From Simulation Modeling to Developing Interventions: A Multipronged Approach to the HIV, HCV and OUD Syndemic

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Outline

• Background on the syndemic of OUD, HCV and HIV
• Cost-effectiveness of HCV screening among young adults
• Developing model of care
• Conclusions/next steps
Syndemic of opioid use disorder, drug overdose and HIV and HCV

Source: Pearlman et al. 2018
Overdose deaths have continued to rise

Based on data available for analysis on: 6/9/2021

Figure 1a. 12 Month-ending Provisional Counts of Drug Overdose Deaths: United States

Source: National Center for Health Statistics, 2021
Opioid overdose epidemic accompanied with rise in HCV cases

Source: CDC, 2018
Opioid overdose epidemic accompanied with HIV outbreak among person who inject drugs, Indiana 2014-2015

Source: Peters et al. NEJM, 2015
1. Developing data to inform national HCV testing and treatment guidelines
Progress in HCV treatment

Source: Innovations.org
HCV treatment cascade, 2013

Source: Yehia et al. Plos one, 2014
Recommendations for the identification of chronic hepatitis C virus infection among persons born during 1945–1965

Bryce D Smith, Rebecca L Morgan, Geoff A Beckett, Yngve Falck-Ytter, Deborah Holtzman, Chong-Gee Teo, Amy Jewett, Britney Baack, David B Rein, Nita Patel, Miriam Alter, Anthony Yartel, John W Ward, Centers for Disease Control and Prevention
Increase in newly reported HCV cases among individuals younger than 30 years of age in MA

Source: MMWR, 2011
Cost-Effectiveness of One-Time Hepatitis C Screening Strategies Among Adolescents and Young Adults in Primary Care Settings

Sabrina A. Assoumou,1,2 Abriana Tasillo,1 Jared A. Leff,3 Bruce R. Schackman,3 Mari-Lynn Drainoni,3,4,5 C. Robert Horsburgh,1,6 M. Anita Barry,1 Craig Regis,7 Arthur Y. Kim,4 Alison Marshall,8,10 Sheel Saxena,11 Peter C. Smith,12 and Benjamin P. Linas1,2,8
What is cost-effectiveness analysis?

• Evaluates an intervention by asking:
  “How much health benefit do we get for our money?”

• Seeks to efficiently allocate limited health resources
Cost-effectiveness analysis

- Two outcome measures
  - Cost ($)
  - Effectiveness (quality-adjusted life years)

- Incremental cost-effectiveness ratio (ICER):
  Additional Resource Use ($) Additional Health Benefits (QALY)
Cost-effectiveness analysis

• Maximizes population-level benefits of medical therapies
• DOES NOT seek to minimize cost
• Requires an explicit willingness to pay threshold
## What are we willing to pay?

<table>
<thead>
<tr>
<th>Service</th>
<th>$/QALY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ART for HIV infection¹</td>
<td>$34,400</td>
</tr>
<tr>
<td>Statins for primary prevention²</td>
<td>$52,100</td>
</tr>
<tr>
<td>Implantable defibrillators³</td>
<td>$89,400</td>
</tr>
<tr>
<td>Dialysis, seriously ill adults⁴</td>
<td>$209,200</td>
</tr>
</tbody>
</table>

* Converted to 2020 currency year

¹ Freedberg et al. NEJM
² Pletcher et al. Annals Internal Medicine 2009
³ Sanders et al. NEJM 2005
⁴ Hamel et al. Annals Internal Medicine 1997
Cost-Effectiveness Analysis Steps

1. Natural History
2. Test characteristics
3. Cost
4. Utility

Literature and clinical studies primary data are synthesized

Info used to populate a simulation model

ICER commonly cited threshold
$50,000 - $100,000

\[ \text{ICER} = \frac{\text{Additional cost}}{\text{Additional clinical benefit}} \]
Cost-Effectiveness of One-Time Hepatitis C Screening Strategies Among Adolescents and Young Adults in Primary Care Settings

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Background

• Increasing rate of HCV among 15 to 30-year-olds in the United states
• Risk-based screening was the recommendation for people who inject drugs (PWID)
• Alternative approaches might be necessary
Study objective

• **Goal:** Evaluate clinical benefit and cost-effectiveness for screening among adolescents and young adults

• **Study population:** 15 to 30-year-olds

• **Setting:** Urban community health centers in neighborhoods with a high overall number of reported HCV cases
Methods (1 of 2)

• We developed a decision analytic model to project:
  • Quality-adjusted life years (QALYs)
  • Lifetime costs (2016 US $)
  • Incremental cost-effectiveness ratios (ICER)
  • Proportion reaching steps along the HCV cascade
    (proportion of cases identified, linked to care, and reaching sustained virologic response)
Methods (2 of 2)

• We evaluated 9 strategies

• Strategies differed in 3 ways:
  • **Type of test:**
    • rapid finger stick vs. standard venipuncture diagnostics
  • **Individual ordering the test:**
    • clinician vs. counselor/tester using standing orders
  • **Approach to testing:**
    • Targeted vs. routine testing
## Base case results

<table>
<thead>
<tr>
<th>Testing Strategy</th>
<th>Total Discounted Cost per Person ($)</th>
<th>Remaining QALY per person (QALY)</th>
<th>Incremental cost-effectiveness ratio ($/QALY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Current Practice</td>
<td>122,080</td>
<td>23.7700</td>
<td>---</td>
</tr>
<tr>
<td>• Clinician ordered, counselor performed targeted rapid testing</td>
<td>122,090</td>
<td>23.7702</td>
<td>40,000</td>
</tr>
<tr>
<td>• Counselor-initiated targeted rapid testing</td>
<td>122,110</td>
<td>23.7706</td>
<td>44,000</td>
</tr>
<tr>
<td>• Counselor-initiated routine rapid testing</td>
<td>122,160</td>
<td>23.7713</td>
<td>71,000</td>
</tr>
</tbody>
</table>

*Base case results after removal of inefficient strategies*
HCV cascade of care

Proportion of HCV-infected patients

- Identified
- Linked
- SVR

Legend:
- Current Practice
- Physician/counselor targeted rapid
- Counselor targeted rapid
- Counselor routine rapid
Selected sensitivity analyses

- Counselor-initiated routine rapid testing was cost-effective at the $100,000/QALY gained threshold unless:
  - PWID prevalence < 0.59%
  - HCV prevalence <15% among 15 to 30-year-old PWID
  - The lifetime re-infection rate >95%
Sensitivity analysis on prevalence of young people who inject drugs
Limitations

- Limited information on rate of HCV testing rates for youth in primary care settings.
- Limited information on cascade of care for youth during the era of direct-acting antiviral therapy.
Conclusions

• Routine testing is cost-effective for 15 to 30-year-olds in communities with a prevalence of young PWID > 0.59%

• Rapid point-of-care testing should be considered instead of standard venipuncture testing

• If routine rapid testing is not feasible, then targeted testing by a dedicated counselor/tester should be considered
Eliminating the Public Health Problem of Hepatitis B and C in the United States: Phase One Report

DETAILS
180 pages | 6 x 9 | PAPERBACK
Hepatitis C Virus Antibody Testing Among Youth in a Large Sample of US FQHCs, 2012-2017

Source: Epstein et al. JAMA, 2019
Hepatitis C Virus Antibody Testing Among Youth in a Large Sample of US FQHCs

Source: Epstein et al. JAMA, 2019
Hepatitis C Virus Antibody Testing Among Youth in a Large Sample of US FQHCs

One patient with documented initiation of HCV treatment

Source: Epstein et al. JAMA, 2019
Hepatitis C Virus Antibody Testing Among Youth in a Large Sample of US FQHCs

During the opioid epidemic, less than 1/3 of patients with opioid use disorder were tested for hepatitis C.

Source: Epstein et al. JAMA, 2019
Section Summary

• Simulation modeling showed that routine HCV screening is cost-effective.
• Data set showed that there are gaps in the continuum of care
2. Developing models of care to improve outcomes
Rapid Versus Laboratory-Based Testing for HIV and Hepatitis C at a Drug Detoxification Treatment Center: A Randomized Trial

Sabrina A. Assoumou,1,2*, Samantha M. Paniagua,2 Benjamin P. Linas,1,3 Jianing Wang,2 Jeffrey H. Samet,4,5 Jonathan Hall,2 Laura F. White,2 and Curt G. Beckwith7,8
Background

- **HIV laboratory-based testing**
  - Advantage: allows identification of acute HIV cases
  - Drawback: test results might take 2 to 3 days

- **Rapid testing**
  - Advantage: Allows for test results within 20 minutes
  - Drawback: Does not enable identification of acute HIV cases
Background (continued)

• The CDC recommends HIV pre-exposure prophylaxis (PrEP) for individuals who are HIV negative and at risk for acquiring HIV.

• A randomized controlled trial showed that HIV PrEP is effective among persons who inject drugs.

• Uptake of HIV PrEP has been low, especially among persons who inject drugs.
Aim

• To develop a testing algorithm for combined HCV and HIV testing at a detox:
  • To compare laboratory-based 4th generation HIV testing to rapid point-of-care testing for HIV
  • To compare laboratory-based testing to rapid point-of-care testing for HCV
Outcomes

• Primary outcome: Test result delivery within two weeks after testing at a detox

• Additional assessment:
  • Real-world identification/notification
  • Interest in HIV PrEP and substance use treatment
Methods

• **Design:**
  • Single site
  • Two-arm randomized trial

• **Site:**
  • Boston Treatment Center (BTC)
    • Largest detox in Boston (~ 1500 visits/year)

• N=200
341 screened

200 (59%) met inclusion criteria

101 (50%) Assigned to Laboratory-based testing

- 88 (87%) performed
  - 0 Reactive
  - 82 Non-reactive

- 13 (13%) not performed
  - 6 hemolyzed

99 (50%) Assigned to rapid testing

- 95 (96%) performed
  - 94 Non-reactive
  - 1 Reactive

- 4 (4%) not performed

141 Excluded*

- 75 Tested within the last 6 months
- 55 Did not give contact information
- 26 Did not sign medical release form
- 33 Other exclusion**

341 screened

375 assigned to laboratory-based testing

88 (87%) tested for HIV

- 0 Reactive
- 82 Non-reactive

- 52 (51%) received results
- 41 (41%) results delivered within 2 weeks

88 (87%) tested for HCV

- 45 Reactive
- 36 Non-reactive

- 95 (96%) received results
- 95 (96%) results delivered within 2 weeks

1 (1%) tested for HIV Rapid testing

- 1 Reactive

1 (1%) tested for HCV Rapid testing

- 51 Reactive

0 (0%) tested for HIV Rapid testing who tested HIV Reactive

95 (96%) tested for HCV Rapid testing who tested HCV Reactive

0 (0%) tested for HIV Rapid testing who tested HCV Reactive

0 (0%) tested for HCV Rapid testing who tested HIV Reactive

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* 141 Excluded
** Other exclusions
Results

• In the past 6 months:
  • 87% had condomless sex
  • 58% injected drugs
  • 41% shared needles/works
  • 54% used substance use treatment services
  • 23% prescribed buprenorphine

• 10% gay or bisexual

• Rapid testing (OR, 22.38; 95% CI, 7.65-63.55) and Black race (OR, 0.26; 95% CI, 0.08-0.84) were associated with result delivery
Real-world identification and notification

Diagnostic test sensitivity multiplied by the proportion with test result delivery

• Rapid testing
  HIV: 95% (0.99 X 0.96)
  HCV: 93% (0.97 X 0.96)

• Laboratory-based testing
  HIV: 41% (0.99 X 0.41)
  HCV: 41% (0.99 X 0.41)
Other results

• Linkage to care within 4 months of testing was 6%.
Additional Assessments

- Past overdose
- Prescribed naloxone
- Prescribed buprenorphine (BUP)
- Interested in BUP
Additional Assessments

- Injected drugs
- Condomless sex
- PrEP awareness
- PrEP interest
Limitations

- Single site
- No information on length of stay to determine if this might have influenced result delivery among different racial/ethnic groups
Conclusions

• Real-world identification and notification for laboratory-based testing was < 50% in a community setting with at-risk transient population.

• Rapid testing should be considered over laboratory-based testing in comparable settings with at-risk transient populations.
Conclusions (continued)

• Further studies needed to determine reasons for lower result delivery among Black participants

• Drug detoxification centers are underutilized venues for:
  • Effective HCV and HIV testing
  • Disseminating
    • HIV PrEP
    • Medications to treat opioid use disorder

• Studies needed to understand poor linkage to care and develop and implement interventions
Patients at a drug detoxification center share perspectives on how to increase hepatitis C treatment uptake: A qualitative study

Sabrina A. Assoumou, Carlos R. Sian, Christina M. Gebel, Benjamin P. Linas, Jeffrey H. Samet, Judith A. Bernstein
Methods

• In-depth, semi-structured qualitative interviews (N=24) at a drug detoxification
• Determine facilitators and barrier to HCV treatment uptake
• Elicit solutions as proposed by participants
• Thematic analysis of coded data
1. Rare progression to HCV linkage to care

- Progression along the HCV treatment continuum of care was rare despite knowledge of positive testing and multiple interactions with the health care and drug treatment systems
  - “...I should have. I always meant to, I just always have an excuse not to. Always busy working and now...you know? [I’m] just trying to stay clean, just, I had plenty of appointments at the time, I had...work, so that took up my whole day...”
  - (28-year-old, White male)
2. Active substance use was an important barrier to linkage to care

- Active substance use was a major barrier to HCV treatment because of disruptions to everyday activities
  
  - “But when I'm using or, you know, rippin' and runnin', I don't really care about my health. I don't care about anything.”

  (30-year-old, White female)
3. Reinfection was a concern

• Re-infection was often perceived as almost inevitable
  • “I went on a run afterwards, and I knew the way that I was using and the people I was using with that I was going to have it again. So to be honest with you, I was basically just waiting to hear them say that I was positive again.”

(33-year-old, White male)
4. Reinfection was a concern (continued)

- Perception of re-infection’s inevitability was exacerbated by a belief that HCV treatment would only be covered once by health insurance or that a patient had to stop using substances before qualifying for treatment coverage
  - “I’m hearing back and forth...I hear that Mass Health will only allow [HCV treatment] one time. And they will pay for only one time is what I’ve heard, and that it is very costly.” (55-year-old, White female)
5. Solution: low-barrier walk-in treatment access

• Low-barrier access to substance use treatment with high-touch care and same-day/walk-in clinician visits was described as a potential solution

  • “...more of like an open schedule...‘cause I feel like anytime you call the doctors it’s like, ‘Oh, this one’s booked until, like, April’ and it will be, like, January. Or..., ‘We only have this time or this time.’”

  (30-year-old, White female)
6. Solution: High touch care (continued)

- “So, it's somebody that is through your insurance that basically they help if you need help getting to your appointments or they'll help represent you court or just, you know, somebody that's a part of the community that is there to help, you know, support you in times of need.”

(32-year-old, Latinx male)
7. Solution: Patient navigation

- Assistance with navigating the health care system and attention to immediate needs such as housing and transportation were mentioned as important components of an intervention to improve treatment uptake.
  - “I need a counselor or somebody to help me to do my things. Do what I need to do, step-by-step... Just sittin' down and doin' it myself, I wouldn't know where to start and when I have tried to get insurance, it was always stopped and then other people helped me try to get it, because I wasn't qualified or approved for it, because of my age or my income.”

(35-year-old, White female)
8. Patient autonomy important

- Patient autonomy to select the approach that best fits individual circumstances was noted as an important element of any interventions
  - “And so, I think that that's why the CSP [community support program] worker is good as well too is 'cause they more or less seek you out and give you the option and then you kind of just go from there if you want the help or not.”

(32-year-old, Latinx male)
Conclusions/Next steps:

• Active substance use was a major barrier to HCV treatment uptake

• Potential suggestions proposed by participants included:
  • Low-barrier access to substance use treatment
  • High-touch care with same-day walk-in options
  • Focus on patient autonomy to select an approach that best fits individual needs and circumstances

• Next step: Use findings from qualitative studies to develop and implement an intervention.
Section Summary

• To address the syndemic of HIV and HCV among persons with opioid use disorder the following are needed:
  • Rapid identification/notification of HIV and HCV
  • Comprehensive care with navigation of the health care system with wraparound services and high-touch care

• Addressing substances use is key to making progress in the care of patients with or at-risk for HIV and HCV
Conclusions

• Tool kit with:
  • Simulation modeling to inform policy
  • Intervention development to have an impact at the patient-level in the real-world
    • Next steps: Developing and piloting an intervention to improve syndemic-related outcomes
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CDC
Centers for Disease Control and Prevention
Questions?