SNOMED CT for monitoring HIV-stage; Implementation in OpenMRS in Kenya

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HIV in Kenia

Aids in de Wereld

- Mensen met HIV/AIDS: 33.400.000
- AIDSdoden in 2008: 2.000.000
- AIDSwezen in 2008: 15.000.000
- Volwassenen met HIV/AIDS: 0.8%

Kaart AIDS in de wereld

- Eastern 4.6%
- Rift Valley 6.3%
- Western 5.4%
- Central 3.6%
- Nyanza 14.9%
- Nairobi 8.8%
- Coast 8.1%

Bron: www.unaids.org

% volwassen bevolking (15 jaar >) geïnfecteerd met HIV
HIV versus AIDS

• HIV+ = infected with HIV virus
• AIDS = infected with HIV-virus and clinical symptoms (AIDS Defining Illness=ADIs)
• CD4 = laboratory test on CD4 cells. The higher the better the immune system works
Treatment HIV/AIDS

• Antibiotics to prevent infections, monitoring, lab investigation.

• WHO recommends anti-retroviral therapy (ART):
  – CD4 < 350 cells/µl with stage I or II
  – CD4 < 500 cells/µl with stage III
  – WHO stage IV independent of CD4 cell count
Clinical staging

- Clinical staging is used where CD4 tests are not readily available

<table>
<thead>
<tr>
<th>Clinical stage 1</th>
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</thead>
<tbody>
<tr>
<td>1. Asymptomatic</td>
</tr>
<tr>
<td>2. Persistent generalized lymphadenopathy (PGL)</td>
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<table>
<thead>
<tr>
<th>Clinical stage 2</th>
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<tbody>
<tr>
<td>1. Moderate unexplained weight loss (&lt;10% of presumed or measured body weight)</td>
</tr>
<tr>
<td>2. Mucocutaneous manifestations (seborrhoeic dermatitis, popular pruritic eruptions, fungal nail infections, recurrent oral ulcerations, angular cheilitis)</td>
</tr>
<tr>
<td>3. Herpes zoster</td>
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<tr>
<td>4. Recurrent upper respiratory tract infections (sinusitis, tonsillitis, bronchitis, otitis media, pharyngitis)</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Clinical stage 3</th>
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</thead>
<tbody>
<tr>
<td>1. Unexplained severe weight loss (over 10% of presumed or measured body weight)</td>
</tr>
<tr>
<td>2. Unexplained chronic diarrhoea for longer than one month</td>
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<tr>
<td>3. Unexplained persistent fever (intermittent or constant for longer than one month)</td>
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<tr>
<td>4. Persistent oral candidiasis</td>
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<tr>
<td>5. Oral hairy leukoplakia</td>
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<tr>
<td>6. Pulmonary tuberculosis</td>
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<tr>
<td>7. Severe bacterial infections (e.g. pneumonia, empyema, pyomyositis, bone or joint infection, meningitis, bacteraemia)</td>
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<tr>
<td>8. Acute necrotizing ulcerative stomatitis, gingivitis or periodontitis</td>
</tr>
<tr>
<td>9. Unexplained anaemia (below 8 g/dl), neutropenia (below 0.5 x 10⁹/l) and/or chronic thrombocytopenia (below 50 x 10⁹/l)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Clinical stage 4</th>
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</thead>
<tbody>
<tr>
<td>Conditions where a presumptive diagnosis can be made using clinical signs or simple investigations:</td>
</tr>
<tr>
<td>1. HIV wasting syndrome</td>
</tr>
<tr>
<td>2. Pneumocystis jiroveci pneumonia (PCP)</td>
</tr>
<tr>
<td>3. Recurrent severe bacterial pneumonia (≥ 2 episodes within 1 year)</td>
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<tr>
<td>4. Cryptococcal meningitis</td>
</tr>
<tr>
<td>5. Toxoplasmosis of the brain</td>
</tr>
<tr>
<td>6. Chronic orolabial, genital or ano-rectal herpes simplex infection for &gt;1 month</td>
</tr>
<tr>
<td>7. Kaposi sarcoma (KS)</td>
</tr>
<tr>
<td>8. HIV encephalopathy</td>
</tr>
<tr>
<td>9. Extra pulmonary tuberculosis (EPTB)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions where confirmatory diagnostic testing is necessary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cryptosporidiosis, with diarrhoea &gt;1 month</td>
</tr>
<tr>
<td>2. Isosporiasis</td>
</tr>
<tr>
<td>3. Cryptococcosis (extra pulmonary)</td>
</tr>
<tr>
<td>4. Disseminated non-tuberculous mycobacterial infection</td>
</tr>
<tr>
<td>5. Cytomegalovirus (CMV) retinitis or infection of the organs (other than liver, spleen, or lymph nodes)</td>
</tr>
<tr>
<td>6. Progressive multifocal leuencephalopathy (PML)</td>
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<tr>
<td>7. Any disseminated mycosis (e.g. histoplasmosis, coccidiomycosis)</td>
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<tr>
<td>8. Candidiasis of the oesophagus or Airways</td>
</tr>
<tr>
<td>9. Non-typoid salmonella (NTS) septicaemia</td>
</tr>
<tr>
<td>10. Lymphoma cerebral or B cell Non Hodgkin’s Lymphoma</td>
</tr>
<tr>
<td>11. Invasive cervical cancer</td>
</tr>
<tr>
<td>12. Visceral leishmaniasis</td>
</tr>
<tr>
<td>13. Symptomatic HIV-associated nephropathy or HIV-associated cardiomyopathy</td>
</tr>
</tbody>
</table>
Challenges in Kenya with HIV care

- Limited laboratory resources -> limited CD4 measurements -> dependent on clinical staging
Other challenges in Kenya HIV care

• Medical knowledge of clinicians/nurse practitioners is low (staging, ART initiation)
• High workload
Other challenges in Kenia HIV care

- Medical knowledge of clinicians/nurse practitioners is low
- High workload
- Paper-based chart
  - unreadable
  - lost
  - patients move
  - incomplete
Other challenges in Kenia HIV care

- Medical knowledge of clinicians/nurse practitioners is low
- High workload
- Paper-based chart
  - unreadable
  - lost
  - patients relocate
  - incomplete

Clinical staging requires high quality of ADI reporting but....

Studies show that ADIs in clinical settings are under-reported by up to 67%
WHO motivates introduction of EMR

• OpenMRS open source EMR based on open standards
• Implemented in JOOTRH, Kisumu, Kenya
  – 7000 active HIV patients
  – 4800 receiving ART
• Expectation
  – ADI registration
    • Fine granularity
    • Standardized
  – Decision support system
    • Staging
    • Start ART
Goal of this project

• Derive a comprehensive RefSet of ADIs based on SNOMED CT and evaluate SNOMED CT’s content coverage for ADIs in a provincial referral hospital in Kenya

• Implement the RefSet as an interface terminology in OpenMRS at JOOTRH
Methods

Methods

- 2008
- CDC & Accenture opportunistic infections
- SNOMED CT subset of diagnosis and organism concepts
- Stored in OWL format
Methods

- Query January 2014 release in SQL database
  - Concept described by Terms “assoc#” AND (“HIV” or “AIDS” or “acquired immunodeficiency syndrome”)
  - Concepts linked by relationship “associated with” to the concept “AIDS (62479008)”
Methods

Snomed CT
The global language of healthcare

Resultaten (5 van 5)
P Pneumonia associated with AIDS
P Pneumocystosis associated with AIDS
P Viral pneumonia associated with AIDS
P Bacterial pneumonia associated with AIDS
P Pneumonitis associated with AIDS

P Pneumonia associated with acquired immunodeficiency syndrome (disorder)
Pneumocystosis associated with acquired immunodeficiency syndrome (disorder)
Viral pneumonia associated with acquired immunodeficiency syndrome (disorder)
Bacterial pneumonia associated with acquired immunodeficiency syndrome (disorder)
Pneumonitis associated with acquired immunodeficiency syndrome (disorder)

Id Definition status Associated with
421671002 Defined AIDS

Associated morphology
Consolidation
Inflammation

Finding site
Lung structure

Bacterial pneumonia associated with AIDS
Candidiasis of lung associated with AIDS
Viral pneumonia associated with AIDS
Methods

• All patients that visited JOOTRH in Febr/March 2014
  • 583 initial patient visits
  • 762 follow-up visits
• Two clinical officers extracted ADIs
• Free-text paper-based records & OpenMRS
• Terms mapped to SNOMED CT concepts
Methods

- Focus groups for clinicians and nurses at JOOTRH
- Asked to list ADIs in local terms (inspired by results of other sources)
- Determine content coverage of SNOMED CT
Results

<table>
<thead>
<tr>
<th>Source</th>
<th>T: n=</th>
<th>C: n=</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDC ADI subset</td>
<td>1,528</td>
<td>907</td>
</tr>
<tr>
<td>SNOMED CT OI subset</td>
<td>254</td>
<td>106</td>
</tr>
<tr>
<td>MCH/PSC chart abstraction</td>
<td>73</td>
<td>39</td>
</tr>
<tr>
<td>Focus Group Discussions:</td>
<td>84</td>
<td>50</td>
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<tr>
<td>clinicians and nurses</td>
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<tr>
<td>Excluded duplicate terms (T: n=21; C: n=12)</td>
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<td></td>
</tr>
<tr>
<td>Excluded duplicates (T: n=40; C: n=18)</td>
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</tr>
<tr>
<td>Merged OI subset (A)</td>
<td>1,761</td>
<td>1,001</td>
</tr>
<tr>
<td>Concept-based</td>
<td></td>
<td></td>
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<tr>
<td>Merged OI subset (B)</td>
<td>117</td>
<td>71</td>
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<tr>
<td>Term-based</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excluded duplicate terms (T: n=8; C: n=20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Reference Set for ADIs</td>
<td>1,870</td>
<td>1,052</td>
</tr>
<tr>
<td>T – Terms or descriptions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C – Concepts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results

• Content coverage ADI in SNOMED CT 100%
• Implementation in OpenMRS
  – ADI Refset implemented as interface terminology
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• Implementation in OpenMRS
  – ADI Refset implemented as interface terminology
  – Distinction of ADIs, non-ADIs and signs/symptoms
  – Autocomplete feature to improve data accuracy
Results

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  - Automatic inference of WHO clinical stage
Results

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• Implementation in OpenMRS
  – ADI Refset implemented as interface terminology
  – Distinction of ADIs, non-ADIs and signs/symptoms
  – Autocomplete feature to improve data accuracy
  – Automatic inference of WHO clinical stage
  – Free-text entry for new ADI concepts
Discussion and conclusion

• Interface terminology for ADI consisting of 1052 concepts and 1870 terms
• Expect full coverage
  – Different sources are combined
  – Only 2 months patient visits
  – Dynamic update based on additional free text
• Implemented in JOOTRH, Kisumu Kenya but shared within OpenMRS community
Further research

• Evaluate the effect of the standardised ADI registration on
  – Data quality (more and finer granular recording of ADIs)
  – Quality of care (better adherence to ART guideline)
  – Outcome of patient (lower morbidity and mortality)
Acknowledgement

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