Promotional campaigns to increase produce consumption to at least 5 servings a day.

U.S. Dietary Guidelines
Healthy People 2010
National Cancer Institute
Produce for Better Health Foundation

Between 1970 - 1997, the U.S. per capita consumption of fruits and vegetables increased 24%!

577 lbs to 718 lbs per year

U.S. Fruit and Vegetable Outbreaks: 1973 - 1998

- Significant increases in the number of produce associated foodborne disease outbreaks in the U.S.
Number of Produce Associated Outbreaks by Decade, 1973 - 1997

<table>
<thead>
<tr>
<th>Decade</th>
<th>Outbreaks / yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973-79</td>
<td>3.7</td>
</tr>
<tr>
<td>1980-89</td>
<td>6.5</td>
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<tr>
<td>1990-97</td>
<td>10.5</td>
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</tbody>
</table>

Selected Produce-Associated Outbreaks, 1990 - 1997

<table>
<thead>
<tr>
<th>Year</th>
<th>Pathogen</th>
<th>Vehicle</th>
<th>Cases</th>
<th># of States</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>1990</td>
<td>S. chester</td>
<td>Cantaloupe</td>
<td>245</td>
<td>30</td>
<td>Central America (CA)</td>
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<tr>
<td>1990</td>
<td>S. javiana</td>
<td>Tomatoes</td>
<td>174</td>
<td>4</td>
<td>US</td>
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<tr>
<td>1990</td>
<td>Hep. A</td>
<td>Strawberries</td>
<td>18</td>
<td>2</td>
<td>US</td>
</tr>
<tr>
<td>1991</td>
<td>S. poona</td>
<td>Cantaloupe</td>
<td>&gt;400</td>
<td>23</td>
<td>US/CA</td>
</tr>
<tr>
<td>1993</td>
<td>O157:H7</td>
<td>Apple cider</td>
<td>23</td>
<td>1</td>
<td>US</td>
</tr>
<tr>
<td>1993</td>
<td>S. montevideo</td>
<td>Tomatoes</td>
<td>84</td>
<td>3</td>
<td>US</td>
</tr>
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<tr>
<td>1994</td>
<td>Shigella flexneri</td>
<td>Scallions</td>
<td>72</td>
<td>2</td>
<td>CA</td>
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<tr>
<td>1995</td>
<td>S. stanley</td>
<td>Alfalfa sprouts</td>
<td>242</td>
<td>17</td>
<td>?</td>
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<tr>
<td>1995</td>
<td>S. hartford</td>
<td>Orange juice</td>
<td>63</td>
<td>21</td>
<td>US</td>
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<tr>
<td>1995</td>
<td>O157:H7</td>
<td>Leaf lettuce</td>
<td>70</td>
<td>1</td>
<td>US</td>
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<tr>
<td>1995/6</td>
<td>S. newport</td>
<td>Alfalfa sprouts</td>
<td>&gt;100</td>
<td>7</td>
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<tr>
<td>1996</td>
<td>O157:H7</td>
<td>Leaf lettuce</td>
<td>49</td>
<td>2</td>
<td>US</td>
</tr>
<tr>
<td>1996</td>
<td>S. montevideo</td>
<td>Alfalfa sprouts</td>
<td>&gt;600</td>
<td>1</td>
<td>US</td>
</tr>
<tr>
<td>1996</td>
<td>Cyclospora</td>
<td>Raspberries</td>
<td>978</td>
<td>20</td>
<td>CA</td>
</tr>
<tr>
<td>1996</td>
<td>O157:H7</td>
<td>Apple juice</td>
<td>71</td>
<td>3</td>
<td>US</td>
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<tr>
<td>1997</td>
<td>Hepatitis A</td>
<td>Strawberries</td>
<td>151</td>
<td>1</td>
<td>CA</td>
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<tr>
<td>1997</td>
<td>Cyclospora</td>
<td>Raspberries</td>
<td>&gt;200</td>
<td>15</td>
<td>CA</td>
</tr>
<tr>
<td>1997</td>
<td>S. infantis/ anatum</td>
<td>Sprouts</td>
<td>81</td>
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Fruit & Vegetable Outbreaks by Specific Agent, 1973 - 1998

<table>
<thead>
<tr>
<th>Agent</th>
<th>1973-87</th>
<th>1988-98</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial</td>
<td>24</td>
<td>57</td>
</tr>
<tr>
<td>Parasitic</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Viral</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Unknown</td>
<td>35 (55%)</td>
<td>41 (37%)</td>
</tr>
<tr>
<td>Total Outbreaks</td>
<td>64</td>
<td>112</td>
</tr>
<tr>
<td>Outbreaks/year</td>
<td>4.3</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Source: CDC Foodborne outbreak surveillance system
**Fruit and Vegetable Bacterial Outbreaks: 1988 - 1998**

- C. jejuni 2
- E. coli O157:H7 22
- E. coli O111:H43 1
- Shigella 4
- Salmonella 25

Source: CDC Foodborne outbreak surveillance system

**US Produce Outbreaks: 1990 - 1998**

- Unknown/Other 7.3%
- Lettuce 16.7%
- Sprouts 9.4%
- Salads Bar 20.8%
- Tomato 2.1%
- Cabbage 5.2%
- Carrots 3.1%
- Fruit 20.8%

Source: CDC Foodborne outbreak surveillance system

**Fruit and Vegetable Outbreaks by Origin of Produce: 1990 - 1998**

- Domestic 79.3%
- Imported 7.5%
- Unknown 17.2%

Source: CDC Foodborne outbreak surveillance system

**Produce Associated Outbreaks**

**Conclusions:**

- Outbreaks have increased by nearly a factor of 3.
- Number of cases per outbreak have increased x10.
- A variety of produce involved.

**Why are Foodborne Illnesses Increasing?**

- Complexities of the Food System
- Aging of the Population
- Chronic Illnesses / Compromised Immunity
- Awareness of Hygiene & Risks Changing
- Changing Microorganisms:
  - More Virulent Strains
  - Adapting to Stresses

**The Cycle of Infection**

HOSTS  
MICROBES  
ENVIRONMENT
Foodborne illness outbreaks are a major cause of:
• Personal distress
• Preventable death
• Avoidable economic burden

Every year foodborne illnesses result in an estimated:
• 76 million cases of foodborne illness.
• 325,000 people hospitalized for foodborne illness.
• 5,200 needless deaths each year.
• Economic losses between 10-83 billion dollars.

Contamination With Microbial Pathogens: Where Can It Occur?
• In fields or orchards
• During harvesting and transport
• During packing or processing
• In distribution and marketing
• In restaurants and food service facilities
• In the home

Sources of Pathogens on Fresh Produce:
• Equipment
• Transport vehicles
• Contaminated flume, wash water, or ice
• Contamination during processing

Sources of Pathogens on Fresh Produce:
• Improper storage and packaging
• Cross contamination
• Improper handling after wholesale or retail purchase

Beuchat, 1996
PREVENTION is the Key to Reducing Microbial Contamination of Fresh Fruits and Vegetables

**Goal:**
Reduce Microbial Risks to Assure Food Safety.

**What Can Growers and Packers Do?**
- Learn About the Risks
- Develop a Food Safety Plan
- Strengthen GAPs
- Document Activities

**Per-Harvest Concerns**
- Contaminated irrigation water
- Too much or too little water
- Fresh or uncomposted manure/fecal material

**Acknowledgements**
This presentation created by Robert B. Gravani and Elizabeth A. Bihn.

Images provided by USDA (k8666), California Department of Health Services Food and Drug Branch, Robert B. Gravani, Elizabeth A. Bihn, Al B. Wagner and Ed McLaughlin.
**Per-Harvest Concerns**

- Wild and domestic animals
- Pesticide use
  - Be aware of pre harvest intervals

**Growing Season**

- Cleaning begins in the field
  - Straw and living or plastic mulch keeps soil off produce.
  - Use windbreaks to reduce dust.
  - Avoid activities that will splash mud onto produce.

**Harvest**

- Best quality of any fruit or vegetable exists at the moment of harvest.
- After that, quality cannot be improved, only maintained.
- “Shelf life begins at harvest”

**Postharvest**

**The Harvesting Process**

- Harvest in non-muddy conditions.
- Keep hands free of soil and other contaminants.
- Use clean and sanitized tools, knives and containers.

**The Harvesting Process**

- Suggestions for harvesting dirty root crops and vegetables that rest on the ground.
  - Use a cloth or cotton gloves to wipe off the majority of soil and leave it in the field.
- Do necessary trimming of roots and leaves at harvest.
The Harvesting Process

- Harvesting wet or dry?
  - Generally, crops best harvested wet are also heat sensitive.
    - Harvest early morning when cool and wet from dew.
  - Crops best harvested dry are not as sensitive to harvesting in the heat of the day.

Crops to Harvest Dry

- Solanaceous family
  - Potatoes
  - Eggplant
  - Peppers
  - Tomatoes
  - Cucurbits
    - Cucumbers
    - Melons
    - Summer squash
  - Green beans
  - Storage onions, garlic, and winter squash
  - These should be dry going into storage

Crops to Harvest Wet

- Fresh greens
- Broccoli, cabbage, cauliflower
- Green top onions and leeks
- If harvesting these crops dry or warm, have a quick cooling process ready.

Field Sort at Harvest

- Damaged, cut or nicked
- Bruised or rotten
- Diseased

Containers

- Smooth, vented, and clean
- Plastic is generally preferred
  - Durability
  - Ease of cleaning

Avoid Handling Damage

- Damaged produce tends to have shorter shelf-life.
- Prone to disease and decay.
- Less appealing.
Preventing Handling Damage

• Wear cotton gloves.
• Set produce gently into containers.
• Don’t over fill containers.
• Take care to avoid stems damaging other fruit.

Postharvest Temperature mgt.

• Harvest during coolest time of day.
• Keep harvested produce in the shade.
• Thoroughly cool as soon as possible.
• Transport in pre-cooled vehicle.

Rules for Cooling With Water

• Always use potable water.
• Produce should always be clean before immersion.
• Slightly dirty produce should be cleaned in water no more than 10°F colder than produce.

Why Clean Produce?

• All produce should be clean when sent to market.
• Visually free of dust, dirt, soil, and debris.

• Improves shelf life
• Increases food safety
• Increases sales

Vegetable Specific Cleaning and Cooling

• Learning the correct process for each vegetable is important to:
  • Maintain quality
  • Minimize food safety hazards
  • Maximize shelf life
**Spinach and Salad Greens**

- **Harvesting:**
  - Morning or cool part of day
  - Knife, scissors, or salad cutter
  - Keep in shade if not cooled immediately
  - Cool within 1 – 2 hours

- **Cooling and Cleaning:**
  - Cool to 32°F
  - Can be iced
  - 10°F Rule

**Asparagus**

- **Harvesting:**
  - Morning or cool part of day
  - Knife, scissors, or salad cutter
  - Harvest into clean, sturdy containers
  - Do not let overheat

- **Cooling and Cleaning:**
  - Cool immediately after harvesting to 35°F
  - Soak in buckets
  - Can be iced

**Snap Beans**

- **Harvesting:**
  - Do not harvest wet
  - Keep stem ends intact
  - Make sure beans don’t get too hot or cold

- **Cooling and Cleaning:**
  - Cool to 41 to 46°F
  - Washing can be avoided if picked clean
  - If washing, screen dry before packing

**Broccoli**

- **Harvesting:**
  - Early morning, can be wet
  - Use clean field knives
  - Take care not to damage crowns with stem ends

- **Cooling and Cleaning:**
  - Cool quickly to 32°F
  - Can be iced
  - Washing can be avoided if harvested clean
  - Can be tank washed

**Tomatoes**

- **Harvesting:**
  - Avoid harvesting wet
  - Twist with downward motion
  - Wear cotton gloves and use to brush off dirt
  - Handle with care

- **Cooling and Cleaning:**
  - Cool to 45 to 55°F
  - Glove clean in field

**Carrots**

- **Harvesting:**
  - Loosen with a fork
  - Cull hairy carrots - bitter
  - Cull forked carrots

- **Cooling and Cleaning:**
  - Cool to 32°F
  - Spray clean on screen table
  - Pressure washer can be used on roots only
  - Can be packed moist and iced
Strawberries

- Harvesting:
  - Harvest fully ripe for best flavor
  - Sugar content does not increase after harvest
  - Free of disease and defects

- Cooling and Cleaning:
  - Cool to 32°F
  - No later than one hour after harvest
  - Room cool or forced air
  - Should not be washed

General Handling Rules

- Harvesting:
  - Use clean tools and containers
  - Avoid soil contact after harvest
  - Cull produce with disease and defects
  - Produce should be seen but not heard

- Cooling and Cleaning:
  - Use only potable water
  - Keep produce out of the sun postharvest
  - Cool as soon as possible
  - Keep cool

A Good Reference

Questions and Discussion

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UW-Extension, Portage County
ken.schroeder@ces.uwex.edu

http://www.familyfarmed.org/wholesalesuccess/