Ten Milestones in Public Health as identified by the Centers for Disease Control (CDC)

1. Vaccines and the Eradication of Disease
2. Automotive Safety
3. Environmental Health
4. Infectious Disease Control
5. Cancer Treatment
6. Cardiovascular Disease
7. Safer and Healthier Foods
8. Advances in Maternal and Child Care
9. Oral Health
10. Addiction
The Social-Ecological Model


Individual Factors:

• The first level identifies biological and personal history factors that increase the likelihood of a public health issue
• Some of these factors are age, education, income, substance use, or history
• Prevention strategies at this level are often designed to promote attitudes, beliefs, and behaviors that ultimately prevent violence. Specific approaches may include education and life skills training.
Vaccines and Disease Prevention Module

Impact of Vaccines

Learning Objectives

1. Explain the **impact of vaccines** and vaccine-preventable diseases

2. Describe the **history of vaccine development** and its impact on population health

3. Explain the **key scientific basis for the success of vaccines**
Impact of Vaccines in the 20th C.

<table>
<thead>
<tr>
<th>Disease</th>
<th>20th Century Annual Morbidity</th>
<th>2005 Total</th>
<th>% Decrease</th>
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<tbody>
<tr>
<td>Smallpox</td>
<td>48,184</td>
<td>0</td>
<td>100</td>
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<tr>
<td>Diphtheria</td>
<td>175,885</td>
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<tr>
<td>Pertussis</td>
<td>147,271</td>
<td>26,616</td>
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<tr>
<td>Tetanus</td>
<td>1,314</td>
<td>27</td>
<td>98</td>
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<tr>
<td>Polio (paralytic)</td>
<td>16,316</td>
<td>1*</td>
<td>&gt;99.9</td>
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<tr>
<td>Measles</td>
<td>503,282</td>
<td>68</td>
<td>&gt;99.9</td>
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<tr>
<td>Mumps</td>
<td>152,209</td>
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<tr>
<td>Rubella</td>
<td>47,745</td>
<td>11</td>
<td>&gt;99.9</td>
</tr>
<tr>
<td>Congenital rubella</td>
<td>823</td>
<td>1</td>
<td>99.8</td>
</tr>
<tr>
<td>Haemophilus influenzae (&lt;5 years)</td>
<td>20,000 (est)</td>
<td>226 (serotype B or unknown serotype)</td>
<td>99</td>
</tr>
</tbody>
</table>


Germ Theory of Disease

- Germ theory of disease states that many diseases are caused by microorganism

- The reproduction and growth of these germs within the host cause the disease

- “Germ” can refer to any microorganism in this sense; not only bacterium

- This idea goes back to antiquity in several cultures

- Antonie Van Leeuwenhoek (1632 – 1723) invented the microscope, and the theory was confirmed by scientists there after

- Bacteriology begins following these advances in scientific know-how
Pasteur, Spontaneous Generation, and Biogenesis

• Louis Pasteur (1822 – 1895)
• French microbiologist and chemist
• Known for his advancement and contributions to:
  • Vaccination
  • Microbial fermentation
  • Pasteurization

• His medical discoveries provided direct support for the germ theory of disease and its application in clinical medicine
• Best known to the general public for his invention of the technique of treating milk and wine to stop bacterial contamination
  • a process now called pasteurization
  • He is regarded as one of the three main founders of bacteriology, with:
    • Ferdinand Cohn, and
    • Robert Koch

• Pasteur is popularly known as the "father of microbiology"

Pasteur, Spontaneous Generation, and Biogenesis

• Spontaneous generation was a theory that described how living organisms could arise from inanimate things
  • Like maggots would arise from dead flesh (without eggs)
  • First formalized by Aristotle

• Pasteur foiled this theory by conducting an experiment in 1859

• He boiled meat broth in a specially designed flask that allowed air to flow while separating particles from the broth

• This lead to the theory of biogenesis
  • the belief that complex living things come only from other living things, by means of reproduction – i.e., life does not spontaneously arise from non-living material

• ...and later to the process of pasteurization
  • a process that kills microbes (mainly bacteria) in food and drink
What is a ‘Vaccine’?

• A vaccine is formally defined as:

  “a preparation of killed, weakened, or fully infectious microbes that is given to produce or increase immunity to a particular disease”

• The Dictionary of Public Health defines vaccine as:

  “The biologically active antigen, usually in liquid solution or colloid suspension that is injected or taken orally to immunize (vaccinate) individuals against communicable diseases. It may be prepared from a culture of live attenuated or killed organisms or from organisms with antigenic properties closely similar to those of the pathogen from which the vaccine is intended to provide protection”

What is a ‘Vaccine’?

• Vaccines can be administered as:
  - An injection,
  - Swallowed orally,
  - Nasal spray
  - And other newer, innovated ways

• Vaccines fall into three broad categories:
  1. Live (attenuated) Vaccine
     • Uses live, weakened version of the virus itself
     • Usually provides lifelong immunity
     • Examples: measles, mumps, and rubella (MMR)
  2. Killed (inactivated) Vaccine
     • Uses a pathogen exposed to Formalin – a chemical that kills its genetic material
     • Requires several injections over time
     • Examples: typhoid and Hib (a bacterial illness that can lead to a brain infection in children)
  3. Toxoid Vaccine:
     1. Uses protein toxins that have been secreted by pathogenic bacteria, but are inactive
     2. Requires several injections over time
     3. Examples: Diphtheria and tetanus
What is a ‘Pathogen’?

• A bacterium, virus, or other microorganism that can cause disease (biology)

• There are several substrates including pathways where the pathogens can invade a host

• The principal pathways have different episodic time frames
  • However, soil contamination has the longest or most persistent potential for harboring a pathogen

• Diseases caused by organisms in humans are known as pathogenic diseases

Types of Pathogens

• Bacterial – (most pathogens are of bacteria)

• Viral

• Fungal

• Prionic – (protein material that do not contain nucleic acids)

• Parasites (other)

• Algal
Vaccine-Preventable Diseases

- Anthrax
- Cervical Cancer
- Diphtheria
- Hepatitis A
- Hepatitis B
- *Haemophilus influenzae* type b (Hib)
- Human Papillomavirus (HPV)
- Influenza (Flu)
- Japanese Encephalitis (JE)
- Lyme Disease
- Measles
- Meningococcal
- Monkeypox
- Mumps
- Pertussis (Whooping Cough)
- Pneumococcal
- Poliomyelitis (Polio)
- Rabies
- Rotavirus
- Rubella (German Measles)
- Shingles (Herpes Zoster)
- Smallpox
- Tetanus (Lockjaw)
- Tuberculosis
- Typhoid Fever
- *Varicella* (Chickenpox)
- Yellow Fever

History of Vaccines: New Vaccines

- 1798 - Smallpox
- 1885 - Rabies
- 1897 - Plague
- 1917 - Cholera
- 1917 - Typhoid vaccine (parenteral)
- 1923 - Diphtheria
- 1926 – Pertussis (whooping cough)
- 1927 - Tuberculosis (BCG)
- 1927 - Tetanus
History of Vaccines: New Vaccines (Cont.)

- 1935 - Yellow Fever
- 1940s – DTP (Diphtheria, Tetanus, and Pertussis)
- 1945 - Influenza
- 1963 - The first measles vaccine licensed
- 1967 - Mumps vaccine licensed
- 1969 - Rubella vaccine licensed
- 1970 - Anthrax vaccine manufactured by the Michigan Department of Public Health
- 1971 - Measles, Mumps, Rubella vaccine licensed (MMR)
- 1981 - Meningococcal polysaccharide vaccine, groups A, C, Y, W135 combined (Menomune)

History of Vaccines: New Vaccines (Cont.)

- 1982 - Hepatitis B vaccine becomes available
- 1983 - Pneumococcal vaccine, 23 valent
- 1990 - *Haemophilus influenzae* type B (Hib) polysaccharide conjugate vaccine licensed for infants
- 1990 - Typhoid vaccine (oral)
- 1995 - Hepatitis A vaccine licensed
- 1998 - First rotavirus vaccine licensed
- 2004 - Pediarix, a vaccine that combines the DTaP, IPV, and Hep B
- 2006 - RotaTeq is a new rotavirus vaccine from Merck
- 2006 - Gardasil, the first HPV vaccine is approved
History of Vaccines: Health Outcomes Milestones

- 1977 - Last indigenous case of smallpox (Somalia)
- 1979 - Last case of polio, caused by wild virus, acquired in the United States
- 1980 - Smallpox declared eradicated from the world
- 1999 - Rotavirus vaccine withdrawn from the market due to adverse events
- 2003 - Measles declared no longer endemic in the Americas
- 2005 - Rubella declared no longer endemic in the United States


History of Vaccines: Challenges and Set-backs

- 1964 – 1965 - 20,000 cases of Congenital Rubella Syndrome occurred during the largest rubella epidemic in the U.S.
- 1976 - Swine Flu: largest public vaccination program in the U.S. to date
  - halted by association with Guillain-Barré syndrome
  - 55K cases compared with low of 1,497 cases in 1983
  - Two-dose measles vaccine (MMR) recommended
History of Vaccines: Challenges and Setbacks (Cont)

• 1999 - Rotavirus vaccine withdrawn from the market as a result of adverse events

• 2001 - September 11 results in increased concern of bioterrorism
  • The U.S. establishes a plan to re-introduce smallpox vaccine if necessary, a vaccine thought never to be needed again

• 2007 - HIV vaccine trial fails

Smallpox

- **What is smallpox?** Acute contagious disease caused by a virus

- **Origin:** 3000 years ago in Egypt or India.

- **Virus family:** Poxviridae or poxvirus.

- **Forms:**
  1. Variola minor (killed one in 100)
  2. Variola major (killed one in three)

- **Transmission:** Airborne droplet

- There is no cure, but vaccination can be used very effectively to prevent infection from developing if given during a period of up to four days after a person has been exposed to the virus.
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Smallpox

• Smallpox is/was:
  • The first disease for which a vaccine was created, and
  • The first disease that was eradicated by humankind!

• Prior to the development of the vaccine, a technique known as **variolation** had been in use for centuries.

• Populations in China, India, Turkey and other parts of the world would introduce scrapings of smallpox sores into healthy people.

• During the late 18th century, Lady Mary Wortley Montague, the wife of a British ambassador to China, observed this custom and discussed this practice in European social circles.

• During the same period, a physician named **Edward Jenner** learned from milkmaids that those who were previously exposed to cowpox developed protection against smallpox during subsequent epidemics.

• Most of them became immune, but between about 1% and 2% of those **variolated** in this way died.
Edward Jenner

- The discovery of smallpox vaccination is generally attributed to the English physician Edward Jenner.

- In 1796 Jenner noticed that milkmaids never seemed to get smallpox because they had caught what he thought was cowpox.

- Jenner set out to prove this by scratching the arm of an eight-year-old boy named James Phipps and deliberately infected him with cowpox pus taken from a blister on the hand of a milkmaid.

- Months later, he infected the boy using pus taken from a smallpox patient.

- The boy didn’t develop the disease! The cowpox had made him immune.

Edward Jenner

- It was not until 1938 that another scientist, Allan Watt Downie, realized that cowpox did not make people immune from smallpox but a related virus, called vaccinia virus.

- Jenner coined the term ‘vaccination’ from the Latin word for cow, vaccus.

- In the 1870s, Louis Pasteur developed preparations that protected people against rabies and anthrax.
  - He coined the term ‘vaccine’ for this type of preparation in honor of Jenner’s accomplishments.
  - “Vaccinia” is truly the world’s first vaccine...

- In the USA, Dryvax became the first approved vaccinia virus vaccine in 1931.

- In 2003, because of the concern for biological warfare, the USA government recommended that all first responders be vaccinated with the vaccinia virus.
SIR,
-- I have received a copy of the evidence at large respecting the discovery of the vaccine inoculation which you have been pleased to send me, and for which I return you my thanks. Having been among the early converts, in this part of the globe, to its efficiency, I took an early part in recommending it to my countrymen. I avail myself of this occasion of rendering you a portion of the tribute of gratitude due to you from the whole human family. Medicine has never before produced any single improvement of such utility. Harvey's discovery of the circulation of the blood was a beautiful addition to our knowledge of the animal economy, but on a review of the practice of medicine before and since that epoch, I do not see any great amelioration which has been derived from that discovery. You have erased from the calendar of human afflictions one of its greatest. Yours is the comfortable reflection that mankind can never forget that you have lived. Future nations will know by history only that the loathsome small-pox has existed and by you has been extirpated. Accept my fervent wishes for your health and happiness and assurances of the greatest respect and consideration.

-Thomas Jefferson to Edward Jenner, May 4, 1806


Global Eradication of Smallpox

• In 1967, the World Health Organization (WHO) targeted smallpox for eradication from the planet by the end of the 20th century

• The WHO achieved this goal, with the last endemic case of smallpox reported in Somalia in 1977 and eradication declared in 1980

• This effort was successful for several reasons, including the lack of any natural reservoir for variola virus and the ease of identifying infected individuals

• Who receives the credit for the eradication of smallpox? This has been somewhat of a controversy, so we will try to sort out the details...
Global Eradication of Smallpox

- Governments of Developed Countries around the world first seriously discussed the possibility of eradication in 1953 at the annual World Health Assembly, but there was little enthusiasm for the idea

- Sceptics pointed to several failed attempts to eradicate other diseases:
  - hookworm at the turn of the 20th century
  - while efforts to stamp out yellow fever had been called off in 1932

- World Health Organization’s own campaign to eradicate malaria was just getting under way in the 1950s – a massive undertaking that succeeded in some countries of the Americas, Asia and Europe, but failed in Africa

- Given widespread doubt in the 1950s that any disease could be eradicated, it required someone with more than just technical knowledge of smallpox control to give WHO’s program its first real impetus

- Who is credited with succeeding in this WHO effort to rid the world of smallpox?

Viktor Zhdanov (1914 – 1987)

- According to the WHO, it was Soviet scientist, Viktor Zhdanov!

- Speaking at the World Health Assembly in 1958, Zhdanov, an epidemiologist by training and deputy health minister of the what was the U.S.S.R., called for the total eradication of the smallpox virus

- Born in the Ukraine, Zhdanov was a Soviet virologist (who may have also worked in the USSR’s biological weapons program)

- He had assisted in containing smallpox USSR in the 1930s

- Zhdanov believed the Soviet success could be repeated elsewhere

- He proposed a four-year global vaccination campaign starting in 1959
Viktor Zhdanov (1914 – 1987)

- Zhdanov also brought his belief in a technique known as lyophilization, or freeze-drying, which had been developed during World War II for dried blood plasma

- Soviet research in the 1950s had shown that several pharmaceutical products could be preserved in this way, including the smallpox vaccine

- Freeze-dried vaccine can be transported and reconstituted when needed

- This was unlike other vaccines, like polio, which has to be refrigerated, greatly complicating the task of getting it into the field

- Zhdanov believed that freeze-dried vaccine would be an essential tool in WHO's smallpox eradication program, and said the Soviet government would furnish WHO with supplies

The World Rally’s to Eradicate Smallpox

- By the end of 1966, smallpox was still circulating in 31 countries and territories

- In 1965, President Lyndon B. Johnson announced that the USA would fully support a program to eradicate smallpox in 20 countries of west and central Africa and backed the idea of global smallpox eradication
  - Only 2.4 million USD were pledged (about $19m USD in today’s value)

- President Johnson said:
  - "as long as smallpox exists anywhere in the world, no country is safe from it. This dread disease spreads so rapidly, that even a single case creates the threat of epidemic. It is clear that every nation of the world, whether or not it has experienced smallpox in recent years, has a major stake in a worldwide eradication program."
Donald Henderson (1928 - 2016)

• Born in Ohio, Henderson was a medical physician and epidemiologist

• Henderson served as Chief of the CDC virus disease surveillance programs from 1960 to 1965

• He and his unit developed a proposal for a United States Agency for International Development (USAID) program to eliminate smallpox and control measles during a 5-year period in 18 contiguous countries in western and central Africa

• In 1966, Henderson was sent to Geneva to head WHO’s Smallpox Eradication unit. From 1967 to 1977, Henderson led an international effort of the WHO to eradicate smallpox from the world

• This project was funded by USAID, with field operations beginning in 1967, but was also the jumpstarter for the WHO’s program to eradicate smallpox throughout the world in 10 years

Smallpox Eradication Today:

• Smallpox eradication timeline:
  • North America - 1952
  • Europe - 1953
  • South America – 1971
  • Asia - 1975
  • Africa – 1977
  • Smallpox was never widespread in Australia

• In 1975, a three-year-old girl from Bangladesh, was the last person in the world to have naturally acquired variola major and the last person in Asia to have active smallpox

• She was isolated at home with house guards posted 24 hours a day until she was no longer infectious

• A house-to-house vaccination campaign within a 1.5 mile radius of her home began immediately, and every house, public meeting area, school, and healer within 5 miles was visited by a member of the Smallpox Eradication Program team to ensure the illness did not spread

• A reward was also offered to anyone for reporting a smallpox case
Automotive Safety Module

Context: The Milestone and its Impact on Public Health

Fatalities are just the tip of the iceberg...

For each death, 18 persons are hospitalized and 400 are medically attended injuries

NHTSA 2020 Report
## Timeline

<table>
<thead>
<tr>
<th>20th Century</th>
<th>Motorization of America</th>
</tr>
</thead>
<tbody>
<tr>
<td>1896</td>
<td>First recorded fatality occurred in London in an onlooker during a demonstration drive</td>
</tr>
<tr>
<td>September 1899</td>
<td>First U.S. fatality occurred in NYC</td>
</tr>
<tr>
<td>Mid-1960s</td>
<td>Modern injury science emerged as a distinct field</td>
</tr>
<tr>
<td>1985</td>
<td>Shift of focus: Accident prevention to injury prevention</td>
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</table>

### 10 Leading Causes of Death by Age Group, United States – 2003

<table>
<thead>
<tr>
<th>Rank</th>
<th>Age Groups</th>
<th>2003 Death Count</th>
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<tbody>
<tr>
<td>1</td>
<td>&lt;1</td>
<td>26,350</td>
</tr>
<tr>
<td>2</td>
<td>1-4</td>
<td>12,850</td>
</tr>
<tr>
<td>3</td>
<td>5-9</td>
<td>12,250</td>
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<td>4</td>
<td>10-14</td>
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<td>11,200</td>
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<tr>
<td>7</td>
<td>35-44</td>
<td>10,850</td>
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<td>8</td>
<td>45-54</td>
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<tr>
<td>9</td>
<td>55-64</td>
<td>10,150</td>
</tr>
<tr>
<td>10</td>
<td>65+</td>
<td>9,800</td>
</tr>
</tbody>
</table>

Source: National Vital Statistics System, National Center for Health Statistics, CDC.

CDC (2006)
The Problem

Motor vehicle injuries occur at all stages of life and includes the following issues:

1. Alcohol-related motor vehicle injuries
2. Child passenger safety
3. Older adult drivers
4. Road traffic safety
5. Teens behind the wheel
Alcohol-Related Crashes

- An alcohol-related motor vehicle crash kills someone every 31 minutes and injures someone non-fatally every 2 minutes
- More than 1.4 million drivers were arrested for driving under the influence of alcohol or narcotics
- About 3 in 10 Americans are involved in an alcohol-related crash in their lifetimes
- The number of alcohol-related fatal crashes is growing
- Costs Americans approximately $51B annually

Child Passenger Safety

- Motor vehicle injuries are among the greatest public health problem facing U.S. children today
- During 2003, a total of 1,591 children aged 14 years and younger died as occupants in motor vehicle crashes, and approximately 220,000 were injured
- Most of these children were riding unrestrained, thus many of these injuries could have been prevented
- Drinking and driving are injury and fatality risk factors for children
Older Adult Drivers

- In 2002, a total of 7,688 people ages 65 and older died in motor vehicle crashes in the U.S.

- Drivers ages 65 and older have higher crash death rates per mile driven than all but teen drivers.

- Rates for motor vehicle-related deaths and injury are twice as high for older men as for older women.

- Motor vehicle-related deaths and injuries among older adults are rising.

CDC (2006)

Teens Behind the Wheel

- Motor vehicle-related injuries are the biggest health threat to teens in U.S.

- Account for 2/5 of deaths overall.

- In 2002, >5,000 teens, ages 16-19 died of injuries caused by motor vehicle crashes.

- Risk highest among 16-19 year-olds.

- Cost (fatal and non-fatal) involving drivers 15-20 years was $40.8 billion in 2002.

CDC (2006)
Road Traffic Safety

- Road traffic crashes kill 1.2 million/year worldwide
- Road traffic crashes injure or disable 20 million to 50 million each year
- Ranks as 11th cause of death and account for 2% of all deaths globally
- By 2020, road traffic injuries predicted to become 3rd largest contributor to global burden of disease
- Economic cost of road traffic injuries is an estimated $518 billion

Public Health and the motorization of America

- Six times as many people drive today as in 1925
- The number of motor vehicles in the country has increased 11-fold since then to approximately 215 million
- The number of miles traveled in motor vehicles is 10 times higher than in the mid-1920s
- More than 79,500 adults ages 20 to 49 died from injuries in 2002
- Motor vehicle crashes were the leading cause of those deaths
Public Health and the motorization of America

• Systematic motor-vehicle safety efforts began during the 1960s
  • In 1960, unintentional injuries caused 93,803 deaths
  • 41% were associated with motor-vehicle crashes

• In 1966, after 5 years of continuously increasing motor-vehicle-related fatality rates, the Highway Safety Act created the National Highway Safety Bureau (NHSB), which later became the National Highway Traffic Safety Administration (NHTSA)

• The systematic approach to motor-vehicle-related injury prevention began with NHSB's first director, Dr. William Haddon

• Haddon, a public health physician, recognized that standard public health methods and epidemiology could be applied to preventing motor-vehicle-related and other injuries

• He defined interactions between host (human), agent (motor vehicle), and environmental (highway) factors before, during, and after crashes resulting in injuries

Four Types of Energy (Cont.)

• Kinetic:
  • falls, motor vehicle crashes

• Electrical:
  • lightning strikes, downed wires

• Chemical:
  • poisonings

• Thermal/Radiant Energy:
  • steam or flame burns

➢ Two types involved in motor vehicle crashes
  • Kinetic
  • Thermal
Energy the Main Cause of Injury

• The Body’s Response to Injury
  • Each body tissue has a unique ability to absorb and dissipate energy without injury until a critical threshold is reached

• Tissue Fragility and Injury Threshold
  • comorbid factors; age as a factor

• Tissue Healing

• Injury Mechanics
  • Kinetic energy causes the majority of injuries

Haddon Matrix (1973)

• Haddon described basic strategies that prevent energy from reaching people at rates or in amounts that are harmful
• These strategies can be summarized as:
  1. not producing energy or potential sources of energy, or reducing the amount of energy
     • e.g., not making gunpowder)
     • reducing the speed capabilities of cars
  2. preventing or modifying the release or transfer of energy
     • (e.g., having safety catches on guns)
     • slowing the burning rate of cloth
     • padding automobile dashboards
  3. separating people from potentially injurious sources of energy
     • using barriers
     • phasing traffic
     • putting electric lines out of reach
### Haddon Matrix (1968)

<table>
<thead>
<tr>
<th>Phases</th>
<th>Individual behavior</th>
<th>Agent</th>
<th>Physical environment</th>
<th>Socio-economic environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Haddon Matrix - Factors

- The matrix of four columns and three rows combines public health concepts of host-agent-environment as targets of change with the concepts of primary, secondary, and tertiary prevention.

- More specifically, the factors defined by the columns in the matrix refer to the interacting factors that contribute to the injury process.

- The host column refers to the person at risk of injury.

- The agent of injury is energy (for example mechanical, thermal, electrical) that is transmitted to the host through a vehicle (inanimate object) or vector (person or other animal).

- Physical environments include all the characteristics of the setting in which the injury event takes place (for example a roadway, building, playground, or sports arena).

- Social and legal norms and practices in the culture are referred to as the social environment.

Runyan, 1988
Haddon Matrix - Phases

• The *phases* in Haddon’s initial configuration referred to rows in the matrix

• These are the phases at which change would have its effect
  • pre-crash
  • crash, or
  • post-crash

• These have been broadened beyond the motor vehicle arena to encompass other injury problems by using the terms “pre-event,” “event” and “post-event”

• By identifying interventions that fit within each cell of the matrix one can generate a list of strategies for addressing a variety of injury or other public health problems

Runyan, 1988

Runyan, et. al.’s 3rd Dimension to Haddon

The third dimension of the matrix incorporates the use of value criteria in the decision making process

Each needs to be carefully thought through in the context of the injury countermeasure being considered, whether:

• a **policy**
  i.e., drinking age laws

• a **program**
  i.e., training of bartenders not to serve underage or inebriated customers

• or a **technological intervention**
  i.e., an ignition interlock device
Haddon Matrix - Use

• First is planning whether using the matrix or any other technique

• Clearly identify clearly the problem to be addressed using appropriate data from the community to assess need

• Before using the matrix to derive potential interventions, it is necessary to identify the injury issue to be addressed;
  • i.e., falls from playground equipment, bicycle crashes, bathtub drownings, child physical abuse, or residential fires

• Second, one needs to define each row and column of the matrix
  • The host is the person in the car
  • The vectors in this example are the vehicles safety features
  • The social environment refers to the social norms, policies, and procedures that govern such practices

Applying Haddon Matrix to Motor Vehicle Crashes (McKay 2008)

<table>
<thead>
<tr>
<th></th>
<th>Host / Human</th>
<th>Vector/Vehicle</th>
<th>Physical/Social Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Event</td>
<td>Intoxication</td>
<td>Speed</td>
<td>Speed Cameras</td>
</tr>
<tr>
<td></td>
<td>Safety Belt Use</td>
<td>Brakes Functioning</td>
<td>Weather</td>
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<td></td>
<td>Speed</td>
<td>I Beams</td>
<td>Social Culture</td>
</tr>
<tr>
<td></td>
<td>Alertness/Sleepiness</td>
<td>Crumple Zones</td>
<td>Willingness to allow others to drive drunk</td>
</tr>
<tr>
<td></td>
<td>Experience</td>
<td></td>
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</tr>
<tr>
<td>Event</td>
<td>Frailty</td>
<td>Speed of Impact</td>
<td>Flammability</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>Air Bags</td>
<td>Guard rails</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>Size</td>
<td>Stiffness of fixed objects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stiffness of Surfaces</td>
<td>Barriers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stability Control</td>
<td>Embankments</td>
</tr>
<tr>
<td>Post-Event</td>
<td>Body Mass Index</td>
<td>Degree of crush</td>
<td>EMS response</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>Fuel System integrity</td>
<td>Trauma Center availability</td>
</tr>
<tr>
<td></td>
<td>Co-morbid conditions</td>
<td></td>
<td>Rehab Programs</td>
</tr>
</tbody>
</table>
Motor vehicle deaths are recorded two ways:

The Auto Safety industry uses the 'per vehicle miles traveled (VMT) unit

The Public Health discipline uses the 'per 100,000 people' unit
The U.S. Department of Transportation’s National Highway Traffic Safety Administrations (NHTSA) maintains statistics on traffic fatalities and monitors trends in highway safety.

The mission of the NHTSA is to:

Save lives, prevent injuries, and reduce economic costs due to road traffic crashes through education, research, safety standards, and enforcement activity.
US DOT National Health Traffic Safety Administration – Latest Stats:

- The 2016 national data shows that:
  - Distraction-related deaths (3,450 fatalities) decreased by 2.2 percent;
  - Drowsy-driving deaths (803 fatalities) decreased by 3.5 percent;
  - Drunk-driving deaths (10,497 fatalities) increased by 1.7 percent;
  - Speeding-related deaths (10,111 fatalities) increased by 4.0 percent;
  - Unbelted deaths (10,428 fatalities) increased by 4.6 percent;
  - Motorcyclist deaths (5,286 fatalities) increased by 5.1 percent;
    - the largest number of motorcyclist fatalities since 2008
  - Pedestrian deaths (5,987 fatalities) increased by 9.0 percent;
    - the highest number since 1990
  - Bicyclist deaths (840 fatalities) increased by 1.3 percent
    - the highest number since 1991

Using colored lanes to differentiate various lanes for various modes of transport

Here, green indicates a bike lane and the red curb is indicates pedestrians
Vehicle Speed and the Risk of Fatality

If hit by a person driving at:

- **20 MPH**
  - Person Survives: 90%
  - Results in a Fatality: 10%

- **30 MPH**
  - Person Survives: 60%
  - Results in a Fatality: 40%

- **40 MPH**
  - Person Survives: 20%
  - Results in a Fatality: 80%


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what is safe street design?

Create a sense of place with street trees, pedestrian-scale lighting, and parks

Slow vehicle speeds with road diets or raised medians

Provide space for cyclists with buffered bike lanes and intersection improvements

Improve safety with high-visibility crosswalks and curb extensions

Smart Street Design – Lane widths

Lane widths should be considered within the assemblage of a given street delineating space to serve all needs, including travel lanes, safety islands, bike lanes, and sidewalks.

Smart Street Design – Sidewalks

As public spaces, sidewalks serve as the front steps to the city, activating streets socially and economically. Safe, accessible, and well-maintained sidewalks are a fundamental and necessary investment for cities, and have been found to enhance general public health and maximize social capital.
Smart Street Design – Gateways/ Curb Extensions

Curb extensions increase the overall visibility of pedestrians by aligning them with the parking lane and reducing the crossing distance for pedestrians.

Smart Street Design – Pinchpoints

Curb extensions may be applied at midblock to slow traffic speeds and add public space. When utilized as a traffic calming treatment, mid-block curb extensions are referred to as "pinchpoints" or "chokers".
Milestones in Public Health: Chapter 3

Healthier Environments

The Social-Ecological Model

TOP 10 CAUSES OF DEATH FROM THE ENVIRONMENT

8.2 million out of 12.6 million deaths caused by the environment are due to noncommunicable diseases.

1st
STROKE
2.5 million

2nd
ISCHEMIC HEART DISEASE
2.3 million

3rd
UNINTENTIONAL INJURY
1.7 million

5th
CHRONIC RESPIRATORY DISEASES
1.4 million

4th
CANCERS
1.7 million

6th
DIARRHEAL DISEASES
846,000

7th
RESPIRATORY INFECTIONS
670,000

8th
INTENTIONAL INJURY
246,000

9th
MALARIA
218,000

10th
BIRTH INJURIES
215,000

HOW THE ENVIRONMENT IMPACTS OUR HEALTH

People are exposed to risk factors in their homes, work places and communities through:

AIR POLLUTION
including indoor and outdoor

CLIMATE CHANGE

INADEQUATE WATER, SANITATION
and hygiene

BUILDING ENVIRONMENTS
including housing and roads

CHEMICALS
and biological agents

AGRICULTURAL PRACTICES
including pesticide use, soil contamination

RADIATION
ionizing and non-ionizing

COMMUNITY NOISE

OCCUPATIONAL RISKS
WHO IS MOST IMPACTED BY THE ENVIRONMENT

Environmental impacts on health are uneven across age and mostly affect the poor.

Low- and middle-income countries bear the greatest share of environmental disease.

Men are slightly more affected due to occupational risks and injuries.

Women bear higher burdens in traditional environmental risks such as smoke from cooking with solid fuels or open fires.

YEARLY

- 4.9 MILLION
  Deaths in adults between 50 and 75 years. The most common causes are communicable, maternal, neonatal, and nutritional diseases.

- 1.7 MILLION
  Deaths in children under 5 years. The most prevalent causes are infectious diseases and accidents.

LET’S WORK TOWARDS A HEALTHIER ENVIRONMENT FOR OUR HEALTH.

WE CAN IMPROVE OUR ENVIRONMENT TO IMPROVE OUR HEALTH

1. Apply low-carbon strategies in energy generation, housing, and the industry.
2. Use more active and public transportation.
3. Introduce clean fuels for cooking, heating, and lighting and clean technologies.
4. Reduce occupational exposures and improve working conditions.
5. Increase access to safe water and adequate sanitation and promote hand washing.
6. Change consumption patterns to lower the use of harmful chemicals, minimize waste production and save water.
7. Implement interventions that can increase safe protective behavior.
8. Pass smoking bans to reduce exposure to second-hand tobacco smoke.
9. Always use a health in all policies approach to ensure healthier environments and prevent disease.
Definitions of Environmental Health
(by the National Environmental Health Association)

Environmental health is the science and practice of preventing human injury and illness and promoting well-being by

- identifying and evaluating environmental sources and hazardous agents, and
- limiting exposures to hazardous physical, chemical, and biological agents in air, water, soil, food, and other environmental media or settings that may adversely affect human health.

Definitions of Environmental Health Professional
(by the National Environmental Health Association)

An environmental health professional or specialist is a practitioner with appropriate academic education and training and registration or certification to;

- investigate, sample, measure, and assess hazardous environmental agents in various environmental media and settings
- recommend and apply protective interventions that control hazards to health
- develop, promote, and enforce guidelines, policies, laws, and regulations
- develop and provide health communications and educational materials
- manage and lead environmental health units within organizations
- perform systems analysis
- engage community members to understand, address, and resolve problems
- review construction and land use plans and make recommendations
- interpret research utilizing science and evidence to understand the relationship between health and environment; and
- interpret data and prepare technical summaries and reports
Five basic disciplines generally contribute to the field of environmental health

**Environmental epidemiology** studies the relationship between environmental exposures (including exposure to chemicals, radiation, microbiological agents, etc.) and human health

**Toxicology** studies how environmental exposures lead to specific health outcomes, generally in animals, as a means to understand possible health outcomes in humans

**Exposure Science** studies human exposure to environmental contaminants by both identifying and quantifying exposures

**Environmental Engineering** applies scientific and engineering principles for protection of human populations from the effects of adverse environmental factors; protection of environments from potentially deleterious effects of natural and human activities; and general improvement of environmental quality

**Environmental Law** includes the network of treaties, statutes, regulations, common and customary laws addressing the effects of human activity on the natural environment
Learning Objectives

- Describe the impact of environment on health
- Discuss environmental risk factors
- Describe the history of advancements in prevention and management of environmental health hazards
- Describe the policies, systems and programs to implement population-based prevention initiatives
The environment is all the physical, chemical and biological factors external to a person, and all the related behaviors.

(This definition excludes behavior not related to environment, as well as behavior related to the social and cultural environment, and genetics.)
Included Environmental Factors Are the Modifiable Parts (or Impacts) of:

- Pollution of air, water or soil with chemical or biological agents
- UV and ionizing radiation
- Noise, electromagnetic fields
- Occupational risks
- Built environments, including housing, land use patterns, roads
- Agricultural methods, irrigation schemes
- Man-made climate change, ecosystem change
- Behavior – related to the availability of safe water and sanitation facilities, such as washing hands and contaminating food with unsafe water or unclean hands

Comparative Risk Assessment

Comparative Risk Assessment is defined as the systematic evaluation of the changes in population health which result from modifying the population distribution of exposure to a risk factor or a group of risk factors. Burden of Disease (or any measure of population health or disease) can be classified.
Environmental Factors Commonly Excluded:

- Alcohol and tobacco consumption, drug abuse
- Diet
- The natural environments of vectors that cannot reasonably be modified (e.g. in rivers, lakes, wetlands)
- Unemployment (provided that it is not related to environmental degradation, occupational disease, etc.)
- Natural biological agents, such as pollen in the outdoor environment
- Person-to-person transmission that cannot reasonably be prevented through environmental interventions such as improving housing, introducing sanitary hygiene, or making improvements in the occupational environment


Environmental Risk Factors and Related Diseases Included in the Comparative Risk Assessment (CRA)

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Related Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor air pollution</td>
<td>Respiratory infections, selected cardiopulmonary diseases, lung cancer</td>
</tr>
<tr>
<td>Indoor air pollution</td>
<td>COPD, lower respiratory infections, lung cancer</td>
</tr>
<tr>
<td>Lead</td>
<td>Mild mental retardation, cardiovascular diseases</td>
</tr>
</tbody>
</table>

* CRA = Comparative Risk Assessment

Environmental Risk Factors and Related Diseases Included in the CRA (Cont.)

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Related Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water, sanitation, and hygiene</td>
<td>Diarrheal diseases, trachoma, schistosomiasis, ascariasis, trichuriasis, hookworm disease</td>
</tr>
<tr>
<td>Climate change</td>
<td>Diarrheal diseases, malaria, selected unintentional injuries, protein-energy malnutrition</td>
</tr>
</tbody>
</table>

*CRA = Comparative Risk Assessment


Rachel Carson (1907 – 1964)

Carson was a trained marine biologist and a founding mother of Conservation

Her first two books, *The Sea Around Us*, and *Under the Sea* were best sellers and provided enough income to pursue more environmental journalism

*Silent Spring* was published in 1962 and is one of the most important documents in the canon of the environmental movement, history, and journalism

*Silent Spring* lead the charge against DDT (Dichlorodiphenyltrichloroethane)

Carson combined scientific knowledge and background with her talented ability to convey the science in a poetic, accessible fashion reached a broad audience and helped to focus opposition to DDT use

In 2012 *Silent Spring* was designated a *National Historic Chemical Landmark* by the American Chemical Society for its role in the development of the modern environmental movement
**DDT (Dichlorodiphenyltrichloroethane)**

DDT is a synthetic first produced in 1874

DDT’s insecticidal action was discovered by the Swiss chemist Paul Hermann Müller in 1939

DDT was available for industrial and domestic use in the USA until 1972

DDT is the best-known of several chlorine-containing pesticides used in the 1940s and 1950s

In insects it opens sodium ion channels in neurons, causing them to fire spontaneously, which leads to spasms and eventual death

DDT was used extensively during World War II by the Allies to control the insect vectors of typhus and nearly eliminated the disease in many parts of Europe

In the South Pacific, it was sprayed aerially for malaria and dengue fever control

In 1945, DDT was made available to farmers as an agricultural insecticide

DDT helped bring the final elimination of malaria in Europe and North America

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**Rachel Carson Homestead in Springdale, PA**

[Image of Rachel Carson Homestead in Springdale, PA]

Open every Saturday from April 12 to November 18, 2017

The Rachel Carson Homestead is a small working farm open to the public for guided tours and self-guided exploration.