This work was partially supported through a research grant from Gilead Sciences. Gilead had no influence on the design, analysis and content of the study.

Presentation based on work by

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School of Social and Community Medicine, University of Bristol
Division of Global Public Health, UC San Diego

Modelling HCV treatment as prevention amongst men who have sex with men in the UK
Modelling HCV treatment as prevention amongst men who have sex with men in the UK – use of UK CHIC data

Peter Vickerman,
Natasha Martin, Louis MacGregor
University of Bristol
HCV among HIV-infected MSM

- Increasing documentation of sexually transmitted HCV among HIV-infected MSM
- Little evidence of HCV transmission amongst HIV-negative MSM
- Co-infection with HCV/HIV accelerates liver disease progression
- HCV treatment success with new direct-acting antiviral therapy >90% sustained viral response ‘cure’ rates
- Modelling indicates utility of HCV treatment as prevention amongst people who inject drugs (PWID)\(^1\)–\(^3\)
  - What about HCV treatment as prevention among HIV+ MSM?

2. Martin NK et al. CID 2013;57(suppl 2):S39-S45
HCV Treatment as prevention among HIV+ MSM: a unique opportunity?

<table>
<thead>
<tr>
<th></th>
<th>HCV+ PWID</th>
<th>HIV+/HCV+ MSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population size</td>
<td>Large &gt; 50,000 in UK</td>
<td>Small compared with PWID</td>
</tr>
<tr>
<td>HCV sero-prevalence</td>
<td>Heterogeneous, from 20–70% in UK</td>
<td>Relatively low (~10%)</td>
</tr>
<tr>
<td>Routine HCV case-finding and HCV treatment</td>
<td>Poor/evolving</td>
<td>Good in many developed country settings</td>
</tr>
<tr>
<td>HCV treatment uptake</td>
<td>Low</td>
<td>Good (~50% are treatment experienced in Berlin¹ &amp; UK²)</td>
</tr>
<tr>
<td>BUT Re-infection rate</td>
<td>Poor data but seems low</td>
<td>Appears higher (5–10x) than primary incidence ³,⁴</td>
</tr>
</tbody>
</table>

2. Ingiliz P et al. Spontaneous clearance rates increase with HCV reinfection episode in HIV-positive men who have sex with men (MSM) independent of HCV subtype. EASL 2014; P781
Modelling aims

- Develop a **dynamic** mathematical model of HCV transmission among diagnosed HIV+ MSM\(^1,2\)

- Fit model to available UK-CHIC data to:
  - Assess the possible trajectory of the HCV epidemic among MSM in UK with current levels of treatment
  - Predict the impact of scaled-up treatment with new DAAs

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**Model parameterisation and calibration – mainly using UK CHIC data**

Calibrated to UK data on:
- **Annual HCV prevalence** among HIV-diagnosed MSM 2004–2011 [UK CHIC]:
  - Increasing sero-prevalence 7-10%
- **Annual HCV incidence** among HIV-diagnosed MSM 2004–2011 [UK CHIC]:
  - Stable at about 1-1.4 per 100 pyrs
- **HCV reinfection incidence** among HIV-diagnosed MSM:
  - One estimate for 2004–2012\(^2\) suggests 7.8 per 100 pyrs

<table>
<thead>
<tr>
<th>Treatment assumption</th>
<th>Current treatment</th>
<th>Scaled-up treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Following <strong>Acute</strong> diagnosis</td>
<td>46% treated in 1 year [UK CHIC]</td>
<td>80% treated in 1 year</td>
</tr>
<tr>
<td>Following <strong>Chronic</strong> diagnosis</td>
<td>22% treated in 1 year [UK CHIC]</td>
<td>80% treated in 1 year</td>
</tr>
<tr>
<td>Treatment rate thereafter</td>
<td>6% treated per year [UK CHIC]</td>
<td>20% treated per year</td>
</tr>
<tr>
<td>SVR of cure rate</td>
<td>80%/30% SVR in acute/chronic stage with IFN/RBV</td>
<td>90% SVR with DAAs</td>
</tr>
</tbody>
</table>

MODEL PROJECTIONS TO 2025
Status quo (current treatment rates and SVR with IFN/RBV) – mean model fit shown
No historic treatment in UK

HCV chronic (RNA+) prevalence among HIV-diagnosed MSM (%)

HCV primary incidence among HIV-diagnosed MSM (100py)

No historic treatment

Martin NK et al CID 2016
Current treatment rate with DAAs (90% SVR) from 2015

CHRONIC PREVALENCE

Primary incidence among HIV-diagnosed MSM (100/py)

Current treatment with DAAs

HCV chronic (RNA+) prevalence among HIV-diagnosed MSM (%)

HCV primary incidence among HIV-diagnosed MSM (100/py)

Current treatment with DAAs

Martin NK et al CID 2016
Scale-up treatment for recent (80%) diagnoses with DAAs from 2015

**CHRONIC PREVALENCE**

- HCV chronic (RNA+) prevalence among HIV-diagnosed MSM
  - Scale-up treatment for recent diagnoses

**PRIMARY INCIDENCE**

- HCV primary incidence among HIV-diagnosed MSM (per 100py)
  - Scale-up treatment for recent diagnoses

Martin NK et al CID 2016
Scale-up treatment for recent (80%) & non-recent diagnoses (20%/yr) with DAAs from 2015
However…

- This modelling and treatment strategy assumes little HCV transmission in HIV-negative MSM
- HCV transmission in HIV negative MSM could be evolving
  - PROUD PrEP trial in UK found HCV incidence in HIV-ve MSM similar to HIV+ve MSM in UK-CHIC (1-1.5 per 100 pyrs)
- Scale-up of PrEP could possibly increase HCV incidence in HIV-negative MSM:
  - High risk MSM may have lower chance of HIV infection but same chance of HCV infection
  - Risk behaviour could increase as occurred with scale up of ART
Highlighted in recent modelling

- Modelling considers reason for HCV epidemic being concentrated in HIV+ MSM
- Incorporated HIV biological effects on HCV
  - Disease progression, spontaneous clearance and possibly infectivity (increased viral load)
- Incorporated sexual behavioural factors amongst MSM (using EMIS UK data):
  - Sexual mixing by HIV status
  - Heterogeneity in sexual risk
- **Question**: What factors explain large difference in HCV prevalence amongst HIV+ MSM versus HIV- MSM
  - Defined as **HCV ratio** which is generally over 10 in studies
Modelled HCV Ratio most dependent on behavioural factors

Baseline has no biological effects of HIV on HCV and population has no heterogeneity and mixes uniformly. *These scenarios also include the biological factors

McGregor L. et al In submission
Changes in behaviour will change HCV ratio – Will effect impact of targeting HCV treatment to diagnosed MSM

Assumes 10% of HIV diagnosed HIV-HCV co-infected MSM are HCV treated annually

McGregor L. et al In submission
Discussion – main findings

• Scale up of DAA treatment rates amongst HIV-diagnosed MSM could cause substantial reductions in HCV chronic prevalence / incidence:

• However, impact is sensitive to amount of HCV transmission in HIV -ve MSM which may be evolving or affected by PrEP scale up

• To monitor progress towards HCV elimination amongst MSM in UK – following data is needed:
  • HCV treatment rates in HIV+ and HIV- MSM
  • HCV reinfection rates
  • Chronic prevalence and incidence in HIV+ and HIV-ve MSM;

• Could an expanded UK CHIC provide this data – link to PrEP cohorts?
Acknowledgements

This work is supported through a research grant from Gilead Sciences. Gilead had no influence on the design, analysis and content of the study.

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Collaborators
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- Valerie Delpech (Public Health England)
- Murad Ruf (Gilead Sciences)
- Mark Nelson (Chelsea and Westminster Hospital)
- Thomas Martin (Kings College London)
- Graham Cooke, Emma Thomson (Imperial College London)
- Yusef Azad (National AIDS Trust)
- Ford Hickson and Peter Weatherburn (LSHTM)
Other important questions

• What are the health benefits of HCV treating HIV-HCV co-infected MSM?
  • Important for cost-benefit analyses of treatment
• How does the HCV epidemic in UK relate to HCV epidemics in other settings:
  • Has implications for modelling of HCV TasP
  • Can UK-CHIC be linked to other MSM cohorts in EU and USA to see how linked transmission is?
• Sexual risk behaviour and mixing effects:
  • What is the role of MSM Apps?
  • How does behaviour differ by PrEP use?
Higher treatment rates only result in greater treatment numbers for 5–7 years.
MODEL FITS TO EPIDEMIOLOGICAL DATA
Model calibration: number HIV-diagnosed MSM in UK

Black diamonds: PHE data

Martin NK et al CID 2016
Model calibration: HCV prevalence (Ab+ or RNA+) among HIV-diagnosed MSM in UK

Black diamonds: UK CHIC data

Martin NK et al CID 2016
Model calibration: HCV primary incidence among HIV-diagnosed MSM in UK

![Graph showing HCV primary incidence among HIV-diagnosed MSM (per 100 person-years) from 2000 to 2024. The black diamonds represent UK CHIC data.]
E.g. 1: Sexual Mixing by HIV Status in MSM

- 97% (black, left)
- 3% (red, left)
- 64% (black, right)
- 36% (red, right)

McGregor L. et al. In submission
E.g. 2: Condom Use by Partner’s and own HIV Status

<table>
<thead>
<tr>
<th>Status</th>
<th>Partner's Use</th>
<th>Own Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV Negative</td>
<td>65%</td>
<td>58%</td>
</tr>
<tr>
<td>HIV Positive</td>
<td>63%</td>
<td>13%</td>
</tr>
</tbody>
</table>

McGregor L. et al. In submission
Scale-up DAA treat for recent (80%) & non-recent diagnoses (20%/yr) and 20% risk reduction from 2015

**CHRONIC PREVALENCE**

HCV chronic (RNA+) prevalence among HIV-diagnosed MSM (%)

**PRIMARY INCIDENCE**

HCV primary incidence among HIV-diagnosed MSM (/100py)

Scale-up treatment AND behaviour change

Martin NK et al CID 2016