitor and prioritize lifestyle risk factors and social determinants of health that unduly affect health outcomes. ■

## About the Authors

Karen Hacker is with the Institute for Community Health, Cambridge, MA; Cambridge Health Alliance, Cambridge; and Harvard Medical School, Boston, MA. Deborah Klein Walker is with Abt Associates, Cambridge.

Correspondence should be sent to Karen Hacker, MD MPH, Institute for Community Health, 163 Gore Street, Cambridge, MA 02141 (e-mail: Khacker@challiance.org). Reprints can be ordered at <http://www.ajph.org> by clicking the “Reprints” link.

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## Contributors

K. Hacker led the writing process and was involved in all aspects of the article from conceptualization to writing and editing. D. K. Walker was involved in all aspects of the article from conceptualization to writing and editing.

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