Innovative regulatory approaches to reduce sodium consumption: could a cap-and-trade system work?

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Many regulatory and professional organizations are calling for strict new regulations to reduce sodium consumption on a population basis. New regulations on sodium may have significant public health and economic impacts. This article explores five regulatory options to reduce sodium consumption: 1) maintaining the status quo, 2) improving risk communication and information, 3) revoking generally regarded as safe status of sodium and regulating its use in food products, 4) establishing a sodium tax, and 5) establishing a market-based, cap-and-trade system for sodium that builds on similar approaches in environmental regulatory policy. Cap-and-trade may be a promising regulatory option for sodium and other ingredients.

INTRODUCTION

Sodium chloride, more commonly known as salt or sodium, is a widely used food ingredient with generally recognized as safe (GRAS) status in the United States in its most common usages. Sodium is an essential nutrient for humans, and salt is used as a flavor enhancer and a preservative in many foods. Salt is also a defining characteristic of many foods (pretzels, pickled vegetables); it performs critical functions in the production of many food products (yeast breads), and plays a key role in food safety (ham, jerky).

Epidemiological studies suggest that consumption of sodium is associated with an increased risk of hypertension, which is a risk factor for cardiovascular disease.\(^1\) The evidence that reducing sodium consumption in the general population will reduce cardiovascular events, such as heart attack and stroke, is more mixed.\(^2,3\)

Many regulatory and public health organizations in the United States and internationally are recommending major reductions – on the order of 50% – in the amount of sodium in the food supply.\(^4,5\) The prospect of new regulations on sodium use and consumption levels raises many important public policy issues. Everyone who eats food will be affected by the regulatory choices that are made, and nutrition regulatory policy can have very large public health and economic consequences. Some of the issues that should be considered include the following: 1) impacts on individual choice and personal preference; 2) effects on public health; 3) economic impacts on individuals, food producers, and the healthcare system; and 4) regulatory effectiveness and efficiency.

Reviewed here are five regulatory options, and the strengths and weaknesses of each are discussed. In addition to reporting on the traditional communication and regulatory approaches, this paper proposes adapting market-based, cap-and-trade approaches that have not previously been applied to regulatory issues in nutrition. The intent is to introduce new concepts to the nutrition regulatory policy field and initiate a discussion about innovative ways that could reduce sodium consumption in an effective and efficient manner.

OPTION 1: MAINTAIN THE STATUS QUO

One option available to regulators and policymakers is to do nothing and maintain the status quo. Regulators and policymakers may decide that the science base is not strong enough to support additional measures to reduce sodium consumption, or that the economic, social, or political costs of additional regulation would be too high. One common argument for maintaining the status quo is that strict regulation of sodium is not appropriate because almost all of the benefits and risks of sodium consum-
tion fall on the individual. An individual who consumes an excessive amount of sodium may increase her own health risks, but her consumption of sodium does not affect the health risks of her friends or coworkers. In the language of political scientists, sodium consumption has more of the characteristics of a private good than of a public good.

There are counter-arguments to this view. For example, government interventions to reduce sodium consumption may be justified because of the additional healthcare costs that may be imposed on society, or there may be a need to protect children from excessive sodium consumption because they are not mature enough to make an informed choice about the risks and benefits of sodium consumption.

The point of this discussion is that the status quo is a viable option that regulators and policymakers must evaluate alongside the other available options.

**OPTION 2: RISK COMMUNICATION AND INFORMATION**

The National Academy of Sciences has argued that risk communication is the preferred approach to manage risk in a democracy. The preferred option for managing a risk that is individual in nature is to provide appropriate risk communication and information to allow individuals to make informed choices that manage their personal risk while balancing all of their other personal needs and preferences. Individuals will not always choose the least risky option, even if they have perfect information. Risk communication is not always sufficient, particularly when individuals do not have control over their exposure to a risk, but it should be carefully explored before adopting more restrictive or burdensome regulations.

Sodium consumption appears to be a risk that is well-suited to a risk communication and information approach. Individuals have the capability to assess their own personal risks from sodium consumption, but unfortunately far too many do not. Individuals have significant, though not perfect, control over their sodium consumption. Individuals can avoid high-sodium foods, choose reduced-sodium options for many foods, and limit their discretionary use of sodium at the table or in meals prepared at home. However, it is important to note that the majority of sodium in the food supply comes from processed foods. Personal control over sodium consumption could be significantly increased with even more information and reduced-sodium food options. Finally, there is currently good, but incomplete, information available on the sodium content of foods. Sodium content is part of the required Nutrition Facts Panel, but the sodium content of foods in restaurants is not always easily available. The amount of information on the sodium content of foods could be increased and could be better communicated to consumers.

The fact that most individuals can work with healthcare providers to assess their personal risks from sodium consumption, control their exposure to sodium, and get good information on sodium content suggests that a risk communication and information strategy could be an effective approach. The fact that sodium consumption is still well above recommended levels suggests that the current implementation of a risk communication and information strategy needs to be improved.

Because risk communication is a promising approach to reducing sodium consumption, a multipronged effort to improve consumer understanding of the risks of sodium consumption and to allow consumers to make effective personal choices about their consumption could be launched. The program should include the following:

1. Education and risk communication programs to improve individuals’ understanding of their current level of sodium consumption and the risks of excessive sodium consumption, especially among high-risk subpopulations;
2. Research on the real and perceived barriers that individuals face in understanding the risk that sodium consumption may pose, the amount of sodium consumed, and the options for reducing sodium consumption;
3. Programs to increase the control that individuals have over their sodium consumption by providing more food options that are lower in sodium and by increasing the palatability of those options. More versions of packaged foods sold through convenience and grocery stores and more menu items provided in fast-food and full-service restaurants that are lower in sodium would expand consumer control over sodium consumption. Providing sodium concentration information on more food products, including at least a ballpark estimation of the sodium in restaurant foods, or prominently displaying options that are lower in sodium, would facilitate informed choices. Food producers and restaurants will need to carefully choose their language to communicate these options to consumers. The term “low-sodium” is a nutrient content claim that has a specific regulatory definition;
4. Communication efforts to increase the amount of information that individuals have about their current sodium consumption.

Such an effort would preserve individual choice and help meet important public health objectives. It would require new research on consumer understanding and risk communication about sodium consumption and health, an extensive outreach and communication effort, research
and product development by the food industry, the development of tools to help individuals monitor their sodium consumption, and ongoing evaluation of the effectiveness of each component of the risk communication and information strategy.

If risk communication and information regarding sodium consumption and health is judged to still be inadequate after the effort described above, other regulatory approaches may be warranted.

**OPTION 3: REVOKING GRAS STATUS AND ESTABLISHING SODIUM CONCENTRATION LIMITS**

The US Food and Drug Administration (FDA) has received a citizen’s petition calling for revocation of the GRAS status of sodium, reclassification of sodium from a food ingredient to a food additive, and greater regulatory controls on the use of sodium in food products.\(^8\)

These traditional approaches establish maximum safe limits for food additives that may be associated with a health risk. The limits are often developed by applying results from toxicological models to estimates of long-term human exposure to the food additive.

There is a long history of using this approach for food additives, and it is appropriate and effective for many food additives. If applied to sodium consumption, food manufacturers would be required to meet the regulations, but may not necessarily have an incentive to meet the public health goal. For example, there would be no incentive to reduce sodium concentration levels below the mandated limit even if it was feasible for certain products.

Furthermore, mandated limits on sodium concentration in certain categories of food products may not maximize economic efficiency or consumer preferences. It is easier and cheaper to reduce sodium in some food products than in others, and consumers have strong taste preferences that can be affected by changes in sodium levels. Mandated limits would restrict the ability of companies to find cost-effective approaches to reduce sodium and to provide products that consumers demand.

**OPTION 4: TAX SODIUM**

One straightforward way to discourage sodium consumption is to tax sodium. Similar taxes have already been proposed for other foods.\(^9\)^\(^{10}\) There is a large body of literature debating the merits of selective taxes on foods that is beyond the scope of this article.\(^11\)^\(^{15}\) However, there are at least two potential problems with the sodium taxation approach that should be noted.

First, a tax on a common food ingredient is likely to be regressive. Individuals with low incomes generally spend a larger percentage of their income on food than do individuals with higher incomes. A 2004 study of the distributional impact of a hypothetical fat tax in the United Kingdom found that it would be regressive. Based on the study’s assumptions, the poorest 2% would pay 0.7% of their income for the fat tax while the richest 2% would pay only 0.1% of their income.\(^16\) A tax on sodium would be very likely to have a disproportionate impact on lower income individuals and households.

Second, a very high tax on sodium may be required in order for sodium consumption levels to be impacted significantly. Taste is a very important factor in food purchase decisions, and individuals may be willing to pay a premium price to continue consuming products with higher sodium levels. The problem could be compounded if food producers passed along the costs of the tax without changing the sodium levels in their food products. Unless the sodium tax was high enough to induce consumers to switch to lower sodium products, the tax could potentially raise food costs without causing a meaningful change in sodium consumption.

This is an empirical question that deserves careful research, but there is some reason to believe that large taxes would be required to make significant changes in consumers’ food purchase decisions. For example, a recent analysis found that “sensitivity of individuals to relative food prices is too small for fat taxes to have much of an effect [on obesity], at least in reasonable ranges of tax rates.”\(^17\) Another article found that carefully targeted food taxes of 17.5% could reduce cardiovascular deaths by up to 1.7% in the United Kingdom. However, the authors noted that food consumption is relatively insensitive to price changes, and warned of possible unintended consequences because food consumption patterns are highly interdependent.\(^12\) The case may be even stronger for sodium since salt is an inexpensive good that accounts for only a tiny share of the consumer budget. If the required taxes are too high, they may not be politically sustainable.

**OPTION 5: A MARKET-BASED, CAP-AND-TRADE SYSTEM TO REDUCE SODIUM CONSUMPTION**

Option 3 – revoking GRAS status and establishing sodium concentration limits – is similar in philosophy to the approach in environmental regulation of requiring mandatory reductions in emissions from each emissions source. In the 1980s a profound change occurred in the regulation of air pollutants, specifically sulfur dioxide (SO\(_2\)). The Clean Air Act Amendments of 1990 established a system of market-based incentives and emissions trading. This system established an overall cap on emissions but allowed individual companies to pursue the most economically efficient means of meeting the overall cap. Companies that exceeded their emission reduction targets were allowed to sell their “excess” reductions to
companies that fell short of their emission reduction targets. The program is widely regarded as an innovative and successful approach to meeting a societal goal using a flexible regulatory system that takes advantage of the greatest strengths of the capitalist system.

Several evaluations of the cap-and-trade systems used in environmental regulatory policy have found that they have achieved significant improvements in air quality at lower costs than conventional programs.18,19

Food producers face many challenges as they attempt to reduce the use of sodium in their products. In many food product categories, consumers prefer higher sodium varieties. An individual company that reduces sodium levels may face reduced sales and be at a competitive disadvantage because the taste of their products may not be acceptable to consumers. Furthermore, any coordinated effort by companies to reduce sodium levels could be viewed as a violation of anti-trust laws, even if it was carried out in an attempt to improve public health. Some foods require the addition of sodium to preserve key characteristics of the final product. Other foods require high concentrations of sodium to maintain acceptable levels of food safety. Because of these challenges, it is easier and cheaper to reduce sodium levels in some products than in others.

Reducing sodium consumption has many of the characteristics of a problem that can be addressed through a cap-and-trade program. For example, the EPA recommends this type of approach when the following conditions are in place: “the environmental and/or public health concern occurs over a relatively large area; a significant number of sources are responsible for the problem; the cost of controls varies from source to source; and emissions can be consistently and accurately measured.”20 For sodium consumption, there are hundreds of thousands of sources, the costs of reducing sodium levels vary widely across products, and sodium use can be consistently and accurately measured.

A cap-and-trade program on total sodium levels in the food system could effectively solve many of these problems. Regulators would establish the overall sodium reduction targets for the food supply and distribute or sell sodium “credits” to food manufacturers and restaurants. Companies that found ways to exceed the targeted reductions could sell their extra sodium credits to firms that found it too difficult or expensive to meet their targets. Reducing sodium would be one more competitive feature of the marketplace – one with a real and direct impact on the bottom line – and companies would have the flexibility to find the most efficient ways to reduce the sodium in their product lines while still competing to make popular products.

Many details of a cap-and-trade system still need to be worked out. Some of the issues that need to be addressed include the following:

1. Sodium distribution and allocation rights. The system should allow new entrants to enter the market without undue barriers. Regularly scheduled auctions of sodium use permits would be one way to allocate sodium rights.

2. Program funding and incentive development. Reducing sodium in the food supply will likely be associated with significant costs, and the question of who should bear these costs should be debated. Arguments can be made that the government should provide incentives and subsidies to ease the transition to reduced use of sodium. Food companies have been producing legal products that meet all regulatory requirements, and they will incur significant costs to achieve what has been identified as an important public health goal and to reduce healthcare spending. Other industries receive significant incentives to achieve societal goals, so a case can be made that some government funding would be warranted. A case can also be made that food companies should absorb the costs of reducing sodium consumption. Studies have associated the current level of sodium consumption with a large number of “excess deaths”, and sodium reduction could arguably be the equivalent of mandated safety features on cars and other products. Ultimately, these are political decisions.

3. Effective and enforceable sodium rights trading market. The implementation of the sodium rights trading market and its subsequent enforcement must ensure that sodium reductions are appropriately distributed among high-risk sub-populations and that the trading system does not exacerbate health disparities. New legislation would be required to establish the statutory authority that the FDA would need in order to implement a cap-and-trade approach to reducing sodium consumption.

4. Post-implementation surveillance program. The sodium consumption of the population would need to be monitored using data from dietary surveys to ensure that all segments of the population were consuming less sodium. It is possible that a cap-and-trade approach to sodium reduction may not benefit all consumers equally. The problem is analogous to the concern over areas of high mercury concentration that may result from a cap-and-trade approach to mercury emissions reductions. Post-implementation surveillance would be critically important to ensure that the program did not exacerbate any health disparities.

Economists have significant experience with these issues as a result of the emissions trading markets developed in the United States and as part of the Kyoto Global
Warming Treaty. Food regulatory agencies could usefully build on these experiences to build an effective cap-and-trade system for sodium.

**EXAMPLE**

The potential savings from a sodium cap-and-trade system can be seen in a hypothetical example. Sodium consumption could be reduced by 33% using either across-the-board reductions or a cap-and-trade system. A cap-and-trade system could achieve the same reduction in sodium consumption at a lower cost than across-the-board reductions.

Consider two producers, A and B, each of which uses 150 units of sodium per year in food products. The regulatory mandate is to reduce the total national sodium use from 300 units/year to 200 units/year. Therefore, this approach requires that each producer reduce its sodium use by 33% (50 units/year). However, there is a major difference in the cost – broadly measured to include research, reformulations, alternative ingredients, and lost sales – that each producer will incur in its effort to reduce sodium in its foods. Producer A will have a cost of $30/unit to reduce its sodium use while producer B will have a cost of only $10/unit. In this across-the-board reduction scenario, the total cost of reducing total sodium use by 33% will be $2,000, with producer A and producer B contributing $1500 and $500, respectively, towards the total reduction amount.

Alternatively, the regulatory mandate could require an overall reduction of 100 units of sodium (33%), but allow the trading of sodium allocations among the producers. In this case, producer B may decide to reduce sodium use by more than the required 50 units because of their lower cost/unit for sodium reduction and then sell the extra credits to producer A. In a real situation, the price of the sodium credits would be determined by the market, but for this example we assume a cost of $15/unit, which is higher than the $10/unit of sodium reduction faced by producer B, but lower than the $30/unit of producer A. Producer B reduces sodium use by 100 units and sells the resulting 50 sodium credits to producer A. Producer B generates $750 in revenue from the sale of the sodium credits (50 units × $15/unit). Producer A does not reduce sodium use at all, but does pay $750 to producer B for their additional sodium reductions. Producer A would pay a net $750 to purchase sodium credits, and producer B would pay a net $250 ($1,000 for the cost of sodium reduction minus $750 of revenue from selling credits). In this hypothetical scenario, sodium use could be reduced by 100 units (33%) for only $1,000 – half the cost of the across-the-board approach.

**LIMITATIONS OF A CAP-AND-TRADE APPROACH FOR SODIUM**

There are at least two additional limitations to the use of a cap-and-trade approach to reduce sodium consumption. First, cap-and-trade approaches were developed for situations in which the harm is experienced collectively and the benefits of reducing the risk cannot be allocated to some individuals and denied to others. For example, a cap-and-trade system for greenhouse gases is intended to reduce the global risk of climate change. In contrast, the risk of hypertension and cardiovascular disease is an individual risk that can be monitored and addressed at the individual level. A cap-and-trade approach for sodium consumption may not be as efficient as more individually-targeted approaches.

Second, there may be more direct methods to limit the amount of sodium available in the food supply. For example, it would be possible for the government to become the sole supplier of sodium. The government could become the sole purchaser of sodium from producers and release only the legislated amount of sodium onto the market. Sodium users and retailers would bid up the price to the equilibrium level.

**CONCLUSION**

The use of sodium in the food supply is receiving significant attention in the United States and around the world, and policy entrepreneurs and regulators are considering possible regulatory options. If further reductions in sodium consumption are deemed necessary, it is important to achieve the reductions in a way that is effective, economically efficient, and equitable for consumers.

This manuscript has examined five options for regulating sodium consumption, including the option of maintaining the status quo. It is important to note that some of these options can be blended. Risk communication is particularly attractive in this case, and improved risk communication would complement any of the other options discussed. Improved information and communication about the risks of excessive sodium consumption is also likely to be the most realistic of the options discussed. However, risk communication efforts to date have not reduced sodium consumption to the recommended levels, so improved risk communication programs and other approaches may be necessary. It may also be possible to combine cap-and-trade and some regulatory restrictions on the maximum concentration of sodium in a food product. The concentration limits could be used to address any “hot spots” that might result from dietary patterns in certain subpopulations while the overall cap-and-trade may allow the concentration limits to be more liberal than they would otherwise need to be.
Cap-and-trade systems have proven to be a highly effective regulatory approach for environmental pollutants. The issue of reducing sodium consumption has much in common with problems that have been successfully addressed using cap-and-trade approaches. Many other food ingredients or additives may also be candidates for a cap-and-trade approach. Using an innovative, market-based system for problems like sodium reduction may allow regulatory agencies to pursue public health goals with maximum economic efficiency.

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**REFERENCES**
