Maricopa County Sodium and Nutrition Standards Procurement Policy Assessment

Phase 3 Report Summary: Health Impact Analysis of Policy Solutions

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June 13, 2012

Funding provided by

Maricopa County Department of Public Health

Department of Public Health

Executive Summary

With funding provided by the Arizona Department of Health Services (ADHS) and the Centers for Disease Control and Prevention (CDC) to identify effective methods for reducing health impacts related to sodium consumption, the Maricopa County Department of Public Health (MCDPH) initiated the Sodium and Nutrition Standards Procurement Policy Assessment study. The purpose of the study is to evaluate food procurement policies and nutrition and sodium standards among Maricopa County departments. This report covers the third and final phase of the study and focuses on the health impact analysis of policy strategies addressing nutrition standards and food procurement. Specifically, the findings of this report cover the results of estimations and simulations modeling the reduction of identified outcome indicators (i.e., blood pressure and individuals affected by hypertension) based on proposed implementation of policies intended to modify sodium consumption through access to more affordable, healthy food options. Highlights from this report include:

Health Impact Analysis (HIA) Methodology

- Causal loop models were created to better understand the relationships among policy approaches, mediating factors that help determine impact, and health impact and cost benefit.
- The HIA utilized data collected from the assessment interviews and surveys conducted during the first two phases of the study, as well as secondary data sources. Data from the assessments included information specific to the scope of food service and consequent economic costs.
- Model community and County employee populations were simulated to project the health and economic benefit of reducing sodium consumption, by venue and countywide.

Sodium Content Varies by Venue

- An extensive review of sample meal and snack options was conducted and it was found that sodium content in meals and snacks served through County venues range from 221mg to 1193mg.
- County vending machine operations tended to have lower sodium content per serving than cafeterias and food courts due to the fact that they stock more lower-sodium, higher sugar snacks and beverages.

Reductions in Sodium Consumption are Associated with Improved Health

- Findings demonstrate that as potential sodium consumption gradually decreases, so too does systolic blood pressure. Reduction rates are more striking in those who already meet criteria for hypertension, suggesting significant benefits for sodium-reduction strategies among those at greatest risk.
- Across venues, County employees and community consumers could experience between a 1% and 2.5% decrease in the frequency of hypertension.
- Projected at a population-level, between 5% and 10% reductions in hypertension cases are probable from universal, countywide sodium reduction.

Health Improvements Have an Impact on Healthcare and Workforce Costs

- For the County jail population, reductions in hypertension cases ranging from 1% to 10% correspond with estimated healthcare savings between $16,302 and $163,024 annually.

- For cafeterias, food courts, and vending operations, reductions in cases of hypertension corresponding with reduced sodium consumption in these venues are estimated to result in annual healthcare savings upwards of $120,000 and savings in lost worker productivity at approximately $6,000.

- Simulated population-level effects for countywide sodium consumption reductions correspond with even more significant savings in healthcare costs (between $93 million and $187 million).

What do the Findings Mean?

- Reducing sodium consumption has a demonstrable impact on health and costs.

- Greater reductions correspond with greater health impact and savings, suggesting the promise of strategies that maximize access to healthy low-sodium choices and that have large scope of effect.

- The Maricopa County Department of Public Health would benefit future sodium reduction initiatives by championing internal efforts to set nutritional standards on food procured.

- These results can be applied to pilot implementation projects to specifically test and evaluate policy efforts that have the greatest likelihood of success. The findings from these pilot studies could provide evidence to garner buy-in from larger local food service venues that have an indirect relationship with the County, such as Chase Field and local recreational facilities.

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Study Overview

The Maricopa County Sodium and Nutrition Standards Procurement Policy Assessment is comprised of 4 steps:

1) Assessment of large volume food service venues to prioritize policy strategies

2) Logic modeling to determine the pathways through which prioritized policies may be related to sodium consumption patterns and health outcomes

3) Health impact analysis of policy strategies on sodium consumption and health outcomes for large food service venues

4) Economic analysis of associated healthcare cost and productivity cost savings with decreases in hypertension

The health impact analysis utilized a combination of indicators and measures to evaluate the potential effects of food procurement and nutrition standard policy alternatives. Equations calculated the reduction of identified outcome indicators (i.e., blood pressure and individuals affected by hypertension) based on proposed implementation of policies intended to modify sodium consumption through access to more affordable, healthy food options.

In order to better understand how policies create change at a systemic or environmental level, causal loop models were created to depict the relationships among the policy approaches (i.e., decreasing the cost of low-sodium options), mediating factors to outcomes (i.e., increased access to and affordability of lower sodium foods), intermediary health impacts (i.e., decreased sodium consumption; decreased systolic blood pressure and hypertension), and long term health impact (i.e., decreased cardiovascular disease and stroke). Additionally, associated economic indicators of health problems (i.e., healthcare and workplace absenteeism costs) were estimated as an impact outcome.

The health impact analysis phase utilized data collected from the assessment interviews and surveys conducted during the first two phases of the study, as well as secondary data sources. Data from the assessments included information specific to the scope of food service:

- number of people served per day
- types of meals served
- nutritional content of meals (sodium levels, fat content, calorie count, sugar content)

Health-related indicator data collected from local and national data sources included:

- systolic blood pressure
- prevalence of hypertension (number of hypertensives and normotensives)
- health-related costs
- cost of absenteeism (for County employees)

Each of these indicators was built into simulation models to estimate reductions in blood pressure, hypertension, healthcare costs, and (where appropriate) costs of workplace absenteeism.

Because reductions in blood pressure and associated hypertension require weeks of reduced sodium consumption[1], only those venues in which foods and beverages are served to a similar population on an ongoing basis (i.e., daily food service, at least 5 days per week, for at least several weeks) were included in the health impact analysis simulations.

The Logic of Linking Sodium Reduction Policies with Health Impact

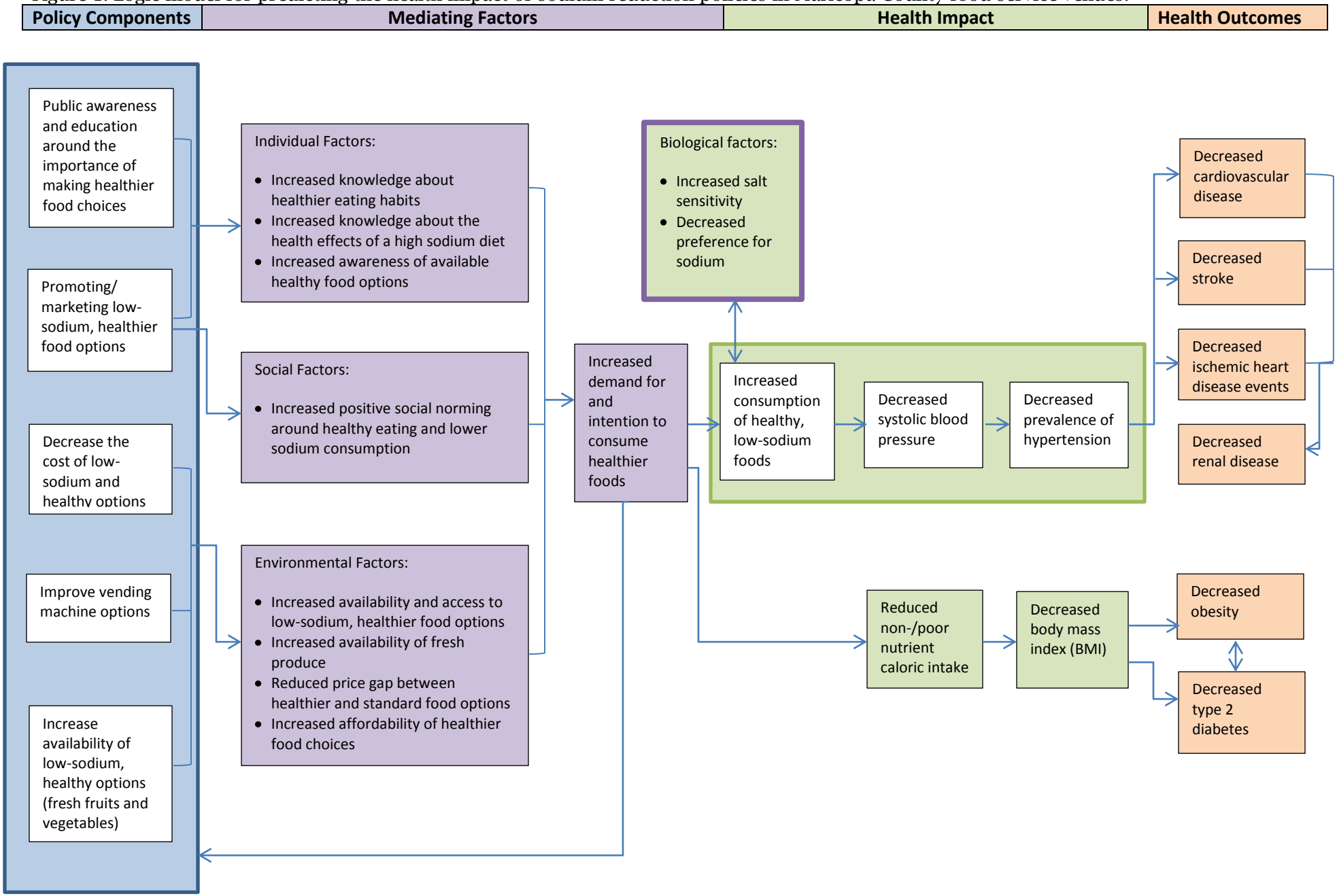
Previous phases of this study outlined the evaluation process for determining the sodium-reduction policy priorities for County food service venues and programs. Causal loop analysis was conducted with the five policy strategies:

1. Public awareness and education around the importance of making healthier food choices
2. Promoting/marketing low-sodium, healthier food options
3. Decrease the cost of low-sodium and healthy options
4. Improve vending machine options
5. Increase availability of low-sodium, healthy options (fresh fruits and vegetables)

The model is based on the theory of change assumption that policies managing the sodium content in County food procurement would reduce high blood pressure, the prevalence of hypertension, and many associated diseases. The pathway through which policy leads to health outcomes is mediated by a number of individual, social, and environmental factors. These factors outline potential changes in behavior, cultural norms, and environmental access that lay the groundwork for food choice, and ultimately health. This change theory is supported by previous similar health impact analysis studies.[2] Figure 1 depicts the results of this causal pathway analysis.

[1] He, F.J., Markandu, N.D., & MacGregor, G.A. (2001). Importance of the renin system for determining blood pressure fall with acute salt restriction in hypertensive and normotensive Whites. *Hypertension, 38*(3), 321-325.
[2] Story, M., Kaphingst, K.M., Robinson-O'Brien, R., & Glanz, K. (2008). Creating healthy food and eating environments: Policy and environmental approaches. *Annual Review of Public Health, 29*, 253-272.

Figure 1. Logic model for predicting the health impact of sodium reduction policies in Maricopa County food service venues.



Health Impact Analysis by Venue

The main goal of the health impact analysis (HIA) was to estimate the potential impact sodium reduction policy strategies would have on hypertension rates in Maricopa County. The study focused on food consumption at large-volume food service venues run by a County department or under a food service-related contract with a County department. The first step is to examine the reduction in systolic blood pressure (SBP), a primary precursor to hypertension, across the County venues examined. Given the anticipated effects of the prioritized policy solutions (see Figure 1 Logic model), reduction rates of SBP for normotensives (those with normal blood pressure) and hypertensives were calculated at sodium reduction rates of 10%, 15%, 20%, 25%, and 30% from estimated baseline venue sodium levels. These rates of reduction are relative to the baseline amount of sodium in foods commonly consumed in County venues.

Nutritional Content of Foods Served through County Venues and Programming

This study examined the nutritional content of foods typically served or provided through Maricopa County's largest food volume venues and programs. These included County cafeterias and food courts (i.e., Change of Venue), vending machine operations, County Sheriff's Office, and Public Health community programming.

The following table provides a summary of estimated nutritional content for meals, snacks, and beverages consumers are likely to purchase or be served in each venue.[3]

Table 1. Nutritional Content by Maricopa County Food Service Venue/Program.

Venue/Program	Average Calories	Average Sodium Content	Average Sugar Content	Average Fat Content	Average Cholesterol Content
Cafeterias and Food Courts* (per meal)	715.8	1193mg	59.8g	27.7g	133.7mg
Sheriff's Office (per meal)**	1250	1150mg	<42g	<97g	150mg
Vending Machines (per serving)***	349	221mg	54g	9.5g	4.8g
Public Health Programming (per serving)	327.5	491mg	9.2g	13.7g	53.5mg

* These venues include the Change of Venue food court and cafeterias at the Mesa Regional Center and the Durango Complex.
** Nutrient content based on the 2005 USDA Dietary Guidelines, which MCSO meals are reportedly based on. Specific nutritional content information could not be obtained for this venue.
***Nutritional content based on aggregated estimates for one serving each of a vending machine snack and beverage.

Generally, sodium content in products sold through vending machines is estimated to be 67mg per serving for beverages and 154mg per serving for foods. Vending machine products tend to have lower levels of sodium per serving, yet higher levels of sugar, due to the fact that many of the products sold through vending are sugar-sweetened beverages and candies that tend to have lower sodium content.

On the other hand, meals provided through Public Health programs and cafeterias and food courts tend to have higher levels of sodium since many of those foods consist of breads and baked goods, processed foods, and fast foods (such as Taco Bell, Pizza Hut, and Starbucks).

[3] Nutritional content generally includes both foods and beverages consumed in each venue.

Reduction in Systolic Blood Pressure (SBP)

Based on the baseline levels of sodium in each venue and the potential full scope of effect for those who take advantage of all food consumption opportunities in each venue (i.e., two meals through the food courts/cafeterias, two meals through MCSO, and servings of a snack and beverage out of vending machines), general reductions in systolic blood pressure (SBP) can be calculated as a result of gradual changes in sodium consumption (Table 2).

Table 2. Estimated Reductions in Systolic Blood Pressure (SBP) by Venue.

Reduction in SBP (mm Hg)			
County Cafeterias and Food Courts			
Reduction in Average Daily Sodium Consumption, mg (%)*	Normotensives	Hypertensives	Weighted Average†
238.6(10%)	0.37	0.75	0.46
298.25(15%)	0.47	0.93	0.58
477.2(20%)	0.75	1.5	0.94
596.5(25%)	0.93	1.86	1.16
715.8(30%)	1.12	2.24	1.4
Maricopa County Sheriff's Office (MCSO)**			
230 (10%)	0.36	0.72	0.40
345 (15%)	0.54	1.08	0.60
460 (20%)	0.72	1.44	0.80
575 (25%)	0.9	1.8	1.00
690 (30%)	1.08	2.16	1.20
Vending Machine Operations***			
22.1(10%)	0.035	0.07	0.044
33.15(15%)	0.052	0.104	0.065
44.2(20%)	0.07	0.14	0.087
55.25(25%)	0.086	0.172	0.107
66.3(30%)	0.105	0.21	0.131

* Because food courts and cafeterias are generally open for both breakfast and lunch, these calculations assume an average of two meals consumed in cafeterias and food courts to obtain maximum possible scope of effect for health impact.

** Daily consumption of sodium is based on the USDA guidelines, which specifies no more than 2300mg per day. Detainees in MCSO are served two meals per day, which are estimated to include no more than 1150mg per meal.

*** The estimated sodium content of food items is 154mg per serving and beverages is 67 mg per serving. Sodium consumption is based on individuals consuming a minimum of 221mg daily, one serving each of a food item and a beverage.

†Weighted average reduction in SBP is based on the high blood pressure prevalence of adults older than 18 in Maricopa County (24.7%), as reported by County 2011 biometric screening data, employee self-report and 2009 statistics from the National Center for Chronic Disease Prevention and Health Promotion.

Reductions in average daily sodium consumption and systolic blood pressure (sbp) were calculated using the following equations:

> Reduction in average daily sodium consumption = targeted percent reduction x average daily sodium consumption[4]
>
> Systolic blood pressure reduction (sbp) = reduction in average daily sodium consumption/ 2300 mg X the appropriate conversion factor (3.6 or 7.2 mm Hg)[5]

These calculations demonstrate that as potential sodium consumption gradually decreases so too does SBP in both hypertensive and normotensive individuals (see weighted averages for total approximated SBP reductions for both hypertensive and normotensive individuals). Reduction rates are more striking in those who already meet criteria for hypertension, suggesting significant benefits from sodium-reduction strategies among those at greatest risk.

It is important to note that reductions in SBP could not be estimated for Public Health programming due to the infrequency of food provision (typically 3-4 events each month), the variability in scope of effect based on the average number of individuals impacted by food service in these programs (range of 10-360 individuals depending on program event), and the lower relative contribution of these foods to one's overall daily sodium consumption. Potential benefits for Department of Public Health employees and program participants can be extrapolated from overall County simulation models presented below.

Reduction in Hypertension Cases and Associated Costs

Based on the Centers for Disease Control and Prevention chronic disease facts, individuals who have hypertension have higher worker absenteeism in comparison to those without hypertension.[6] Absenteeism increases considerably for workers with hypertension if the individuals are also overweight or obese.[7] The American Hospital Association also reports that on average per 1000 workers with hypertension, 181 workdays are missed for the American hypertensive working population. For the Southwest, the hypertensive working population misses an average of 160 days per 1000 workers.

With the potential of SBP reductions across food service venues, reductions in hypertension cases and associated costs in healthcare and lost work productivity for the County can be estimated. For the simulations conducted, healthcare costs for those with hypertension were estimated at $1966 per person per year using the hypertension treatment cost per person in 2010 and adjusting for inflation using the Medical Care Consumer Price Index to represent 2012 dollars.[8] The estimated health care costs include prescription expenditures and costs attributed to chronic diseases related to hypertension.

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[4] Centers for Disease Control and Prevention. (2011, March 21). Retrieved from http://www.cdc.gov/bloodpressure/facts.htm

[5] He, F.J., & MacGregor, G.A. (2004). Effect of longer-term modest salt reduction on blood pressure. Cochrane Database System Review, 3: CD004937

[6] Centers for Disease Control (2011).

[7] Sullivan, P., Ghushchyan, V., and Ben-Joseph, R. (2008). The effect of obesity and cardiometabolic risk factors on expenditures and productivity in the United States. *Obesity, 16*(9), 2155-62.

[8] Medical Care Consumer Price Index from the Bureau of Labor and Statistics; Kim, G. (2010). *The potential health impact of reducing excess sodium consumption in Los Angeles County*. County of Los Angeles Public Health, Division of Chronic Disease & Injury Prevention.

Maricopa County's Jail Population

Given that the composition of the jail population fluctuates and detainees can remain in custody anywhere from one day up to one year, it is difficult to precisely predict the reduction in hypertension cases and healthcare costs. Therefore, approximations are made for scenarios that may lead to a change in hypertension cases from 1% to 10%.

Table 3. Estimated Reductions in Hypertension and Health Costs for Jail Detainees.

Change in % of Hypertension Cases*	Reduction in # of hypertensive cases	Direct Healthcare costs saved annually**
1%	9	$17,694
2%	18	$35,388
5%	44	$86,504
10%	89	$174,974

* Based on a baseline of 866, which is an estimated 11% hypertension rate among average daily detainee population of 8055.
** Based on estimated healthcare cost of $1,966 per capita annually.

Cases ranging from 1% to 10% correspond with estimated healthcare savings between $16,302 and $163,024 annually – healthcare costs directly attributable to the County budget.

Maricopa County's Workforce and Community Consumers

Using a combination of Maricopa County workforce data and approximations about the community population that may consume meals and snacks at County-sponsored venues, simulation models were constructed to estimate potential benefits from sodium reduction strategies. The Maricopa County working populations are estimated based on the departments located in the area of each venue. The community population is a robust estimate of the amount of the community that would have access to the venues daily. Previous public health surveys indicate that 48% of the working population uses the food courts and cafeterias, and 39% uses vending. It is assumed for the community population that 25% of that population will use a food court, cafeteria, or vending. To account for these percentages, individuals were randomly chosen to be a part of the 48%, 39%, or 25% of the population; these individuals may also be a part of the population that is assumed to be hypertensive.

The hypertensive population for the workforce is determined based on the prevalence of hypertension in a surveyed sample of the Maricopa County workforce (per County biometric screening data). To use the incidence rate for the workforce, the data must be available for the new cases of hypertension in the past year within the workforce. The hypertensive population within the community is simulated based on the incidence rate of high blood pressure determined by the CDC for age group populations.[9] Those percentages were applied to Arizona's population by age group to determine an approximate total amount of the hypertensive Arizonan population. For example, the CDC states that 54% of men and 53% of women ages 55-64 are likely to develop or have hypertension.[10] A weighted average between the male and female percentages is taken for each age group and then multiplied by the total number of individuals within that age group for the Arizonan population. As a result, it was determined that approximately 25% of the Arizona population is likely to have or develop hypertension.

[9] He & MacGregor (2004)
[10] He & MacGregor (2004)

To further increase the capabilities of the simulation models, given an individual's normotensive or hypertensive state, a range of probability values are chosen (from a uniform distribution) to simulate various outcomes for that individual. For example, an individual who is normotensive has a higher probability of making a healthy choice versus a hypertensive individual. Therefore it was initially simulated that a normotensive individual had a higher chance (75%) of making the healthy food decision at any venue, whereas the hypertensive individual had a less than 50% chance. However multiple scenarios were simulated and a range of probability values are chosen to cover multiple scenarios for the two different populations.

Table 4 presents the assumptions about consumer numbers from both the County workforce and the community, and probable rates of sodium consumption at food courts, cafeterias, and through vending. Because it is more likely across both community and workforce populations that one meal per day would be consumed in the food courts, cafeterias, and grills, this assumption was built into the models.

Table 4. Approximated Scope of Effect and Per Meal Sodium Content for Simulated Populations.

Venue	Working Population	Community Population	Average Sodium Content per meal/snack
Downtown Phoenix Change of Venue Food Court *	5300	3000	1041mg
Mesa Regional Center Cafeteria*	800	400	1110mg
Durango Complex Grill*	1200	300	1110mg
Vending Machines (countywide)**	14000	4700	519mg (maximum of 480mg for Healthy Vending items)
* Assumes consumers eat one meal a day at these venues. ** Assumes daily consumption of approximately 3 servings of food and 1 beverage serving given the prevalence of "larger serving sizes" commonly placed in vending machines.[11]			

Given the opportunity to make healthier food choices following increased access, affordability, and promotion around reduced sodium options through each of these venues, simulation models estimated associated reductions in blood pressure, cases of hypertension, and cost savings in both healthcare and workplace absenteeism. Assuming maximum reach and probability that all possible consumers would make healthy low-sodium options, Table 5 presents simulated estimations in health and cost benefits.

[11] French, S.A., Story, M., & Jeffery, R.W.(2001). Environmental influences on eating and physical activity. *Annual Review of Public Health, 22,*309-335.

Table 5. Simulated Population Benefits from Reductions in Sodium Consumption at Select Venues.

Change in Sodium Consumption (mg)*	Average Systolic Blood Pressure Reduction (mm Hg)	Percent Decrease in the Frequency of Hypertension	Decrease in the Number of Cases of Hypertension**	Potential Annual Health Care Cost Savings [in 2012 dollars] ($)***	Potential Annual Savings due to worker absenteeism
Downtown Phoenix Change of Venue Food Court					
104.1 (10%)	0.24	0.82%	17	$33,422	$1,520
208.2 (20%)	0.49	0.96%	20	$39,320	$1,824
312.3 (30%)	0.73	1.45%	30	$58,980	$2,888
Mesa Regional Center Cafeteria					
111 (10%)	0.26	1.00%	3	$5,898	$456
222 (20%)	0.52	1.33%	4	$7,864	$608
333 (30%)	0.78	1.67%	5	$9,830	$760
Durango Complex Grill					
111 (10%)	0.26	1.10%	4	$7,864	$456
222 (20%)	0.52	1.33%	5	$9,830	$608
333 (30%)	0.78	2.40%	9	$17,694	$1,216
Vending Machine Operations					
51.9 (10%)	0.11	1.18%	55	$108,130	$4,480
103.8 (20%)	0.23	1.22%	57	$112,062	$6,232
155.7 (30%)	0.34	1.30%	61	$119,926	$5,928

* Assumes hypertensives and normotensives have an equal probability of making the healthiest choice (0.75).
**Each individual in the simulated population is randomly assigned a systolic blood pressure value in the corresponding ranges, (120-139) if normotensive, and (140+) if hypertensive. This model assumes roughly 25% of the community and County employee population has hypertension (based on previous survey results and biometric screening data).
***Based on average annual healthcare cost of $1966 per capita.

As expected, greater reductions in sodium correspond with decreases in hypertension cases and associated health and absenteeism costs. For venues with greater scope of effect (i.e., serving more customers per day), the potential health and workforce impacts are greater. It is important to note that these findings present a scenario of greatest benefit where consumers have high baseline rates of sodium consumption and have a high likelihood of making healthy choices if given the opportunity. These assumptions need to be taken into account in planning for future policy work in this area.

Given the above assumptions across these venues, with gradual reductions in sodium consumption, County employees and community consumers could experience between a 1% and 2.5% decrease in the frequency of hypertension, with a corresponding savings in healthcare costs upwards of $120,000 and savings in lost worker productivity estimated around $6,000.

Estimated Overall Countywide Impact of Sodium Reduction Initiatives

Considering the approximated reductions in hypertension for those impacted by the large-scale venues evaluated in this study, it is reasonable to expect that the Maricopa County population (approximately 3.8 million people) would benefit as a whole from a reduction in sodium consumption. The following model simulates the Maricopa County population assuming that 25% of the total population has hypertension, which is a reasonable estimate since 35% of Maricopa County's population is over the age of 45, and between the ages of 45-55, 37% of the male population suffers from high blood pressure, while 54% of men between the ages of 56-64 suffer from high blood pressure which increases with age (with comparable percentages for women in the same age groups).[12]

The simulations are based on the assumption that individuals eat at least three meals per day, with maximum values for daily sodium content estimated at the national average of 3578 mg per day[13].

Table 6. Estimated Countywide Health Impact of Sodium Reduction Strategies.

Percent Reduction in Population Sodium Consumption (mg)	Average Systolic Blood Pressure Reduction (mm Hg)	Percent Decrease in the Frequency of Hypertension	Decrease in the Number of Cases of Hypertension	Potential Annual Health Care Cost Savings [in 2012 dollars] ($)
357.8(10%)	0.84	5.00%	47,479	$93,343,714
536.7(15%)	1.26	5.02%	47,729	$93,835,214
715.6(20%)	1.68	7.54%	71,671	$140,905,186
894.5(25%)	2.1	7.55%	71,699	$140,960,234
1073.4(30%)	2.52	10.00%	94,823	$186,422,018

Given population-level reductions in sodium consumption, the potential for Maricopa County to benefit from reductions in cases of hypertension and associated healthcare costs is significant. These findings are important to note considering many County venues are accessible to the general population.

Conclusions and Implications

Following the logic that policies increasing the availability, affordability, and promotion around healthier, low-sodium options contribute to changes in food choices, blood pressure, and rates of hypertension-related disease, results of this health impact analysis suggest that reducing sodium consumption at various levels is associated with improved health and lower costs for the County. Specifically, as sodium consumption decreases incrementally in each food service venue, reductions in blood pressure increase proportionally. With SBP reductions come relative reductions in hypertension cases. In total, these case reductions are estimated to contribute to between approximately $6,000 and $120,000 in annual healthcare cost savings and upwards of $6,000 in annual workplace absenteeism savings. Certain venues, such as County cafeterias, food courts, and grills, appear to make a greater contribution given the scope of food service and the higher estimated baseline rates of sodium consumption. However, if sodium reduction

[12] Centers for Disease Control (2011)
[13] He & MacGregor (2004)

strategies were focused in each of these venues, an estimated 29,700 individuals could be impacted with potential savings in healthcare costs between $155,314 and $206,430 and savings in workplace productivity between $6,912 and $10,792.

While the magnitude of presented cost savings may not appear particularly compelling, it is important to note that they are based on projections of estimated consumer populations, foods consumed, and nutritional content at each venue studied. In considering a countywide scope in which sodium reduction initiatives could have a larger population-level impact, significantly greater benefits may be realized. The implications of these findings suggest that larger scale, sustained reductions in sodium consumption can contribute to even greater health and workforce benefits. Also, given that those with hypertension are more likely to have other chronic health problems, such as obesity (Sullivan et al., 2008), these estimates may only capture a portion of the overall health benefit potential of at-risk individuals who improve their food choices by consuming lower sodium, lower calorie, and lower fat options (see Figure 1 Logic Model).

Although analyses specific to its programming could not be built into the models to determine health impact, the Maricopa County Department of Public Health would benefit from setting a countywide example by championing internal food policy efforts. This is especially meaningful considering that much of the food procured for public health programming and events tends to be higher sodium, higher calorie, and higher fat fast food-type restaurant meals or prepackaged processed snacks. Assuming this role and demonstrating success in changing departmental food procurement should increase the likelihood that other County leadership will be motivated to implement sodium reduction policy solutions in order to have greater countywide impact.

While the results suggest that chronic disease and associated healthcare and workplace costs can be mitigated by changes in food choices and food policies, the findings are limited by a number of assumptions around the frequency of food consumption, the demographics and health conditions of food venue patrons, and the number of environmental and behavioral variables that impact consumption behavior both inside and outside evaluated venues. The County would benefit from building off of these health impact results by piloting implementation studies in select venues that have the potential for greatest impact (i.e., County cafeterias and food courts) to more rigorously test the implications of specific policies. From here, the County can collect persuasive evidence of sodium-reduction strategy effectiveness that can be expanded to food service venues outside of direct County control and that may not have consistent daily scope of effect, such as events at Chase Field, corporations operating food service at County golf courses and parks, and agencies operating distributive meal programs to community populations served by the County.

Appendix – Expanded Study Methodology

A significant limitation of the health impact and economic analyses included the inaccessibility of precise food sales and consumer behavior data from each of the venues. Reasonable approximations of foods and beverages typically purchased and their nutritional content were estimated from equivalent items at comparable venues.

Estimation of Nutritional Content

Vendors were not able to provide precise sales or food volume data (i.e., sales receipts, inventory counts) for the purposes of this study for one of two reasons: 1) these data are not regularly collected (i.e., for vending machine operators), or 2) organizational restrictions prevented providing these data at the time the study was conducted (i.e., for vendors managing the County food court). Rather, vendors were able to provide sample menus, lists of common products sold, and the types of commercially prepared foods typically sold (for instance, Pizza Hut and Taco Bell products in the Change of Venue Café). Where necessary, values for nutrient content were estimated for representative meals on sample menus and common vending machine products sold using publically accessible nutrition information for equivalent items provided through similar venues. For instance, Pizza Hut corporate sources were accessed to obtain nutritional information on common menu items that would likely be sold through the Pizza Hut franchise in the Change of Venue food court. Nutritional content of grill and cafeteria-type items was estimated from nutritional information of similar products sold through companies such as Corner Bakery, McDonalds, and Chili's. This process was conducted for other food or menu items on the sample menus and lists of products provided by vendors.

The analysis of nutritional content in each venue included both beverages and foods. Sodium content was estimated separately for foods and beverages given that beverages tend to have lower levels of sodium per serving. These averages were then summed together in Table 1 to reflect an overall estimation of a typical meal (or snack selection in the case of vending machines) that may be consumed in each venue.

Access to specifics about the meals served through the Maricopa County Sheriff's Office (MCSO) and their nutritional content was a significant limitation of the study. Consultation with the MCSO dietitian indicated that detainees are served two meals per day with a maximum caloric intake of 2,500 calories and that nutritional requirements for these meals can be obtained from the 2005 USDA Dietary Guidelines, which indicate that daily sodium content must be less than 2,300mg, sugar content cannot exceed more than 8 teaspoons for every 2,000 calories, total fat must be less than 35% of daily calories (875 calories of the total 2,500 calorie diet, which equals 97 fat grams), and cholesterol cannot exceed 300mg per day.

Estimation of Health Impact

The sodium figures in Table 2 reflect a gradual percentage decrease from estimated baseline sodium values in Table 1. Percentages from 10% to 30% of baseline sodium content in each venue were calculated and these resulting reduction values are presented in the first column of Table 2. Representative research was consulted to determine the dose-response relationship between reduction of sodium consumption and reductions in systolic blood pressure, in which a 2,300mg sodium reduction is estimated to correspond with a 3.6 millimeters of mercury decrease in SBP for normotensives and a 7.2 mm of mercury decrease in hypertensives.[14]

Health impact analyses (reduction in systolic blood pressure and cases of hypertension) presented in Table 2 take into account that detainees and cafeteria and food court consumers have the opportunity to eat two meals in these venues and that vending machine patrons have

[14] He & MacGregor (2004)

the opportunity to consume at least one snack and beverage serving. Therefore, potential reductions in sodium consumption and related hypertension in these venues reflect the maximum possible scope of effect of health impact. Outside of specific consumer behavior data from these food service sites, these are reasonable assumptions about scope of effect to make and consistent with previous model studies of sodium reduction policies.[15]

Simulation of Economic Impact

The sodium content information in Table 4 is broken out into the estimated values for each of the cafeteria/food court/grill venues (Downtown Phoenix, Mesa Regional Center, and Durango Complex) in order to demonstrate the potential scope of effect with consumer populations that would be most likely affected by food service in each of the venues. Research studies have found that the serving sizes in food products provided through venues such as vending machines have increased over time.[16] Multiple vending machine suppliers sell "larger serving size" products (packages that contain more than one serving) and standard vending machines are often able to accommodate these larger packages. A review of the common products found through local suppliers (i.e., Vistar) found that they often contain at least 2-3 servings per package. Therefore, sodium values for vending machines presented in Table 4 take the likelihood of consuming larger serving size packages into account. The simulated economic impact populations use the data in Table 4 to approximate the diverse consumer populations that would have access to each food venue (i.e., County Administration staff for the downtown Phoenix Superior Court Complex; Corrections Department for the Durango Complex).

The simulated models presented in Table 5 consider both the County employee and community consumer populations that would access the foods in each venue. Baseline rates of hypertension built into the models were determined by the results of a 2011 County employee biometric screening, a self-report Public Health survey of employees, and County rates of hypertension in the general population.[17] In the absence of venue data on consumption behavior, the research team was required to estimate the likelihood of venue access by both employee and community consumers. Given that community populations would most likely access a County food court or cafeteria only once in a day, the simulated population models calculate the health and economic impacts following consumption of one meal in these venues. The findings from these models can be extrapolated to those who eat more often in these venues.

[15] Gase et al. (2011)
[16] French et al. (2001)
[17] Centers for Disease Control and Prevention (2011)