U.S. Community-Based Epidemiology: Implications for Clinical Practice

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Professor of Medicine
Johns Hopkins University
Learning Objectives

Upon completion of this presentation, learners should be better able to:

• Identify how the epidemiology of HIV-infection is evolving in the U.S.
• Describe how different sub-populations with HIV are being affected
• Adapt your practice to the changes in clinical epidemiology
Faculty and Planning Committee
Disclosures
Please consult your program book.

Off-Label Disclosure

There will be no off-label/investigational uses discussed in this presentation.
Which of the following statements are true regarding the HIV epidemic the U.S. currently?

1. The demography is homogeneous in regard to race and HIV transmission risk group across the country.
2. Because of a high rate of new HIV infection in young people, the median age of those with HIV infection is going down.
3. African-Americans have the highest rate of new HIV infection.
4. The median income of those infected with HIV is $25,000.
In which area are the HIV prevalence rates the highest?

1. Haiti
2. Ethiopia
3. US Poverty Areas
4. Angola
5. All of the above
From 1997 to 2007, the median CD4 level at first presentation for HIV care across the U.S.

1. Has increased from 200 to 400 cells/mm³
2. Has increased from 250 to 300 cells/mm³
3. Has remained completely stable at 225 cell/mm³
4. Has decreased from 350 to 300 cells/mm³
5. Has increased from 175 to 450 cells/mm³
In 2007, a person in North America infected with HIV at age 20 would be expected to live to about what age?

1. 40
2. 50
3. 60
4. 70
5. 80
Which of the following statements are true regarding HIV-Associated Non-AIDS (HANA) comorbidities in the U.S.

1. Cardiovascular comorbidity is principally due to HIV infection itself, with other risk factors contributing less to the incidence of new disease

2. Though decreased, hospitalization rates for AIDS-defining illnesses remain higher for than for non-AIDS-defining comorbidity

3. All non-AIDS malignancies are occurring at earlier ages than would be expected in a matched non-HIV-infected population

4. HIV Associated Neurocognitive Disorders have a prevalence of over 50% in those over age 60

5. All of the above
Rates of Adults and Adolescents Living with a Diagnosis of HIV Infection, Year–end 2009—46 States and 5 U.S. Dependent Areas

N = 800,784

Note. Data include persons with a diagnosis of HIV infection regardless of stage of disease at diagnosis. All displayed data have been statistically adjusted to account for reporting delays, but not for incomplete reporting.
Rates of Diagnoses of HIV Infection among Adults and Adolescents, 2010—46 States and 5 U.S. Dependent Areas

N = 48,079

Note. Data include persons with a diagnosis of HIV infection regardless of stage of disease at diagnosis. All displayed data have been statistically adjusted to account for reporting delays, but not for incomplete reporting.
Diagnoses of HIV Infection among Adults and Adolescents, by Sex and Race/Ethnicity, 2010—46 States and 5 U.S. Dependent Areas

Males
N= 37,910

- 24%
- 32%
- 41%
- 1%

Females
N= 10,168

- 17%
- 18%
- 62%

Note. Data include persons with a diagnosis of HIV infection regardless of stage of disease at diagnosis. All displayed data have been statistically adjusted to account for reporting delays, but not for incomplete reporting.

a Hispanics/Latinos can be of any race.
Diagnoses of HIV Infection among Adults and Adolescents, by Transmission Category, 2010—46 States and 5 U.S. Dependent Areas
N=48,079

Note. Data include persons with a diagnosis of HIV infection regardless of stage of disease at diagnosis. All displayed data have been statistically adjusted to account for reporting delays and missing risk-factor information, but not for incomplete reporting.

a Heterosexual contact with a person known to have, or to be at high risk for, HIV infection.
b Includes hemophilia, blood transfusion, perinatal exposure, and risk factor not reported or not identified.
New HIV Infections in the U.S. - 2010

http://www.cdc.gov/hiv/topics/surveillance/resources/slides
Demographic Variation in HIV in the U.S.

http://www.cdc.gov/nchhstp/stateprofiles/usmap.htm
Demographic Variation in HIV in the U.S.

http://www.cdc.gov/nchhstp/stateprofiles/usmap.htm
Communities in Crisis: Is there a generalized HIV epidemic in impoverished urban areas of the United State?

Denning P, DiNenno E. @ http://www.cdc.gov/hiv/topics/surveillance/resources/other/poverty.htm
Communities in Crisis: Is there a generalized HIV epidemic in impoverished urban areas of the United State?

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Denning P, DiNenno E. @ http://www.cdc.gov/hiv/topics/surveillance/resources/other/poverty.htm
HIV Prevalence in Sub-Saharan Africa and U.S. Populations

El-Sadr WM, et al. NEJM 2010; 362:967
HPTN 064 (ISIS Study)—HIV Incidence in Women at Risk for HIV: US
Hodder S, et al. CROI 2012. Abs #1048

- N=2099 women (88% black) enrolled in 6 “hot spots”
- HIV annual incidence (0.24%) was ~5 times higher than CDC 2009 annual HIV incidence estimate (0.05%) overall for US black women, and comparable to Congo (0.28%).
- Thirty-two women (1.5%) entered the study unaware of their HIV infection.
- Known HIV infection in a sexual partner was strongly associated with HIV infection, yet > 40% of women unaware of their partner's HIV status.
• US HIV epidemic primarily affects discrete geographic areas
• Disproportionately in specific neighborhoods
  – Limited social mobility
  – Sexual networks of higher prevalence
  – Substance use; varies with the community
  – Vulnerable socioeconomic status
Vulnerable SES and Health Disparities/Inequalities

Health disparities/inequalities has been defined as “potentially avoidable differences in health (or in health risks that policy can influence) between groups of people who are more and less advantaged socially; these differences systematically place socially disadvantaged groups at further disadvantage on health”

[Braver P. Ann Rev Public Health 2006; 27:167.27]
Health Disparities in PLWH in the U.S.

- Mortality rate 7.92 fold higher for blacks vs. whites
- Mortality rate 2.72 fold higher for low vs. high SES

Differences documented in clinical outcomes by income, race, and to a lesser extent, sex

- In the US the prevalence rate of HIV is reported at 6-fold greater in blacks compared to whites, and the infection rate in persons below the poverty line is substantially higher.

- There are few major medical conditions that have so selected minorities and “have nots.”

Hall HI, et al. MMWR Surveil Sum 2011; 60:87.

Lansky A, et al. JAIDS 2010; 55 (supp 2) S:64
Vulnerable SES and Health Disparities/Inequalities

Optimizing health outcomes among people living with HIV and reducing HIV-related disparities is a major goal of the National HIV/AIDS Strategy for the United States [http://www.whitehouse.gov/administration/eop/onap/nhas]
Challenges to Quality HIV Health Care

- Poverty; Lack of economic resources for food, transportation, unstable housing, access to medical care (preventive and treatment)
- Inadequate or unhealthy support network
- Education and health literacy
- Substance, alcohol, tobacco use
- Mental health
- Stigma, fear, discrimination
- Mistrust of the health care system
- Incarceration
Challenges: HIV Diagnosis, Engagement, Retention and Treatment

MMWR 2011; 60:1618
CD4 Levels at HIV Care Presentation Over Time

### Characteristics Associated with CD4 at Entry into HIV Care


<table>
<thead>
<tr>
<th>Characteristic</th>
<th>CD4 &lt; 201</th>
<th>CD4 201-500</th>
<th>CD4 &gt; 500</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male vs. Female</td>
<td>45.1%</td>
<td>37.6%</td>
<td>17.2%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td></td>
<td>37.6%</td>
<td>39.6%</td>
<td>22.8%</td>
<td></td>
</tr>
<tr>
<td>Black vs. White</td>
<td>44.4%</td>
<td>38.2%</td>
<td>17.4%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td></td>
<td>37.4%</td>
<td>39.3%</td>
<td>23.3%</td>
<td></td>
</tr>
<tr>
<td>Age &gt; 50 vs. Age &lt; 30</td>
<td>49.1%</td>
<td>34.9%</td>
<td>16.1%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td></td>
<td>35.0%</td>
<td>42.4%</td>
<td>22.6%</td>
<td></td>
</tr>
<tr>
<td>Uninsured vs. Private</td>
<td>42.8%</td>
<td>38.3%</td>
<td>19.0%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td></td>
<td>36.9%</td>
<td>41.0%</td>
<td>22.1%</td>
<td></td>
</tr>
</tbody>
</table>

Source: HIV Research Network
### Characteristics Associated with Worse Retention in Care at 2 Years

Ulett KB, et al. AIDS Pat Care STDs 2009; 23:41

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black vs. Other Races</td>
<td>1.60 (1.14-2.24)</td>
</tr>
<tr>
<td>Substance use</td>
<td>1.63 (1.13-2.37)</td>
</tr>
<tr>
<td>Uninsured vs. Insurance</td>
<td>1.46 (1.01-2.10)</td>
</tr>
<tr>
<td>Female vs. Male</td>
<td>1.38 (0.94-2.02)</td>
</tr>
<tr>
<td>Older age (per 10 yrs)</td>
<td>0.70 (0.58-0.84)</td>
</tr>
</tbody>
</table>
HIV–1 RNA Thresholds from 1996 through 2010 at Johns Hopkins


Hogg R, et al. CROI 2012; Abstract 137

Life expectancy at age 20 years

- 1996-99: 34.4
- 2000-02: 36.9
- 2003-05: 43.1
- 2006-07: 47.1
Life Expectancy in North America: By Race
Hogg R, et al. CROI 2012; Abstract 137

Source: CDC Vital and health statistics, US Life tables by race in 2006
Life expectancy in North America: By Transmission Group

Hogg R, et al. CROI 2012; Abstract 137

Life expectancy at age 20 years

- IDU: 28.1
- MSM: 51.6
- Heterosexual: 47.7
Persons Living with HIV by Age (2010)

CDC. HIV Surveillance Report, Vol 22
New HIV Diagnosis by Age (2010)

Proportion of older and younger adults at first presentation for HIV clinical care

p-value < 0.01
Multimorbidity: HIV Associated Non AIDS (HANA) Conditions

• Vascular: Coronary Artery Disease, Congestive Heart Disease, Thrombosis, Stroke
• Cancer: Infection related cancers-e.g. Anal; Non-infection related cancers-e.g. Lung
• Bone: Osteoporosis, Avascular Necrosis
• Renal: most is not HIVAN
• Liver: risk of and rapid progression to cirrhosis and hepatoma
• Neurological: Peripheral neuropathy, HAND
Morbidity: Swiss HIV Cohort Study


<table>
<thead>
<tr>
<th>Outcome</th>
<th>Rate (95% CI per 1000 PY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVA</td>
<td>1.73 (1.26-2.37)</td>
</tr>
<tr>
<td>MI</td>
<td>2.44 (1.88-3.18)</td>
</tr>
<tr>
<td>Coronary angioplasty</td>
<td>3.38 (2.70-4.23)</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>2.71 (2.11-3.48)</td>
</tr>
<tr>
<td>Fracture</td>
<td>5.48 (4.60-6.54)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2.13 (2.46-3.94)</td>
</tr>
<tr>
<td>Liver event</td>
<td>2.53 (1.95-3.28)</td>
</tr>
<tr>
<td>Kidney event</td>
<td>1.37 (0.97-1.95)</td>
</tr>
<tr>
<td>CDC stage C event</td>
<td>4.32 (3.53-5.28)</td>
</tr>
</tbody>
</table>
Hospitalization of HIV-Infected Patients, 2001-2008


Source: HIV Research Network
HIV Associated Neurocognitive Disorders (HAND)
Frequency of Cognitive Impairment in HIV over Age 60

Valcour V, et al CROI 2012, Abs # 498
Untreated HIV Infection

- Loss of immuno-regulatory cells
- Thymic dysfunction and loss of regenerative potential
- CMV replication
- HIV replication
- Loss of gut mucosal integrity and microbial translocation

HAART

Decreased but persistent (1) defects in T cell regenerative potential, (2) loss of immunoregulatory function, (3) CMV and other copathogen levels, and (4) microbial translocation

Chronic inflammation

- T cell maturation
- Progenitor cell exhaustion
- T cell dysfunction

Immunosenescence and clinical disease

Non-HIV Risk Factors

• Aging - all comorbidities
• Smoking - CVD, cancer
• Obesity - CVD, diabetes, hypertension
• Alcohol Use - CLD, CVD, hypertension, diabetes
• Substance Use - CKD, CLD, CVD
• Minority race: CKD, CVD
• Lack of preventive health care – all comorbidities
• Poverty: all comorbidities
Risk of MI in the D:A:D

Risk of MI in the D:A:D
Worm SW, et al. AIDS, 2011; 25: 1497

- Un adjusted
- Adjusted for HDL
- Adjusted for TC
- Adjusted for all three lipids
- All three lipids further adjusted for age and sex
- Further adjusted for CVD risk factors, HIV and treatment
- Further adjusted for DM and LLT
- Further adjusted for fasting glucose
Age at Cancer Diagnosis in People with AIDS in the US

Shiels MS, et al.
Ann Int Med 2010; 153:452

**Prostate Cancer**

**Colon Cancer**

**Breast Cancer**

**Liver Cancer**

**Anal Cancer**

**Lung Cancer**

**Hodgkin Lymphoma**

- **Observed in the AIDS population**
- **Observed in the general population**
- **Expected in the general population**
Non-HIV and HIV Risk Factors and Survival in Patients on ART


Group 0: HIV- controls
Group 1: HIV+ only
Group 2: HIV+ HIV RF only
Group 3: HIV+ HIV RF, Comorbidities
Group 4: HIV+ HIV RF, Comorbidities, Sub. Abuse
Mortality Higher in Publicly Insured HIV-infected Persons on ART with CD4 > 200


Significantly more CVD events and liver-related mortality. CVD, CKD and chronic hepatitis more common comorbidities
Comorbidity and Polypharmacy, by Age


A

<table>
<thead>
<tr>
<th>Age group</th>
<th>No comedication</th>
<th>One comedication</th>
<th>Two comedinations</th>
<th>Three comedinations</th>
<th>Four or more comedinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 years</td>
<td>80%</td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>50–64 years</td>
<td>70%</td>
<td>30%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>65+ years</td>
<td>60%</td>
<td>40%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

B

<table>
<thead>
<tr>
<th>Age group</th>
<th>No comorbidity</th>
<th>One comorbidity</th>
<th>Two comorbidities</th>
<th>Three comorbidities</th>
<th>Four or more comorbidities</th>
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</thead>
<tbody>
<tr>
<td>&lt;50 years</td>
<td>80%</td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>50–64 years</td>
<td>70%</td>
<td>30%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>65+ years</td>
<td>60%</td>
<td>40%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
### Non-ART Medications, by Age


<table>
<thead>
<tr>
<th>Medication</th>
<th>Total n (%)</th>
<th>&lt;50</th>
<th>50-64</th>
<th>≥65</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihypertensives (not ACE inhibitors)</td>
<td>831 (9.8)</td>
<td>323 (5.6)</td>
<td>367 (16.4)</td>
<td>141 (31.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>935 (11.1)</td>
<td>355 (6.2)</td>
<td>432 (19.4)</td>
<td>148 (32.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lipid-lowering agents</td>
<td>1071 (12.7)</td>
<td>356 (6.2)</td>
<td>527 (23.6)</td>
<td>188 (41.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Oral antidiabetics</td>
<td>179 (2.1)</td>
<td>51 (0.9)</td>
<td>87 (3.9)</td>
<td>41 (9.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Insulin</td>
<td>116 (1.4)</td>
<td>40 (0.7)</td>
<td>50 (2.2)</td>
<td>26 (5.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antiplatelet drugs</td>
<td>488 (5.8)</td>
<td>121 (2.1)</td>
<td>237 (10.6)</td>
<td>130 (28.9)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Mean Pill Burden in HIV Infection (ARV-experienced)
Krentz HB, et al. Antivir Ther 2012; Feb 23 (online).
### Who will Provide HIV Care?

<table>
<thead>
<tr>
<th>Aspect of Care</th>
<th>Then</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hospital care</strong></td>
<td>Almost all HIV-infected patients were hospitalized at some point</td>
<td>Few patients are hospitalized</td>
</tr>
<tr>
<td><strong>Inpatient profile</strong></td>
<td>Patients represented a cross section of the epidemic and clinical issues were intellectually stimulating</td>
<td>Patients are often hospitalized for non-HIV conditions (e.g., psychiatric illness)</td>
</tr>
<tr>
<td><strong>Outpatient care</strong></td>
<td>Little chance of success; feelings of depression and hopelessness</td>
<td>Trainees are not exposed to the successes of treatment visible in the outpatient setting</td>
</tr>
<tr>
<td><strong>Reimbursement</strong></td>
<td>High rates due to hospitalization and home care</td>
<td>Low rates</td>
</tr>
<tr>
<td><strong>Funding for research from government and institutions</strong></td>
<td>Available; opportunities for young investigators to advance their careers</td>
<td>In decline; fewer clinical trials conducted, with greater opportunities in other clinical areas (hepatitis C)</td>
</tr>
<tr>
<td><strong>Environment/climate</strong></td>
<td>HIV medicine viewed as new and exciting and considered a cause and a passion</td>
<td>HIV medicine viewed as one of many low-paying career choices</td>
</tr>
</tbody>
</table>

Epidemic concentrated in the gay community, which was politically organized and active

Epidemic diffuse, with a concentration among poor, disenfranchised populations

*SOURCES: Gallant, 2010; Saag, 2010.*
### Costs of HIV Care in the U.S.


<table>
<thead>
<tr>
<th>CD4 Stratum (cells/mm³)</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 50</td>
</tr>
<tr>
<td>ARV</td>
<td>$7,679</td>
</tr>
<tr>
<td>Other Medication</td>
<td>$13,991</td>
</tr>
<tr>
<td>Inpatient</td>
<td>$16,626</td>
</tr>
<tr>
<td>Outpatient</td>
<td>$1,575</td>
</tr>
<tr>
<td>ED</td>
<td>$549</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$40,420</td>
</tr>
</tbody>
</table>

Source: HIV Research Network
Federal Funding for HIV/AIDS Care, FY 2010

Source: Kates J. Kaiser Family Foundation Analysis of Data from OMB, 2010.

$13.2 billion

Medicaid (federal only) $4.7
Medicare $5.1
Ryan White $2.3
VA $0.8
FEHB $0.1
SAMHSA $0.1
Other $0.1

Source: Kaiser Family Foundation Analysis of Data from OMB, 2010.
Affordable Care Act and HIV Care

- Medicaid coverage will expand to all low-income Americans; no longer wait for AIDS diagnosis
- Insurers will not be able to deny coverage or charge more for pre-existing conditions
- Affordable Insurance Exchanges an option if no access to employer-based insurance or Medicaid
- No lifetime limit on essential health benefits
- Closes the ‘donut hole’ in Medicare; ADAP can contribute to the Out of Pocket Spending Limit
- Increased funding to expand the medical work force
COMPILATION OF PATIENT PROTECTION AND AFFORDABLE CARE ACT

- **Very favorable**:
  - Total: 18%
  - Democrats: 34%
  - Independents: 15%
  - Republicans: 4%

- **Somewhat favorable**:
  - Total: 23%
  - Democrats: 32%
  - Independents: 25%
  - Republicans: 8%

- **Somewhat unfavorable**:
  - Total: 11%
  - Democrats: 6%
  - Independents: 13%
  - Republicans: 15%

- **Very unfavorable**:
  - Total: 29%
  - Democrats: 6%
  - Independents: 29%
  - Republicans: 60%
Summary

• U.S. incidence of HIV infection stable at ~50,000 new infections/year; U.S. prevalence of HIV infection estimated 1.2 million
• HIV-infection disproportionately affecting -
  • Blacks and Latino vs. white
  • Men who have sex with men: especially young MSM
  • Urban poor
  • Groups at high risk of HIV in the U.S. are also at high risk of health disparities/inequalities and comorbidities
• Epidemic is aging in the U.S.; 38% of those living with HIV are age > 50 and the prevalence is increasing
Summary

- Care is becoming more complex; multimorbidity; polypharmacy, frailty of aging
- Both HIV infection and the underlying risk factors in the populations infected
- Fragmented and cost-constrained health care system
  - HIV care costs
  - HIV workforce
  - Health care reform
Which of the following statements are true regarding the HIV epidemic the U.S. currently?

1. The demography is homogeneous in regard to race and HIV transmission risk group across the country.
2. Because of a high rate of new HIV infection in young people, the median age of those with HIV infection is going down.
3. African-Americans have the highest rate of new HIV infection.
4. The median income of those infected with HIV is $25,000.
In which area are the HIV prevalence rates the highest?

1. Haiti
2. Ethiopia
3. US Poverty Areas
4. Angola
5. All of the above
From 1997 to 2007, the median CD4 level at first presentation for HIV care across the U.S.

1. Has increased from 200 to 400 cells/mm³
2. Has increased from 250 to 300 cells/mm³
3. Has remained completely stable at 225 cell/mm³
4. Has decreased from 350 to 300 cells/mm³
5. Has increased from 175 to 450 cells/mm³
In 2007, a person in North America infected with HIV at age 20 would be expected to live to about what age?

1. 40
2. 50
3. 60
4. 70
5. 80
Which of the following statements are true regarding HIV-Associated Non-AIDS (HANA) comorbidities in the U.S.

1. Cardiovascular comorbidity is principally due to HIV infection itself, with other risk factors contributing less to the incidence of new disease
2. Though decreased, hospitalization rates for AIDS-defining illnesses remain higher for than for non-AIDS-defining comorbidity
3. All non-AIDS malignancies are occurring at earlier ages than would be expected in a matched non-HIV-infected population
4. HIV Associated Neurocognitive Disorders have a prevalence of over 50% in those over age 60
5. All of the above
Are you?

1. An HIV primary care physician, NP, or PA
2. An HIV Specialist (I leave the primary care to others)
3. An HIV nurse
4. A social worker or case manager
5. A pharmacist
6. Other clinical
7. I don’t see patients