Health Professionals' Roles in Animal Agriculture, Climate Change, and Human Health

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Abstract: What we eat is rapidly becoming an issue of global concern. With food shortages, the rise in chronic disease, and global warming, the impact of our dietary choices seems more relevant today than ever. Globally, a transition is taking place toward greater consumption of foods of animal origin, in lieu of plant-based diets. With this transition comes intensification of animal agriculture that in turn is associated with the emergence of zoonotic infectious diseases, environmental degradation, and the epidemics of chronic disease and obesity. Health professionals should be aware of these trends and consider them as they promote healthier and more environmentally-sustainable diets.
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Introduction

Over 9 billion land animals are slaughtered for food annually in the U.S.,[1,2] approximately 1 million per hour. The U.S. is home to only about 5% of the global population but produces nearly 15%of the world's meat supply,[3] and the average American consumes 110 pounds of red meat and 74 pounds of poultry per year.[4] Global demand for meat has increased substantially in recent decades. Between 1975 and 1990, per capita meat consumption increased an estimated 1.4% per year.[5] World meat production is expected to double by 2020,[6] in part due to national and international regulations that allow animal agribusiness to externalize costs and to aggressive corporate marketing campaigns.[7–10] For example, the U.S. Federal Government subsidy system and food assistance programs heavily promote the production and distribution of meat and dairy products,[11–17] over plant-based foods.

Recently an investigation of a California dairy cow slaughter plant by the Humane Society of the U.S. (HSUS) documented the abuse and slaughter of cows too sick or injured to walk, leading to the recall of 143 million pounds of beef in February 2008, the largest in U.S. history.[18] The investigation raised considerable concern about the safety of the meat supply, including inadequate regulatory oversight by the U.S. Department of Agriculture (USDA), partly due to the high throughput of animals slaughtered for food.

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Climate Change and Environmental Degradation

As a result of the steady rise in animal-product promotion and demand, traditional farming practices in the latter half of the last century were replaced in the U.S. largely by immense, intensive animal operations; in the developing world, they are being replaced at a rate of more than 4% a year.[6] The industrialization of animal agriculture is an important contributor to global environmental degradation and climate change.[19]

Animal agriculture accounts for 37%, 65%, and 64% of anthropogenic methane, nitrous oxide, and ammonia emissions, respectively, from ruminant fermentation, livestock waste, fertilizer use and other factors.[20] Methane and nitrous oxide have 23 and 296 times, respectively, the global warming potential of CO_2.[20] In 2006, the UN Food and Agriculture Organization (FAO) declared that animal agriculture contributes 18% of annual anthropogenic greenhouse gas emissions, measured in CO_2-equivalents, more than that of the worldwide transportation sector.[20] The public health effects of climate change are already being felt around the world and the UN Intergovernmental Panel on Climate Change projects that they will worsen considerably.[21–26]

Animal agriculture constitutes 30% of the total land surface, the largest use of land by humans.[20] Thirty-three percent of total arable land is used to produce feedcrops,[20] with energy input that far outweighs the output. Approximately 70% of previously forested land in the Latin American Amazon is used as grazing pastures, with the remainder being used largely for feedcrop production.[20] Annually in the U.S., 45 million

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tons of plant protein are used to produce 7.5 million tons of animal protein.[27] Most of this plant protein could instead be consumed directly by humans and could, in part, alleviate some growing concerns about a global food shortage.

Animal agriculture consumes 70% of the fresh water and contributes extensively to land, air, and water pollution.[20] Pesticides and fertilizers, including manure, may contaminate waterways. In the U.S., animal agriculture is responsible for 37% of pesticide use and 32% and 33%, respectively, of the nitrogen and phosphorus loads found in fresh water sources.[20] Surveys in North Carolina and Iowa found substantial increases in asthma symptoms in children residing near industrial pig operations and decreased quality of life measures in surrounding communities.[28–30] The combined environmental impact of animal agriculture has led the FAO to declare in 2006 that "the livestock sector emerges as one of the top two or three most significant contributors to the most serious environmental problems, at every scale from local to global."[20]

Emerging and Re-Emerging Infectious Diseases

In 2004, the WHO, the World Organization for Animal Health, and the FAO reported that the increasing global demand for animal protein in the human diet, associated with the expansion and intensification of animal agriculture, long-distance live-animal transport and other factors, were in part responsible for the emergence of zoonotic diseases.[31] Industrial agriculture practices have been blamed for the emergence of bovine spongiform encephalopathy, multidrug-resistant foodborne bacteria, and highly pathogenic strains of avian influenza.[32]

An estimated 76 million Americans are stricken with a foodborne illness every year.[33] Worldwide, foodborne microbial disease kills an estimated 20 million people annually, with animal products topping the list of causes.[34] The global rise in the incidence of foodborne diseases is attributed to greater consumption of animal products, the intensification of farm operations, and rising temperatures.[35,36]

Annually, more than a ton of farm-animal manure is produced per capita in the U. S.[37] Farm-animal manure is the source of more than 100 zoonotic pathogens,[38] which may contaminate food and water supplies. Manure-contaminated irrigation water, for example, was likely the source of the largest recorded outbreak of *Escherichia coli* O157:H7, affecting more than 7000 schoolchildren in Japan.[39]

Under conditions ripe for zoonotic pathogen emergence and transmission, such as the high-density confinement of farm animals under unhygienic conditions,[6] farm animal growth rates may be impaired in light of the infectious load to which they are exposed. This may be mitigated by a constant influx of growth-promoting antibiotics.[40] Half of all U.S. antimicrobials are fed to farm animals.[41,42] The mass use of clinically significant antibiotics in animal agriculture selects for drug-resistant pathogens and mobile genetic elements carrying resistance determinants that may be responsible for the majority of the increases in antibiotic-resistant human isolates reported.[43,44]

Chronic Diseases

Historically, chronic diseases, including obesity, have plagued the developed world, whereas developing countries have been more affected by communicable diseases. However, obesity and chronic diseases are increasingly a concern in developing nations.[10] An estimated 65% of U.S. adults are overweight or obese,[45] and globally, more than 1 billion adults are overweight.[46] Especially concerning is the increasing global prevalence of childhood obesity.[46] Obesity increases the risk for diabetes, arthritis, asthma, hypertension, and hypercholesterolemia.[47]Worldwide, cardiovascular disease, cancer, and diabetes are three of the four main causes of death.[48]

The worldwide transition from a predominantly plant-based diet to a diet high in meat has been identified as a noteworthy contributor to the rise in chronic disease.[10,49] Animal products are the main source of saturated fats that promote cardiovascular disease[49] and the sole source of cholesterol intake. Comparative studies reveal that those who follow plant-based diets generally have lower weights than those who do not,[50,51] even across ethnic groups.[50] While not conclusive, evidence suggests that the increase in worldwide obesity and diabetes may in part be associated with increased animal-product consumption, in addition to decreased exercise and other factors.[10]

The classic study by Armstrong and Doll[52] revealed significant association between meat consumption and colon cancer incidence in over 25 countries. Studies in Japan revealed a rising incidence in colorectal cancer with greater adoption of Western dietary habits and consumption of meat, milk, eggs, and fats and oils.[53,54] Other studies revealed similar associations between rising meat consumption in Asian countries and colon cancer incidence and/or mortality.[55,56] Although confounding factors must also be considered, these and other studies collectively provide strong evidence of the causal link between meat and colorectal cancer.[57–59] In 2007, the World Cancer Research Fund and the American Institute for Cancer Research panel report concluded that there was convincing evidence to limit red meat intake, completely avoid processed meat, and follow a plant-based diet to reduce the overall risk for cancer.[59]

Consumption of various animal products is also associated with increased risk for other cancers. Endometrial cancer risk is associated with increased intake of

total energy, fat, and protein from animal sources.[60] A meta-analysis found an increased endometrial cancer risk with increased meat, particularly red meat, consumption.[61] Dairy-product consumption has been associated with prostate cancer[62–64]; the European Prospective Investigation into Cancer and Nutrition study of 142,251 men found that high intake of dairy calcium and protein increased the risk of prostate cancer.[65] Calcium from nondairy foods was not associated with increased cancer risk. In recent studies, breast cancer risk has been associated with higher intake of processed meat, total meat, and/or red meat,[66–69] and with higher intakes of total and saturated fats.[69]

Healthcare costs attributable to meat consumption are substantial, estimated in the U.S. at between $29 billion and $61 billion per year, in 1992 dollars.[70] In contrast, many studies suggest that those who consume plant-based diets have decreased risk, mortality, and/or progression of cardiovascular disease,[71–73] diabetes,[74] certain cancers,[75–77] and obesity.[78,79] Diets high in legumes, whole grains, fruits, and vegetables appear to be protective against these chronic diseases.[80–82]

What Healthcare Providers Can Do

Physicians and other healthcare providers can play a critical role in promoting healthier food options and reversing the trend toward greater livestock production. Healthcare providers can help accomplish this in three main ways: as advocates, as providers, and as role models.

As evidence-based advocates, healthcare providers can provide medical input into federal policies that affect nutrition and health. The American Public Health Association (APHA), the American Medical Association, and the President's Cancer Panel of the National Cancer Institute have highlighted the importance to the obesity epidemic of federal food policy, as well as the importance of physician and public health leadership in federal nutrition policy reform.[8,83,84] Currently, U.S. agricultural policy disparately promotes animal products, in contradiction with the U.S. Dietary Guideline's emphasis on plant-based foods. A calculated 73% of over $60 billion in federal commodities payments for domestic food consumption between 1995 and 2005 supported the production of meat, eggs, and dairy, either directly or indirectly through feedcrop supports.[11–17] Less than 0.5% of federal subsidies is allocated to fruits and vegetables.

After the California slaughter plant investigation and meat recall of February 2008, public food safety concerns were especially heightened, since a large fraction of the meat that was recalled had already been distributed to school lunch programs.[18] Surplus agricultural products, largely animal products high in fat and cholesterol, are distributed through school lunch and other food assistance programs. An estimated 100,000 schools receive these commodities, possibly contributing to the fact that approximately 80% of elementary and secondary schools violate limits on total and saturated fat content.[85,86]

International studies have demonstrated that changes in agricultural subsidy policy can mitigate rising chronic disease rates. In Poland, the withdrawal of large animal-product subsidies led to decreased saturated fat intake and increased fruit and vegetable intake, followed by a subsequent decrease in ischemic heart disease mortality.[87] After long periods of increases, mortality from heart disease and stroke decreased by 25% and 10%, respectively, between 1991 and 1994 among those aged 45–64. Between 1986 to 1990 and 1994, there was a 23% decrease in animal fat availability, 48% increase in vegetable fat availability, and an almost 50% increase in importation of certain fruits. In Eastern European countries in 2002, substantial decline in cardiovascular mortality was associated with increased consumption of plant oils rich in alpha-linolenic acid.[88]

In addition to involvement in food policy, healthcare providers should have a coordinated voice in environmental policy. The APHA has a policy calling for a moratorium on factory farms.[89]Other physician and healthcare groups could follow suit. Recently, the U.S. Environmental Protection Agency proposed that livestock farms be exempt from reporting emissions of ammonia, hydrogen sulfide and other pollutants.[90] Input from healthcare providers is needed to prevent such regressions in environmental protections that may otherwise pose adverse public health consequences.

As healthcare providers, all physicians, nurses, and physicians assistants can incorporate nutrition counseling into routine care. When physicians advise their patients about nutrition, incidence of chronic diseases may decline.[91–94] Despite the potential of counseling to improve dietary practices, many primary care physicians never include nutrition or dietary counseling in their patient visits, or include only perfunctory counseling.[95–98] Medical societies can facilitate the incorporation of routine nutrition counseling by advocating for greater physician reimbursement for such care.

Finally, as individuals, healthcare providers can serve as examples and leaders when they alter their own lifestyle behaviors. One of the least exploited and most significant and consistent counseling predictors is the positive effect of a physician's healthy personal practices on his or her clinical prevention-related practices.[99–103] Specifically, physicians' healthy dietary practices positively affect their clinical nutrition counseling attitudes[99] and practices[91,99,102,103]; and U.S. medical students find nutrition counseling more relevant if they consume more fruits and vegetables.[104]

Health professionals can set an example by consuming fewer animal products at home and at work, and by demanding healthier plant-based options in hospital

cafeterias, doctors' and nurses' lounges, and at professional conferences and meetings. The APHA and the Johns Hopkins Center for a Livable Future offer prime examples of how meatless meals can be promoted.[105,106] Through the work of Health Care Without Harm coalition, over 122 hospitals in the U.S. have signed a pledge to offer healthier food items to visitors, patients, and staff.[107] Health professionals can also stress nutrition education in Continuing Medical Education courses.

Given the animal agriculture sector's considerable role in environmental degradation, zoonotic disease emergence, and chronic disease promotion, reducing livestock production and promoting healthy plant-based diets should be a global health priority. Healthcare providers can, individually and collectively, play a significant role in ensuring healthy and environmentally sustainable nutrition policies and practices.

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