Sexually Transmitted Infections: Epidemiology, prevention and treatment

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Departments of Global Health and Medicine
University of Washington
Outline

- Epidemiology of STDs
- STDs as a risk factor for HIV
- STDs and PrEP
- Syndromic management: why are we still using it in low and middle income countries?
- Priorities for STD control
Challenges and opportunities

• Highest STI burden are in places with weak health care infrastructure
• Most STIs are asymptomatic
• Neglected due to resources & greatest burden is in stigmatized groups
• Increases susceptibility to HIV
• Unknowns:
  – Cost-effective bacterial STI control strategies
  – Primary prevention of HSV-2
  – Best way to integrate FP, STI and HIV prevention
  – Timeline & prospects for STI vaccines
STIs continue to increase globally

- Dramatic recent increases in bacterial STI incidence in era of effective HIV treatment & prevention

  WHO 2016 Estimates: adults 15 to 49
  376 million new cases of curable STI
  Curable STI (Chlamydia, gonorrhoea, syphilis and trichomoniasis)

- Gonorrhea: continued antimicrobial resistance
- Syphilis: incidence above pre-AIDS era in MSM, spread into heterosexual networks
- Reappearance of classics: LGV proctitis

http://www.cdc.gov/std; Pathela Sex Transm Dis 2019; WHO; Oliver Clin Infect Dis 2018; Braun DL Clin Infect Dis 2018
The U.S. Syphilis Epidemic: 2017

- 88% of cases
- 80% in MSM
- 46% in MSM HIV+

Primary / Secondary Syphilis in Men

- Primary / Secondary: 156% increase compared with 2013
- Congenital syphilis: 154% increase

Primary/ Secondary & Congenital Syphilis in Women

- 918 congenital cases
- In California, >50% of cases without prenatal care
- Strong links to meth, heroin

Source: http://www.cdc.gov/std
The wily gonococcus

International spread of gonococcal resistance to CTX
- Resistance to CTX plus high-level resistance to azithromycin in UK requiring treatment with ertapenem (2018)
- Contacts in South East Asia
- Two new cases of resistant gonorrhea in UK, January 2019
Countries with reported decreased susceptibility/resistance (DS/R) to ceftriaxone & azithromycin in *N. gonorrhoeae*, WHO GASP 2015-16

**Ceftriaxone**
- 15/63 (23.8%) countries
- 7 countries ≥ 5%

**Azithromycin**
- 50/62 (81%) countries
- 30 countries ≥ 5%

"Whether the global use of azithromycin in mono- or dual antimicrobial therapy of gonorrhoea is contributing to global increases in azithromycin resistance remains to be elucidated."

M. Unemo (submitted)

STIs in subSaharan Africa: STIMA

- Meta-analysis of 18 HIV prevention studies from 1993-2011, representing >37,000 women
- Higher prevalence for all STIs (other than HSV-2) in 15-24 year old women compared to 25-49 year old
- Chlamydia prevalence: South Africa 15% (95% CI 13-18%); East Africa 10% (95% CI 7-14%)
- GC prevalence: South Africa 5% (95% CI 3-6%); East Africa 2% (95% CI 3-6%)
- Syphilis concentrated in high risk women
- High prevalence of HSV-2 (70-83%) and BV (33-43%)

Torrone, PLoS Med 2018
Status of STI services in Africa

- Very high prevalence of CT, GC, trich, and BV in young women ages 16-22

- Sequelae of GC and CT understudied & underappreciated
  - PID, infertility, ectopic pregnancy, chronic pelvic pain
  - Stigma & increased HIV risk related to infertility

- Syndromic management for vaginal discharge has very poor sensitivity (23%) and specificity (85%)
  - Diagnostic accuracy of 50%; very poor for accurate management of cervical infections

- Limited evaluation of STD symptoms, only syphilis and HIV testing in public clinics, ANC, HIV and PrEP programs
  - Integration of FP & HIV has been challenging; integration of PrEP with sexual reproductive health may be easier
STIs in pregnant women in Cape Town

Poor sensitivity (35%) and specificity (80%) of syndromic STI management

Of 80 women diagnosed with an STI, only 7.5% were treated syndromically

Factors associated with an STI: Unmarried or not cohabiting with father (aOR 2.2), HIV-positive (aOR 1.9) and recent STI symptoms (aOR 6.6)

Joseph Davey, PLoS One 2019
STIs and HIV acquisition risk

A Vicious Cycle: STDs *predict* future HIV Risk

<table>
<thead>
<tr>
<th>Condition</th>
<th>HIV Diagnosis Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectal GC or CT</td>
<td>1 in 15 MSM within 1 year.*</td>
</tr>
<tr>
<td>Primary or Secondary Syphilis</td>
<td>1 in 18 MSM within 1 year.**</td>
</tr>
<tr>
<td>No rectal STD or syphilis infection</td>
<td>1 in 53 MSM within 1 year.*</td>
</tr>
</tbody>
</table>

*STD Clinic Patients, New York City. Pathela, CID 2013:57;**
**Matched STD/HIV Surveillance Data, New York City. Pathela, CID 2015:61
HIV Incidence and Predictors of Incident HIV among Men Who Have Sex with Men Attending a Sexual Health Clinic in Melbourne, Australia

King T. Cheung1,2, Christopher K. Fairley1,3, Tim R. H. Read1,3, Ian Denham1, Glenda Fehler1, Catriona S. Bradshaw1,3, Marcus Y. Chen1,3, Eric P. F. Chow1,3*

Retrospective cohort study of 5256 MSM attending Melbourne Sexual Health Centre 2007–2013 with at least two HIV tests within 12 months of each other; 81 incident HIV infections
- Inconsistent condom use during anal sex
- IDU
- PEP use
- Any STI diagnosis in last 12 months

Characteristics included: (1) inconsistent condom use during anal sex; (2) injecting drug use; (3) PEP use; and (4) STI diagnosis.

Fig 1. The population attributable fraction for HIV and HIV incidence of different risk characteristics.

doi:10.1371/journal.pone.0156160.g001
### STIs and HIV incidence among African women in ECHO trial

**N= 7830**

<table>
<thead>
<tr>
<th></th>
<th>DMPA</th>
<th>Copper IUD</th>
<th>LNG implant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N events</td>
<td>Rate</td>
</tr>
<tr>
<td><strong>Chlamydia or GC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both negative</td>
<td>2030</td>
<td>104</td>
<td><strong>3.8</strong></td>
</tr>
<tr>
<td>Either/both positive</td>
<td>519</td>
<td>39</td>
<td><strong>5.7</strong></td>
</tr>
</tbody>
</table>

- Almost 2 fold higher HIV incidence in ECHO with women who had CT and GC
- Much talk but little progress in integration of FP, STI, and HIV prevention services
- PrEP provides an opportunity to actualize this long overdue integration

ECHO consortium, Lancet 2019, supplement table 8
STIs and PrEP: What is the connection?
Est. numbers on PrEP:

- <100
- 100 - 1,000
- 1,000 – 10,000
- 10,000 – 100,000
- >100,000

Data from AVAC.org 2018 - https://www.prepwatch.org/country-updates/

Oral PrEP Global Roll-out in 2018

- 40 countries with Truvada approved for PrEP
- We have come a long ways but we have a very long way to go
STIs occur in persons using PrEP

But the population who needs PrEP has high STI rates – and STI rates have been rising in countries prior to PrEP (McCormack et al. Lancet 2016)
Does PrEP increase STIs?

- Traeger 2018: Systematic review and meta-analysis of 1 open label and 16 observational studies
  - 8 studies of STI prevalence (n=4388)
  - 13 studies condom use (n=5008)
Effect of PrEP on STIs

- Rates of bacterial STIs increasing over time; however, rises pre-date PrEP use
- Higher risk in more recent studies: after 2016 OR 1.5 (95% CI 1.1-2.1)
- No significant increase in proportion reporting condomless sex
- Heterogeneity in results, some trend towards increased condomless receptive anal sex with ≥10 partners, with an HIV-positive or HIV-unknown partner, and never using condoms during anal sex

Traeger et al, CID 2018
Objective: To assess HIV incidence in MSM and TGW who have sex with men and who are administered daily TAF/FTC or TDF/FTC

Extraordinarily high annual STI incidence:
- gonorrhea 45%
- chlamydia 42%
- syphilis 10%

Hare, CROI 2019, abstract 104LB
STIs in MSM in Australian PrEPX study

- 48% of 2981 MSM diagnosed with STIs over 1 year of follow-up
- STIs concentrated in subset; 25% accounted for 76% of STIs
- Younger age, more partners, & group sex associated with STIs
- 40% increase in STIs after starting PrEP
  - 12% increase after adjusting for testing frequency

Figure. Distribution of Participants and STI Diagnoses by Number of Infections per Participant During Follow-up

Traeger JAMA 2019
• Evaluated 88 articles about STI prevalence and incidence among PrEP users

• Data from 26 countries; two-thirds from high income countries and for MSM

• Pooled prevalence of GC, CT and early syphilis of 24%

• Pooled incidence of GC, CT and early syphilis of 72/100 person-years on PrEP

• Need active integration of HIV prevention and STI services

Ong et al JAMA 2019
## Pooled STI prevalence estimates

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Ong systematic review</th>
<th>Global estimates 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled prevalence (95% CI)</td>
<td>Men</td>
</tr>
<tr>
<td>Chlamydia</td>
<td>10.8 (6.4-16.1)</td>
<td>2.7 (1.9-3.7)</td>
</tr>
<tr>
<td>Gonorrhoea</td>
<td>11.6 (7.6-16.2)</td>
<td>0.7 (0.5-1.1)</td>
</tr>
<tr>
<td>Early syphilis</td>
<td>5.0 (3.1-7.4)</td>
<td>0.5 (0.4-0.6)</td>
</tr>
</tbody>
</table>

Ong, JAMA 2019
## Chlamydia prevalence and incidence in young African women using PrEP

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Participants</th>
<th>CT Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOICE</td>
<td>(South Africa, Uganda, Zimbabwe)</td>
<td>N=5029</td>
<td>12%</td>
</tr>
<tr>
<td>MTN-020/ASPIRE</td>
<td>(Malawi, So Africa, Uganda, Zimbabwe)</td>
<td>N=2629</td>
<td>12%</td>
</tr>
<tr>
<td>Plus Pills</td>
<td>(Cape Town)</td>
<td>N=150</td>
<td>48%</td>
</tr>
<tr>
<td>HPTN 082</td>
<td>(Cape Town, Johannesburg, Harare)</td>
<td>N=427</td>
<td>29%</td>
</tr>
<tr>
<td>POWER</td>
<td>(Cape Town, Johannesburg, Kisumu)</td>
<td>N=1504</td>
<td>26%</td>
</tr>
<tr>
<td>3P project</td>
<td>(Cape Town)</td>
<td>N=200</td>
<td>25%</td>
</tr>
<tr>
<td>ECHO</td>
<td>(eSwatini, Kenya, South Africa, &amp; Zambia)</td>
<td>N=7829</td>
<td>18%</td>
</tr>
</tbody>
</table>

90-98% of women were asymptomatic in studies that assessed symptoms.
### Chlamydia prevalence and incidence in young African women in HIV prevention studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>N</th>
<th>CT prevalence</th>
<th>CT incidence</th>
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<tr>
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<td>1504</td>
<td>26%</td>
<td>53%</td>
</tr>
<tr>
<td><strong>3P project</strong></td>
<td>(Cape Town)</td>
<td>200</td>
<td>25%</td>
<td>42%</td>
</tr>
<tr>
<td><strong>ECHO</strong></td>
<td>(eSwatini, Kenya, South Africa, &amp; Zambia)</td>
<td>7829</td>
<td>18%</td>
<td>NA</td>
</tr>
</tbody>
</table>

- Most incident CT infections were in different women than prevalent CT
- High incidence not treatment failure; indicates high CT prevalence in male SP
## GC prevalence and incidence in young African women in HIV prevention studies

<table>
<thead>
<tr>
<th>Study</th>
<th>GC prevalence</th>
<th>GC incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOICE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(South Africa, Uganda, Zimbabwe) N=5029</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td><strong>MTN-020/ASPIRE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Malawi, So Africa, Uganda, Zimbabwe) N=2629</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Plus Pills</strong></td>
<td>6%</td>
<td>NA</td>
</tr>
<tr>
<td>(Cape Town) N=150</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HPTN 082</strong></td>
<td>8%</td>
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</tr>
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<td><strong>POWER</strong></td>
<td>10%</td>
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<tr>
<td>(Cape Town, Johannesburg, Kisumu) N=1504</td>
<td></td>
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</tr>
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<td><strong>3P project</strong></td>
<td>11%</td>
<td>14%</td>
</tr>
<tr>
<td>(Cape Town) N=200</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ECHO</strong></td>
<td>5%</td>
<td>NA</td>
</tr>
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<td>(eSwatini, Kenya, South Africa, &amp; Zambia) N=7829</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*<1% syphilis and 6-8% trichomonas*
 Incident STI infections in young southern African women using PrEP

- Most incident STIs were new infections
  - 79 (66%) of 119 chlamydial infections
  - 41 (85%) of 48 GC infections
  - 23 (79%) of 29 trichomonas infections
- Not likely failure of STI treatment or partner notification
- Few characteristics distinguished participants with an STI from those without an STI during follow-up
  - High prevalence and incidence without strong predictors makes targeted screening a challenge

HPTN 082: Evaluation of daily oral PrEP as a primary prevention strategy for young African women

Study Population

- Uninfected women
  - Ages 16-25 yrs
  - Johannesburg & Cape Town, South Africa
  - Harare, Zimbabwe

Target Enrollment

- 400 women who accept PrEP at enrollment
- ≤ 200 women who decline PrEP at enrollment

Delany-Moretliwe, ISSTDR 2019, Tues O10.3
Conclusions: STIs as an indicator of risk compensation on PrEP

• There is limited evidence of risk compensation
• Absence of evidence is not evidence of absence
• Is reduced condom use an unintended consequence of PrEP?
  • NO!
    – Many people prefer sex without condoms
    – We have an alternative preventive technology to reduce the fear of HIV – it is entirely consequential!
• We need to strengthen our STI control programmes
Priorities for STI prevention and treatment
Priority 1
Improve & move beyond syndromic STI management

Why is syndromic management still the standard of care?
• Limited investment in STI programs in low & middle income countries
• Cost of STI testing & lab systems
• Belief that symptomatic STIs are most important
  • Yet, asymptomatic STIs increase inflammation and HIV risk

We have known the limitations of syndromic management for vaginal discharge syndrome 2 decades
• Very poor sensitivity & specificity in women
• Contributes to antibiotic resistance
• False sense of security in providers and patients, given low sensitivity and specificity

Masson STI 2019
Hoffman STD 2019
Torrone PLoS Med 2018
Kulartne PLoS One 2018
Kaida BMC ID 2018
Priority 1a: Integrate point of care STI tests and revise WHO syndromic algorithms for women

- Risk screening for GC, CT and syphilis in Rwandan women
  - Pregnant, transactional sex past year, new SP past 3 months, clinical signs
- Diagnostic testing based on risk score and symptoms
  - GC/CT (GenXpert), Trich (OSOM), syphilis (Determine) & vaginal pH (5.5 cutoff)
- POC integration is feasible and improves case-finding and management
- Higher sensitivity and specificity of WISH compared to WHO algorithms
  - **WISH algorithm for CT & GC:** 75% sensitivity & 100% specificity
  - **WHO algorithm for CT & GC:** 61% sensitivity & 45% specificity

<table>
<thead>
<tr>
<th>Infections associated with vaginal discharge or lower abdominal pain</th>
<th>Gold standard testing (n=705)</th>
<th>WHO algorithms (n=705)</th>
<th>WISH algorithms (n=705)</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least one</td>
<td>306/690* (44%)</td>
<td>392 (56%)</td>
<td>608 (86%)</td>
</tr>
<tr>
<td>Chlamydia trachomatis</td>
<td>60 (9%)</td>
<td>392 (56%)</td>
<td>43 (6%)</td>
</tr>
<tr>
<td>Neisseria gonorrhoea</td>
<td>50 (7%)</td>
<td>392 (56%)</td>
<td>38 (5%)</td>
</tr>
<tr>
<td>Trichomonas vaginalis</td>
<td>111/690* (16%)</td>
<td>392 (56%)</td>
<td>92 (13%)</td>
</tr>
<tr>
<td>Bacterial vaginosis</td>
<td>125/690* (18%)</td>
<td>392 (56%)</td>
<td>466 (66%)†</td>
</tr>
<tr>
<td>Vulvovaginal candidiasian</td>
<td>59/690* (9%)</td>
<td>366 (52%)</td>
<td>235 (33%)</td>
</tr>
</tbody>
</table>

Verwijs, Lancet ID 2019
Priority 1b: Make sensitive STI diagnostic tests affordable

Negotiate volume guarantee and costs for GC and CT NAAT tests

- GenXpert machines are already in many countries; ‘near patient’, not quite POC (results in 90 minutes)
- binx GC and CT POC assay with results in 30 min, recently approved by FDA
- Precedence with HIV self-test kits that negotiated volume reduced costs substantially
- Estimate cost-effectiveness of downstream benefits of infections detected, treated, and adverse outcomes averted
Needs for diagnostic STI tests

- WHO REASSURED criteria
  - Real time connectivity
  - Ease of specimen collection
  - Affordable, *accurate, accessibility, architecture*
  - Sensitive
  - Specific
  - User-friendly & simple
  - Rapid & robust
  - Equipment free
  - Delivered to end users

- Only HIV, syphilis and TV tests meet ASSURED criteria

- Need WHO and donor (PEPFAR, Global Fund, UNITAID) volume guarantee & price negotiations for GC and CT NAAT
Status of POC STI diagnostics

CT, GC, Trich & HPV

Unemo et al Lancet ID 2017
Point of view on STI diagnostics

• Validation of assays is important, but…

• Equally important is the need to understand how to implement STI diagnostic testing in the ‘real world’
  – Costs vs. benefits
  – Acceptable
  – Feasible within constrained health systems
### Priority 2
Integrate PrEP with reproductive health services

- PrEP is not a stand-alone service; meeting reproductive health needs could increase PrEP uptake and persistence
- What is the ‘minimum PrEP package’? How to do it simply and cost-effectively?

#### Minimum package for all attending PrEP service
- HIV testing (national algorithm)
- Syndromic STI diagnosis and Rx
- TB screening
- PEP
- Pregnancy test
- Contraception
- Counselling
- Condoms

#### Additional minimum package for those choosing PrEP
- Creatinine (future plans to review frequency)
- Adherence support – peer support

#### Other services to link to as needed
- Laboratory STI diagnosis
- Hep B screening & vaccination
- Pregnancy test - links for ANC and abortion services
- Mental health services
- IPV/GBV service
- Alcohol/substance use services
- CxCa screening and Rx
- VMMC

#### Demand creation
- Prevention/PrEP awareness
- HIVST to inc prevention and PrEP info
- NDoH web tool for info and service sites

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*Slide adapted from Rachel Baggaley, WHO*
STI services are key part of PrEP delivery

- STI testing in PrEP programs meets young women’s and key populations’ needs, values & preferences

- Increasing investment in PrEP programs could benefit STI control
  - Earlier diagnosis & treatment (quarterly visits for refills)
  - Appropriate STI treatment will reduce antimicrobial resistance
  - Could leverage lower STI test costs
  - Opportunity for POC diagnostics
STI service models in PrEP programs

PrEP services with Rapid or POCT for STI
- UK – Dean St Express

PrEP integrated into STI services
- UK, Australia
- Multi-site Ct/Ng screening

PrEP services with minimal STI screening
- Japan, Brazil, Thailand
- Syphilis only
  - Often no CT/NG screening due to costs

PrEP services with syndromic management +/- presumptive treatment
- South Africa, Kenya

PrEP services with referral to another clinic sites STI services
- Thailand (some sites)

PrEP services with no STI service

Slide courtesy of Jason Ong
Priority 3: Do expedited partner treatment
Feasible, acceptable & underutilized

• Durban clinic used GenXpert POC testing for CT, GC, and TV with results in 2 hrs
• Expedited partner treatment kit
• 267 women, median age of 23
• 18% CT, 5% GC, 3% TV
• Of 63 women with STI, 87% accepted EPT kit & 89% reported partner was treated
• Focus group discussions: improved communication with SP, who appreciated not having to take time off work/travel to clinic, no IPV reported
Priority 4
Address antimicrobial resistance in LMIC

- Update treatment guidelines
- Lab capacity building and sentinel surveillance of antimicrobial resistance in GC
- Modify syndromic STD case management
- Increase use of sensitive diagnostic STI tests (NAAT for GC and CT)
- When available, use POC diagnostic assays that detect GC resistance
- Evaluate new antibiotics (e.g., zoliflodacin)
Priority 5
Scale up HPV vaccination

- Systematic review of 65 articles in 14 high income countries
- 83% reduction in HPV 16 & 18 among girls ages 13-19 and 66% reduction in women ages 20-24 after 5-8 years
- Cross-protection against HPV 31, 33, and 45 with 100% reduction in CIN2+
- Greatest and fastest impact with multiple age-cohort vaccination & high coverage
- Limited data from LMIC which account for >80% of deaths from HPV-related cancers
- Global call to eliminate cervical cancer; address vaccine supply constraints
- Provides a platform for future adolescent STI and HIV vaccines and interventions

Drollet Lancet 2019
deSanjose & Delany-Moretlwe, Lancet 2019
On Demand PEP Doxycycline 200 mg (~24 hours after sex, up to 72 hours)

No PEP

Visits: baseline and every 2 months
Serologic assays for HIV and syphilis
PCR assays for chlamydia and gonorrhea
Urine, anal, and throat samples collected

Incidence of gonorrhea (n=47):
No PEP (n=25): 35/100 person-years.
PEP (n=22): 29/100 person-years.

Post-exposure prophylaxis with doxycycline to prevent sexually transmitted infections in men who have sex with men: an open-label randomised substudy of the ANRS IPERGAY trial

Jean-Michel Molina, Isabelle Chauveau, Christian Chériaux, Gilles Picoux, Eric Cua, Constance Delaunoye, Catherine Capparant, Durinda Rojas-Castro, Julien Forast, Bréatrice Berlot, Cécile Bélec, Laurent Cotte, Olivier Robineau, François Raffi, Pierre Charbonneau, Alexandre Azon, Julie Chas, Laurence Niedobitski, Bruno Spire, Luis Sgagio-Teyssier, Diane Lorette, Solène Le Meste, Véronique Doit, Laurence Meyers, for the ANRS IPERGAY Study Group

Time to First Chlamydia and Syphilis With On-Demand PEP With Doxycycline for MSM

Time to First Chlamydia (ITT)
Median follow-up: 8.7 months

Cumulative Probability

Incidence of chlamydia (n=29):
No PEP (n=21): 20/100 person-years.
PEP (n=7): 9/100 person-years.

HR: 0.30 (P=0.003)

Time to First Syphilis (ITT)
Median follow-up: 8.7 months

Cumulative Probability

Incidence of syphilis (n=13):
No PEP (n=10): 13/100 person-years.
PEP (n=3): 4/100 person-years.

HR: 0.27 (P=0.04)

Time to First Gonorrhea (ITT)
Median follow-up: 8.7 months

Cumulative Probability

Incidence of gonorrhea (n=47):
No PEP (n=25): 35/100 person-years.
PEP (n=22): 29/100 person-years.

HR: 0.83 (P=0.52)
Equipoise to study doxy PEP for syphilis & CT

**Pros**

- Effective in MSM on event driven PrEP in France
- Relatively safe drug
- Easy to administer
- Few other options for STI prevention
- High interest among MSM surveyed (Spinelli 2018)

**Cons**

- Limited data; duration?
- Costs
- Side effects of doxycycline
  - Esophagitis
  - Photosensitivity
- Risk compensation?
- Antibiotic resistance?
- Microbiome effects?

**Next steps**

- Doxy PEP & PrEP studies in MSM in US, Australia & France
- Doxy PEP in Kenyan women
Priority 7: Invest in STI vaccines

- Need interventions to reduce incident GC, given growing cephalosporin and multi-class resistance
- Meningococcal B vaccine: 31% reduction in incident GC in New Zealand
  - This outer membrane component is part of the 4CMenB vaccine, BEXSERO (GSK)
- Model simulations predict that a 40% reduction in prevalence is achievable with a gonococcal vaccine of only 20% efficacy if immunity does not wane
- Warrants additional prospective evaluation in high GC incidence populations

Petousis-Harris Lancet 2017
Whelan  Emerg Infect Dis 2016;
Petousis-Harris, International Pathogenic Neisseria Conf 2016
Craig A, et al Vaccine 2015
Conclusion: Time is now; action is imperative

- STDs have been neglected in many countries
  - ART, ANC, & VMMC programs rarely test for STIs

- Many missed opportunities to improve reproductive health and help women recognize their risk of STIs and infertility, as well as HIV
  - STIs associated with adverse pregnancy outcomes
  - Infertility due to STIs may increase condomless sex and HIV exposure

- These issues are not going away
  - Improve syndromic management & increase use of sensitive STI diagnostic tests
  - Need more data and advocacy
  - Opportunity for integration of HIV, FP and STI services
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