Every year, one in six Americans get sick from eating food contaminated with pathogens—bacteria, viruses or parasites that cause human illness. Most people suffer from mild symptoms and recover quickly—often with no medical attention at all. But some cases are extremely serious and send over 100,000 people to the hospital and kill an estimated 3,000 per year.

Federal, state and local government agencies all have a role in keeping the nation’s food supply safe. They are charged with regulating hundreds of thousands of growers, producers, distributors, grocery stores and restaurants that provide Americans with massive quantities of food each year. But these food safety agencies regulate different foods, operate using different rules and often have different priorities. That fragmented oversight of an admittedly complex system allows contaminated foods to slip through and sicken consumers.

The General Accounting Office, the National Academy of Sciences and other expert groups have called on two federal agencies charged with food safety—the U.S. Food and Drug Administration (FDA) and the Food Safety and Inspection Service of the U.S. Department of Agriculture (USDA) to take steps to address those problems—at least at the federal level. Experts say the FDA and USDA often work in a piecemeal fashion, reacting to the outbreak of the day rather than taking steps to prevent safety problems. They are urging the FDA and USDA to adopt a more unified, preventative and risk-based approach to the most pressing food safety problems.

A risk-based approach to food safety requires the agencies to target limited budget resources to better protect the health of American consumers. To do that, regulators first need to identify which pathogens in which foods make people sick most often.

Right now, the agencies rely on various data, in particular estimates by the Centers for Disease Control and Prevention (CDC) on the annual number of illnesses, hospitalizations and deaths associated with specific pathogens. However, the CDC’s estimates do not pair pathogens with specific foods, a shortfall that means regulators do not know the foods or pathogen-food combinations to target with safety measures. Moreover, these counts of acute illness do not include the long-term consequences of food-related illness, such as kidney failure or paralysis.

The new report by researchers at the University of Florida’s Emerging Pathogens Institute offers food safety officials a systematic way to identify both the pathogens and pathogen-food combinations that can lead to a high burden of disease. This study, “Ranking the Risks: The 10 Pathogen-Food Combinations with the Greatest Burden on Public Health,” provides FDA, USDA and other regulators for the first time with a top 10 list of worst offenders—the pathogen-food combinations most likely to cause significant public health burdens, like lost days of work, high cost of medical care, long-term disability and premature death. It will allow food safety regulators to target scarce public dollars toward the biggest food safety problems and find solutions to protect consumers.
What Did the Study Find?

The analysis found that 14 pathogens in foods cost the United States $14 billion a year in human disease, resulting in large numbers of deaths, hospitalizations and long-term complications. More than 90 percent of this health burden can be traced to just five pathogens: *Salmonella, Campylobacter, Listeria monocytogenes, Toxoplasma gondii* and norovirus.

Even more important for the purpose of prevention, this analysis also identifies the foods most commonly contaminated by those pathogens. The team discovered that the top 10 pathogen-food combinations were responsible for more than $8 billion in direct medical costs and lost wages, as well as significant loss of quality of life.

The top-ranked pathogen-food combinations, shown in the graph on the next page, include: poultry tainted with *Campylobacter*, which causes more than 600,000 estimated cases of illness annually and puts nearly 7,000 people in the hospital; pork contaminated with *Toxoplasma*, which sickens more than 35,000 and puts nearly 2,000 Americans in the hospital annually; and deli meats tainted with *Listeria*, which causes nearly 600 hospitalizations and more than 100 deaths each year.

**Study Approach**

Researchers at the Emerging Pathogens Institute developed a tool to rank the top pathogens and pathogen-food combinations called the Foodborne Illness Risk Ranking Model (FIRRMM). This model is built upon existing data published by CDC, the USDA Economic Research Service and others, as well as on primary data collection by the researchers.

The researchers estimated the impact of acute illnesses and chronic complications due to 14 pathogens, including costs of hospitalization, doctor visits and other medical costs, as well as lost wages and an economic value placed on each premature death. The team focused on these 14 because they are responsible for 95 percent of total cases of foodborne illness due to known pathogens.

For each pathogen, the researchers also estimated health impacts in terms of Quality-Adjusted Life Years (QALYs), a standardized measure of disease burden that includes pain and suffering as well as the impact on normal activities caused by an illness. The QALY estimates the burden of living with a disability such as blindness, organ failure or paralysis.

Then, based on an analysis of over 10 years of foodborne outbreaks and a peer-reviewed survey of nearly 50 experts, the researchers attributed estimated illnesses from each of the 14 pathogens to 12 different types of foods. They thus estimated impacts due to 168 pathogen-food combinations—foods that are contaminated with pathogens—like chicken and *Salmonella* or pork contaminated with *Toxoplasma*. 
These Top-10 pathogen-food combinations cause the greatest burden to the public health, says a new report by researchers at the University of Florida’s Emerging Pathogen Institute. The researchers ranked the combinations by calculating short and long-term costs due to foodborne illness, as well as loss of quality adjusted life years (QALYs), a standardized measure used in public health to assess pain, suffering, and other impacts to quality of life. Federal, state and local agencies charged with food safety should target the Top 10 worst offenders in order to reduce the risk to consumers, says the report.

**Finding:**
Salmonella is the leading foodborne pathogen in the United States, causing the largest number of deaths, a great many hospitalizations and the highest cost burden. In addition, it is one of the few foodborne pathogens for which illnesses have not significantly declined over the past 10 years. Although Salmonella is usually associated with poultry, this pathogen can be found in a wide range of foods regulated by both the FDA and the USDA, including produce (notably tomatoes, cantaloupes and sprouts), eggs, beef and pork.

**Recommendation:**
FDA and USDA should develop a joint Salmonella initiative that coordinates federal efforts and which targets risk reduction in a wide range of foods. The lack of a unified strategy has impaired the government’s ability to appreciably reduce Salmonella risks.

**Finding:**
Poultry causes more foodborne disease than any other type of food, according to this analysis. Contaminated poultry is responsible for $2.4 billion in costs of illness, primarily due to Salmonella and Campylobacter.

**Recommendation:**
USDA should consider toughening recently announced performance standards for Salmonella and Campylobacter in chicken and turkey. The new standards are expected to reduce illness from these pathogens by just 1–2 percent, not enough to make a big difference from a public health standpoint.
**Finding:**

Four of the top 10 pathogen-food combinations pose major risks during pregnancy. When expectant mothers become infected with *Listeria* and *Toxoplasma*, particularly from deli meats, soft cheeses and raw or undercooked beef, pork, or other meat, it can lead to miscarriage, stillbirth or life-long problems in the affected child, such as severe mental impairment and physical disability.

**Recommendation:**

Federal agencies should strengthen detection and prevention efforts aimed at keeping these pathogens out of commonly contaminated foods like deli meats or soft cheeses. In addition, CDC should step up educational efforts to protect pregnant women, especially those in high-risk ethnic subgroups. For example, Spanish language efforts should be geared toward pregnant Latinas, as risks of listeriosis are high from queso fresco, a traditional Mexican raw-milk cheese. In addition, USDA should develop an evidence-based strategy for reducing toxoplasmosis risks due to contaminated meats such as beef, pork and lamb.

**Finding:**

CDC estimates nearly 90,000 illnesses due to foodborne *Toxoplasma* each year, resulting in hundreds of deaths, physical and mental disabilities and $3$ billion in costs of illness. Yet researchers lack good information about which foods are responsible for transmitting this pathogen; the exact roles of pork, beef, lamb, cured meats, shellfish and other potential pathways are poorly understood.

**Recommendation:**

The federal government must develop evidence-based methods to identify and prevent the most common pathways of contamination.
How safe is our food? Not safe enough, according to this report. But this report also provides a way to improve the current system by targeting the worst pathogen-food combinations.

Based on a new approach, the report finds that a majority of foodborne disease is caused by a small number of pathogens in a limited number of foods. The researchers estimated the impacts of foodborne illness in dollars and QALYs, considering both acute symptoms and chronic complications that can sometimes affect adults and infants. Long-term health problems, such as paralysis, blindness, severe mental impairment and more, extract a large public burden over the long run in terms of lost productivity, human suffering and diminished quality of life.

The report estimates that the top-ranked 14 pathogens in foods result in a cost of illness of $14 billion per year and a loss of more than 63,000 QALYs. Over $12 billion and 55,000 in QALY loss is caused by only five microorganisms: *Salmonella*, *Toxoplasma gondii*, *Listeria monocytogenes*, norovirus and *Campylobacter*. About $8 billion or 37,000 in lost QALYs, representing more than half of the total burden, is due to the top 10 pathogen-food combinations, including *Campylobacter* in poultry; *Salmonella* in poultry, complex foods, produce and eggs; *Listeria monocytogenes* in deli meats and soft cheeses; *Toxoplasma gondii* in pork and beef; and norovirus in complex foods. These estimates are based on the best available science.

This analysis, for the first time, allows policymakers to rank and better understand the pathogen-food combinations that cause the largest burden on society. Food safety experts have long identified inadequacies in the current fragmented system, one that lacks evidence-based methods of targeting the biggest food safety problems. Of the estimated 50 million cases of foodborne illness each year, most are preventable. The hope is that this report and associated risk ranking model will be used by policymakers and regulators as part of a more unified, preventative and risk-based approach to food safety.

With a more targeted, risk-based approach to food safety, policymakers can ensure safer foods for all Americans.