HIV/AIDS: Epidemiologic Perspective

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Session Overview

• Key concepts in epidemiology
• What is epidemiology?
• Study design
• Measures of association

• Epidemiology of HIV

Epidemiology: A Brief Introduction

What is Epidemiology?

EPI
Upon

DEMOS
People

LOGOS
Study

The study of anything that happens to people

History of Epidemiology
History of Epidemiology

What is Epidemiology?

• The study of the distribution and determinants of disease frequency in human populations and the application of this study to control health problems
  • Disease frequency - count cases, need system, records
  • Disease distribution - who, when, where
  • Determinant - a characteristic that influences whether or not disease occurs

Study Design: Overview

• Observational
  • Ecologic
  • Cross-sectional
  • Case-Control
  • Cohort
• Experimental
  • Randomized trials / Intervention studies

Ecological Study: HIV and Income

Ecological Study

“Stop global warming - become a pirate!”

GapMinder HIV Chart 2009

Venganza.org
Cross-sectional Study

Population

Selected sample

Risk factor
- Disease present
- No disease

Risk factor
- Disease present
- No disease

Case-control Study

Analytic Epidemiology

Time
- Past
- Present
- Future

Case-control Study

Cohort

Outcome

Exposure

Outcome

Case-control Study

Cohort Study

HIV Prevalence

Women

Men

Total

Percent

Tanzania

Urban

Rural

Cohen, 1996

Past

Future
Cohort Study

- The longest U.S. study of people with HIV/AIDS
- Over 1,000 publications
- Numerous seminal discoveries:
  - How best to diagnose HIV infection
  - The direct relationship between viral load and HIV disease progression
  - The importance of CD4 T-cells and link between low numbers of these cells and progression to clinical AIDS
  - The central role of immune activation in HIV disease
  - How to best manage HIV/AIDS care and treatment
  - The epidemiology of major diseases that occur in conjunction with HIV/AIDS, including Kaposi’s sarcoma

Randomized Trial

- Intervention group
  - Outcome present?
    - Yes
    - No
- Control group
  - Outcome present?
    - Yes
    - No

Randomized Trial

<table>
<thead>
<tr>
<th>Study Features</th>
<th>Week 48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laminidine + Zidovudine + Efavirenz (n=12)</td>
<td></td>
</tr>
<tr>
<td>Tenofir + Zidovudine + Efavirenz (n=12)</td>
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Mathews, 2008

Randomized Trial

1. Vitamin A alone
2. Multivitamins excluding Vitamin A
3. Multivitamins including Vitamin A
4. Placebo

- Preformed Vitamin A: 5000 IU
- β-Carotene: 30 mg
- B1: 20 mg
- B2: 20 mg
- B6: 25 mg
- Niacin: 100 mg
- B12: 50 µg
- C: 500 mg
- E: 30 mg
- Folate: 0.8 mg

- 1 & 3: Vitamin A 200,000 IU
- 2 & 4: Placebo daily

TOV Study Profile

Mathews, 2008

Measures of Disease Frequency

- Prevalence
  - Number of cases of a disease in a specified population at a designated point in time

- Incidence
  - Measures occurrence of new cases of disease that develop in a population over a specified time period
  - At risk, follow-up time

Prevalence and Incidence: Public Health

- Prevalence
  - To estimate the needs of medical facilities and to allocate resources for treating diseased individual
  - Heterogonous: Prevalence = Incidence X duration

- Incidence
  - To evaluate effectiveness of programs that try to prevent disease and for etiologic studies
Measures of Disease Occurrence

Prevalence vs. Incidence?

Summary
- Research questions should inform epidemiologic methods
- Critical role of epidemiologic methods in public health research
- Strengths and limitations of methods utilized
- Training in epidemiology

HIV/AIDS

“The time has come to close the book on infectious diseases. We have basically wiped out infection...”


Key Terms

- Incidence = # of new cases that develop during a given time period
- Prevalence = # of cases at a specific time point
- Endemic = habitual presence of a disease under normal circumstances
- Epidemic = occurrence of larger number of cases than expected ordinarily and derived from a common/propagated source
- Pandemic = a worldwide epidemic

Natural History of Disease

<table>
<thead>
<tr>
<th>Exposure to etiological agent</th>
<th>Pathologic changes</th>
<th>Symptoms</th>
<th>Usual time of diagnosis</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV exposure (undiagnosed)</td>
<td></td>
<td>Clinical illness with signs and symptoms</td>
<td>HIV infection</td>
<td>AIDS diagnosis...</td>
</tr>
</tbody>
</table>

HIV in the United States

- More than one million people are living with HIV in the U.S.
- Every 9 1/2 minutes, someone in the U.S. is infected with HIV
- One in five people living with HIV doesn’t know they are infected
- Only 45% of HIV-infected patients in the U.S. are currently receiving regular medical care
Global Burden of HIV/AIDS

Over 7000 new infections per day:
97% in low and middle income countries

Estimated number of adults and children newly infected with HIV | 2011

Total: 2.5 million [2.2 million – 2.8 million]

Children (<15 years) estimated to be living with HIV | 2011

Total: 3.4 million [3.1 million – 3.9 million]

Global Response to HIV/AIDS

UNAIDS, 2012 Global Report

HIV Investment in Low and Middle-Income Countries in Billions of USD (2005-2011)
HIV Investment vs. Resource Needs

Change in HIV Incidence Over Time 2001-2011

% Change in AIDS-related Deaths (2005-2011)

HIV/AIDS Burden in the Past Two Decades

People Newly Infected with HIV Annually
HIV Prevalence in Young Adults

<table>
<thead>
<tr>
<th>Country</th>
<th>15-19 years</th>
<th>20-24 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td></td>
<td></td>
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<tr>
<td>Republic of the Congo</td>
<td></td>
<td></td>
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<tr>
<td>Lesotho</td>
<td></td>
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<tr>
<td>South Africa</td>
<td></td>
<td></td>
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<tr>
<td>Zimbabwe</td>
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Are women more vulnerable to the impact of HIV?

Steve McCurry, National Geographic

Risk of Mother to Child HIV Transmission Without Interventions

<table>
<thead>
<tr>
<th>Phase</th>
<th>Probability</th>
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<tbody>
<tr>
<td>Pregnancy</td>
<td>5-10%</td>
</tr>
<tr>
<td>Labor and Delivery</td>
<td>10-20%</td>
</tr>
<tr>
<td>Breastfeeding</td>
<td>10-20%</td>
</tr>
<tr>
<td>Overall</td>
<td>30-45%</td>
</tr>
</tbody>
</table>

Number of People Receiving Antiretroviral Therapy in Low and Middle Income Countries (2002-2011)

Proportion of Eligible People Receiving ART

<table>
<thead>
<tr>
<th>Proportion</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20%</td>
<td></td>
</tr>
<tr>
<td>20-39%</td>
<td></td>
</tr>
<tr>
<td>40-59%</td>
<td></td>
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<tr>
<td>60-79%</td>
<td></td>
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<tr>
<td>&gt;80%</td>
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Adult Retention in ARV Therapy in First 48 Months
HIV Investment in Resource-Limited Countries

Antiretroviral Therapy to Prevent MTCT of HIV

Gaps in Antiretroviral Therapy to Prevent Mother to Child HIV Transmission

Gap in ART Coverage for PMTCT of HIV Globally

New UNAIDS Targets for 2015

Integration of Vertical HIV Approaches with Comprehensive Care and Treatment

Recognizing the genuine opportunity to scale up the end of AIDS, countries pledged to the 2011 United Nations Political Declaration on HIV and AIDS (1) to take specific steps to achieve ambitious targets by 2015. Drawing from the 2011 Political Declaration, UNAIDS has articulated 10 specific targets for 2015 to guide collective action.

1. Reduce new infections by 50%.
2. Reduce HIV transmission among women who inject drugs by 50%.
3. Eliminate new infections among children and substantially reduce the number of mothers dying from AIDS-related causes.
4. Provide antiretroviral therapy to 15 million people.
5. Reduce the number of people living with AIDS who die from tuberculosis by 50%.
7. Eliminate gender inequalities and gender-based violence and reduce and increase the capacity of women and girls to protect themselves from HIV.
8. Eliminate stigma and discrimination against people living with and affected by HIV by promoting laws and policies that ensure the full realization of all human rights and fundamental freedoms.
9. Eliminate restrictions for people living with HIV on entry, stay and residence.
10. Eliminate parallel systems for HIV-related services to strengthen the integration of the AIDS response in global health and development efforts.
HIV and Nutrition

Partners in Health: Courtesy of Paul Farmer

Malnutrition and Disease

Malnutrition

- Inadequate dietary intake
- Appetite loss
- Nutrient loss
- Malabsorption
- Altered metabolism

Weight loss
Growth faltering
Lowered immunity
Mucosal damage

Nutritional deficiencies

Malnutrition and HIV

- Increased oxidative stress
- Immune suppression
- Increased HIV replication
- Hastened disease progression
- Increased morbidity

HIV

Integration of HIV Prevention into Antenatal Care

<table>
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<tr>
<th>Pregnancy</th>
<th>Labor and Delivery</th>
<th>Postnatal</th>
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</thead>
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- Prevention
- Treatment of sexually transmitted infections
- Adequate nutrition
- Treatment of malaria and other infections
- Counseling on safe sex, infant feeding, family planning, self-care, planning for the future
- Voluntary counseling and testing (VCT)
- Access to antiretroviral therapy (HAART)

- ARVs
- Safe delivery planning
- Non-invasive procedures
- Elective Caesarian section
- Minimal infant exposure to maternal fluids

- ARVs
- Counseling and support for infant feeding
- Prevention and treatment of breastfeeding problems
- Promotion of breast health (screening for infections)
- Care of infant thrush and oral lesions
- Counseling on complementary feeding and weaning
- Nutritional support
- Infection prevention

Women’s Health

- Pregnancy
- Labor and Delivery
- Postnatal

Summary

- Despite progress, HIV/AIDS continues to pose a severe threat to human health
- Disproportionate burden in lower income countries, particularly women
- In addition to rapid scale-up of essential antiretroviral therapy, further efforts in prevention are urgently needed
- Emphasis on prevention is needed to prevent new infections
- HIV/AIDS care and treatment needs to be further integrated with health services, including antenatal care, nutrition, infectious disease, and infant and child young feeding

Asante sana!