Colorado HCV Care Cascade

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Statistical Analyst
SUMMARY

Colorado overview
Reportable labs in Colorado
Care cascade development
Limitations & conclusion
Colorado Overview

- Population: 5,813,725
  - 20th most populous state
- Rate per 100,000 (2019): 46.6
- VH lives in the STI/HIV/VH office
- Staff breakdown
  - 0.2 FTE data analyst
  - 2 FTE case ascertainment
    - Data entry and interviews
  - 1 FTE data entry specialist
  - 1 FTE prevention coordinator

Fig 1. Diagnoses and rate of diagnosis of confirmed chronic HCV in Colorado, 2011-2020
CEDRS (Colorado Electronic Disease Reporting System)

- Event-based database
  - An individual will have a profile ID and potentially multiple event IDs

  ![Fig 2. CEDRS; hepatitis diagnoses](image)

- Each unique event ID has other data that corresponds to that diagnosis in other tables within CEDRS - including lab data
CEDRS

- Case ascertainment receives labs through:
  - ELR primarily
  - Encrypted email in fax form
  - EFax Corp line
- There are 50-350 lab entries per day, often with multiple labs per patient
  - Utilize other databases (Patient360, CIIS, QHN) to correctly input a case
- Takes one month to do quarterly data cleaning changes
Data cleaning and maintenance

- Duplicate events
  - Two event IDs for the same diagnosis
- Duplicate individuals
- Using labs to confirm event status of diagnoses
  - Probable versus confirmed
  - Cases that should be deleted
- Missing lab results
  - Case investigation team will double check medical records and populate missing fields for HCV RNA tests when they can
- All of these processes are done quarterly
- Code took ~ 8 hours to write
Data cleaning and maintenance

- Duplicate events
  - Two event IDs for the same diagnosis
- Duplicate individuals
  - Fuzzy joins on name and date of birth
- Using labs to confirm event status of diagnoses
  - Probable versus confirmed
  - Cases that should be deleted
- Missing lab results
  - Case investigation team will double check medical records and populate missing fields for HCV RNA tests when they can
- All of these processes are done quarterly
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Care Cascade Process

- Data available to us:
  - RNA/viral tests
    - Negatives became reportable in 2019 after BOH change
  - Antibody tests
- Treatment data are not reported

1. Create tables for each stage of the cascade with:
   a. Unique ID
   b. Collection date of the lab test
   c. Result of the lab test
2. Merge tables on the unique ID so the result is a wide dataset with one row per diagnosis
   a. Do this step by step to ensure the tests occur chronologically

Fig 4. Care cascade steps

| Positive HCV RNA | First negative RNA | HCV RNA | Second negative HCV RNA at least 3 months later | Reinfection |
STEP 1
Find first positive HCV RNA and it’s collection date

Code chunk below creates a dataset with only positive viral tests

Fig 6. R code chunk

```r
# To create a dataset with only positive viral tests
hcv_first_positive_v1 <- coc_dataset_labs_inc_ab_cleaned
filter(TestType %in% viremic_tests)
select(EventID, ProfileID, EventStatus, LabSpecimenID, CollectionDate, TestType, ResultText, QuantitativeResult)
filter(ResultText != "negative")
```
**STEP 1**

Find first positive HCV RNA and collection date

**STEP 2**

Find two subsequent negative HCV RNAs

Create a new dataset with negative RNAs, merge back with unique ID, calculate time between tests

Use two negative HCV RNAs as a proxy for completing treatment

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**Fig 7. HCV diagnosis data row**

<table>
<thead>
<tr>
<th>EventID</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ProfileID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease</td>
<td>Hepatitis C, Chronic</td>
<td></td>
</tr>
<tr>
<td>EventStatus</td>
<td>Confirmed</td>
<td></td>
</tr>
<tr>
<td>ReportedDate</td>
<td>6/8/2019</td>
<td></td>
</tr>
<tr>
<td>positive_antibody_test</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FirstPosAntibody_CollectionDate</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>antibody_test</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>positive_viral_load_test</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FirstPosVL_CollectionDate</td>
<td>6/5/2019</td>
<td></td>
</tr>
<tr>
<td>positive_viral_load_test_char</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>time_ab_to_pos_vl</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>negative_vl_test_first</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FirstNegCollectionDate</td>
<td>9/11/2019</td>
<td></td>
</tr>
<tr>
<td>time_posvl_to_negvl</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>SecondVLTestForSVR_CollectionDate</td>
<td>12/11/2019</td>
<td></td>
</tr>
<tr>
<td>time_between_neg_vl</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>negative_vl_test_second</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SVR</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
STEP 3
Identify reinfections

Find a positive RNA at least 6 months following a confirmed SVR

With a reinfection, an individual will have the same ProfileID and a different EventID for the unique diagnosis

<table>
<thead>
<tr>
<th>EventID</th>
<th>ProfileID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease</td>
<td>Hepatitis C, Chronic</td>
</tr>
<tr>
<td>EventStatus</td>
<td>Confirmed</td>
</tr>
<tr>
<td>ReportedDate</td>
<td>6/8/2019</td>
</tr>
<tr>
<td>positive_antibody_test</td>
<td>0</td>
</tr>
<tr>
<td>FirstPosAntibody_CollectionDate</td>
<td>NA</td>
</tr>
<tr>
<td>antibody_test</td>
<td>no</td>
</tr>
<tr>
<td>positive_viral_load_test</td>
<td>1</td>
</tr>
<tr>
<td>FirstPosVL_CollectionDate</td>
<td>6/5/2019</td>
</tr>
<tr>
<td>positive_viral_load_test_char</td>
<td>yes</td>
</tr>
<tr>
<td>time_ab_to_pos_vl</td>
<td>NA</td>
</tr>
<tr>
<td>negative_vl_test_first</td>
<td>1</td>
</tr>
<tr>
<td>FirstNegCollectionDate</td>
<td>9/11/2019</td>
</tr>
<tr>
<td>time_posvl_to_negvl</td>
<td>98</td>
</tr>
<tr>
<td>SecondVLTestForSVR_CollectionDate</td>
<td>12/11/2019</td>
</tr>
<tr>
<td>time_between_neg_vl</td>
<td>91</td>
</tr>
<tr>
<td>negative_vl_test_second</td>
<td>1</td>
</tr>
<tr>
<td>SVR</td>
<td>1</td>
</tr>
<tr>
<td>time_pos_vl_to_SVR</td>
<td>189</td>
</tr>
<tr>
<td>ReinfecitonCollectionDate</td>
<td>4/14/2021</td>
</tr>
<tr>
<td>reinfection</td>
<td>1</td>
</tr>
<tr>
<td>time_from_svr_to_reinfection</td>
<td>490</td>
</tr>
</tbody>
</table>
Colorado HCV Care Cascade

Any person with a positive HCV RNA test.

Positive Antibody Test: 2,210

Positive Viral Load Test: 2,693

Negative VL Test First: 703

SVR: 264

Reinfecction: 2

Total Individuals: 2,693

- 82.06% of total with a reactive antibody test
- 100.00% of total with a positive HCV RNA test
- 26.10% of total with an initial negative HCV RNA test
- 9.80% of total with SVR
- 0.07% of total with a reinfection of HCV

Includes all confirmed and probable HCV diagnoses in CEDRS diagnosed in 2019 and after.

Negative HCV RNAs became reportable in 2019.

Data presented is through: 2/25/2022

Data pulled: 2/25/2022
Limitations

- If someone moves out of Colorado
- If an individual does not pursue a second negative HCV RNA after completing treatment
  - No treatments are reported to CDPHE, only labs
  - This is why we take into account liberal and conservative estimates of SVR, but only publish confirmed SVR
- As of 2021, Colorado Medicaid no longer requires a HCV RNA 4 weeks into an individual’s treatment
  - This means many Medicaid clients may only have one negative HCV RNA reported to CDPHE
- These limitations likely result in an underestimation of those that have been cured of HCV
- Also result in a potential underestimation of reinfections
Conclusions

- Helps us get a better idea of prevalence in CO
- Added HCV CoC to our annual surveillance report
  - Broken out by reliable variables inc. sex, county of diagnosis, and age at diagnosis
- Plans to:
  - Increase data sharing where possible
  - Match with vital statistics data
- 2 months to develop

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>People with a positive HCV RNA test in 2019*</td>
<td>2,675</td>
<td>100%</td>
</tr>
<tr>
<td>People with a subsequent negative HCV RNA test**</td>
<td>700</td>
<td>26.17%</td>
</tr>
<tr>
<td>People verified to have reached SVR***</td>
<td>264</td>
<td>9.87%</td>
</tr>
<tr>
<td>People who have been reinfected with HCV**</td>
<td>2</td>
<td>0.07%</td>
</tr>
</tbody>
</table>

Data source: CEDRS. *Defined as persons diagnosed with chronic hepatitis C virus through year-end 2019. **Percentage of those with a negative viral load test reported to CDPHE after their positive viral load. ***Percentage of total diagnoses that reached SVR which is defined as two negative viral loads at least 3 months apart. ****Percentage of total diagnoses that reached SVR and had a positive viral load 6 months after reaching SVR.
Acknowledgements

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