Colorado HCV Care Cascade

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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
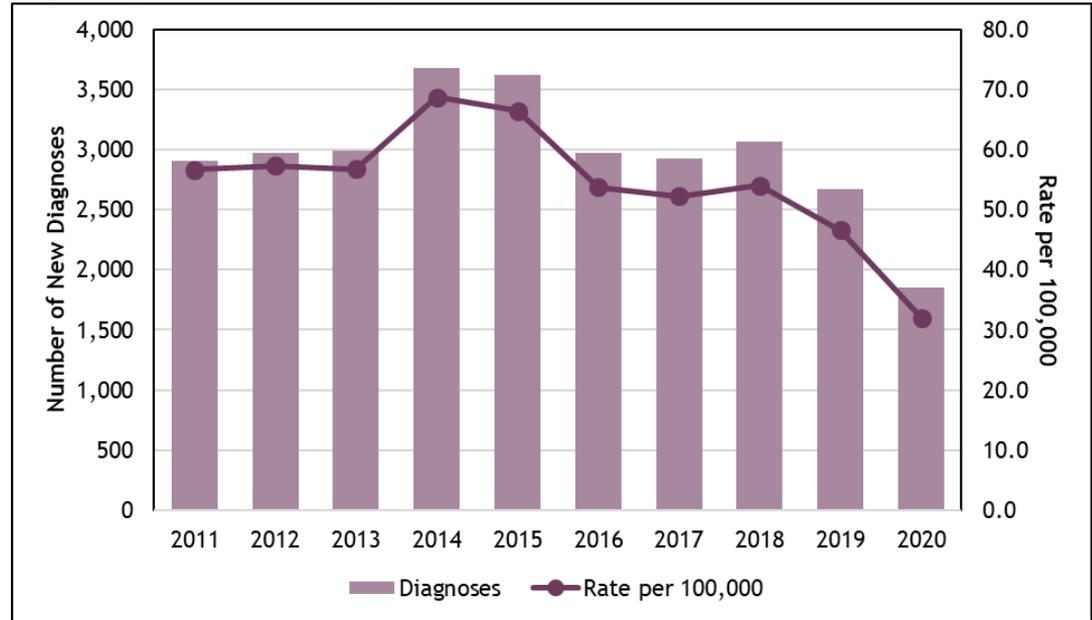
CEDRS (Colorado Electronic Disease Reporting System)

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

Fig 2. CEDRS; hepatitis diagnoses

EventID	ProfileID	Disease	EventStatus	ReportedDate
409	552	Hepatitis C, Chronic	Probable	2019-09-11
434	552	Hepatitis A	Confirmed	2019-09-11
717	552	Hepatitis B, Chronic	Confirmed	2020-02-10

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

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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

Fig 3. CEDRS; HCV labs with missing results

TestType	ResultText	QuantitativeResult
HCV viral load quantitative	unknown	<15
HCV viral load quantitative	unknown	<15
HCV viral load quantitative	missing	6.62 log iu/ml
HCV viral load quantitative	unknown	<15

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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**
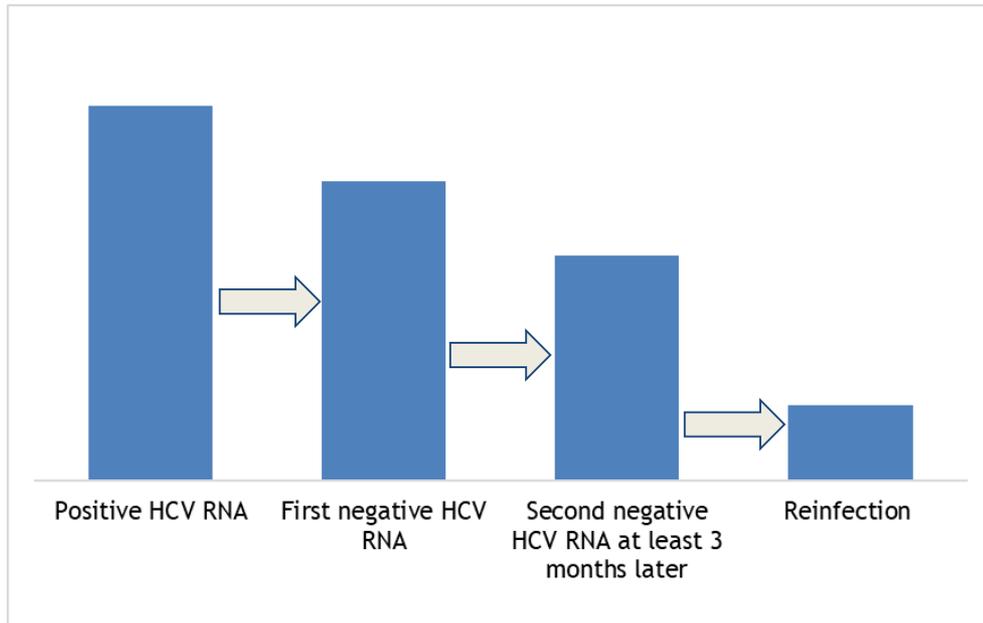- Code took ~ 8 hours to write

Fig 4. CEDRS; HCV labs

TestType	ResultText	QuantitativeResult	ResultDate	CollectionDate
anti-HCV	positive	28.90-1	2019-01-04	2019-01-03
HCV viral load quantitative	positive	4420000-iu/ml	2019-01-08	2019-01-03
HCV RNA Genotype	result is text	3a	2019-06-07	2019-06-03
HCV viral load quantitative	positive	<15	2020-01-18	2020-01-17
HCV viral load quantitative	positive	10200	2020-01-30	2020-01-29
HCV viral load quantitative	positive	4240000	2020-03-13	2020-03-12
HCV viral load quantitative	positive	27	2020-03-30	2020-03-27
HCV viral load quantitative	negative	0	2020-04-22	2020-04-20
HCV viral load quantitative	negative	0	2020-05-22	2020-05-20
HCV viral load quantitative	negative	0	2020-06-17	2020-06-16
HCV viral load quantitative	negative	0	2020-07-14	2020-07-10
HCV viral load quantitative	negative	0	2020-08-10	2020-08-08
HCV viral load quantitative	negative	not detected	2020-09-17	2020-09-11

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 HCV RNA → Second negative HCV RNA at least 3 months later → Reinfection

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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
hcv_first_positive_vl<-coc_dataset_labs_inc_ab_cleaned %>%
  filter(TestType %in% viremic_tests) %>%
  select(EventID,ProfileID,EventStatus,LabSpecimenID,CollectionDate,TestType,ResultText,QuantitativeResult) %>%
  # filter out NAs
  drop_na(CollectionDate) %>%
  # remove any negative tests
  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

Fig 7. HCV diagnosis data row

EventID	
ProfileID	
Disease	Hepatitis C, Chronic
EventStatus	Confirmed
ReportedDate	6/8/2019
positive_antibody_test	0
FirstPosAntibody_CollectionDate	NA
antibody_test	no
positive_viral_load_test	1
FirstPosVL_CollectionDate	6/5/2019
positive_viral_load_test_char	yes
time_ab_to_pos_vl	NA
negative_vl_test_first	1
FirstNegCollectionDate	9/11/2019
time_posvl_to_negvl	98
SecondVLTestForSVR_CollectionDate	12/11/2019
time_between_neg_vl	91
negative_vl_test_second	1
SVR	1

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

Fig 8. HCV diagnosis data row

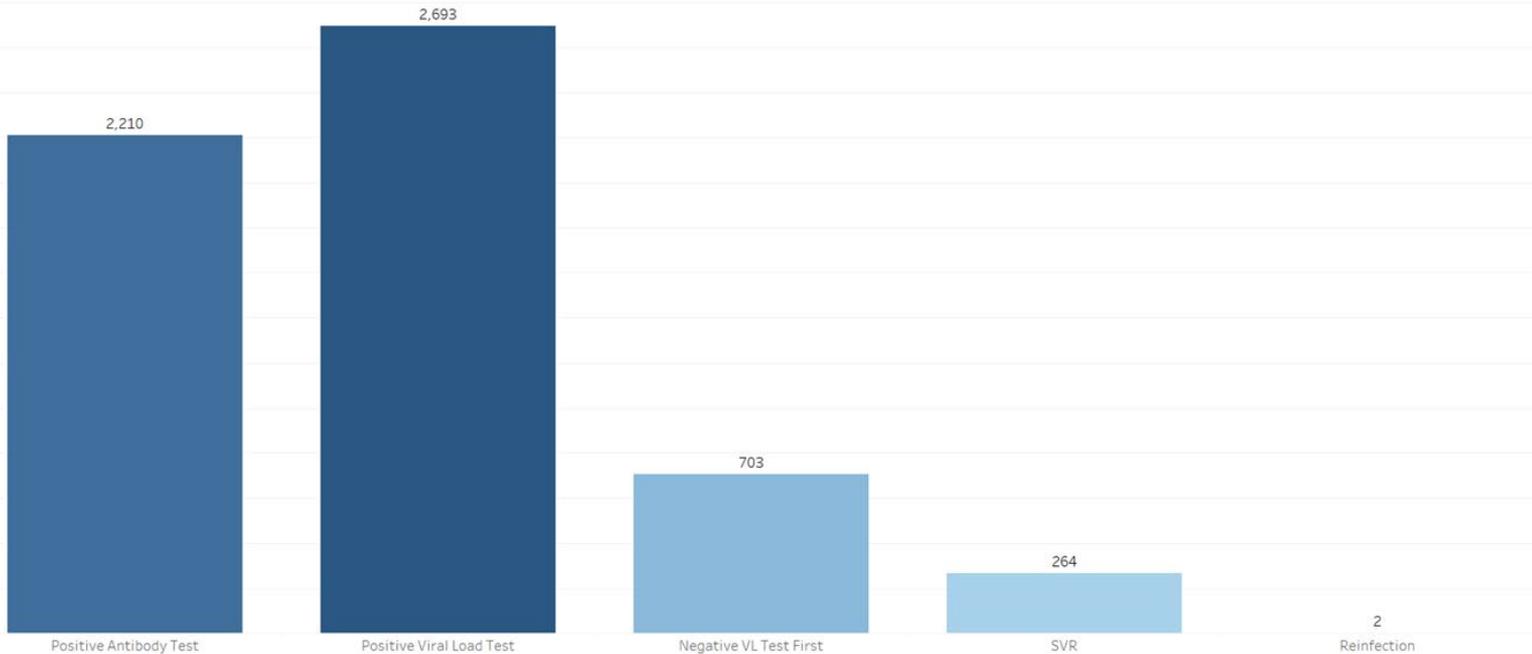|	
EventID	
ProfileID	
Disease	Hepatitis C, Chronic
EventStatus	Confirmed
ReportedDate	6/8/2019
positive_antibody_test	0
FirstPosAntibody_CollectionDate	NA
antibody_test	no
positive_viral_load_test	1
FirstPosVL_CollectionDate	6/5/2019
positive_viral_load_test_char	yes
time_ab_to_pos_vl	NA
negative_vl_test_first	1
FirstNegCollectionDate	9/11/2019
time_posvl_to_negvl	98
SecondVLTestForSVR_CollectionDate	12/11/2019
time_between_neg_vl	91
negative_vl_test_second	1
SVR	1
time_pos_vl_to_SVR	189
ReinfectionCollectionDate	4/14/2021
reinfection	1
time_from_svr_to_reinfection	490

Colorado HCV Care Cascade

Any person with a reactive HCV antibody test that is not followed by a negative HCV RNA test.

Any person with a positive HCV RNA test.

Any person with a negative HCV RNA following a positive HCV RNA.

Any person with a second negative HCV RNA test at least 3 months after their initial negative HCV RNA test.

Any person with a confirmed SVR with a subsequent positive HCV RNA test at least 6 months after confirmed SVR.

Diagnosis Year
2019

Sex/Gender
(All)

Age at Diagnosis
(All)

Race/Ethnicity
(All)

County at Diagnosis
(All)

County Class at Diagnosis
(All)

Homeless At Diagnosis
(All)

Has had a positive HCV RNA
Yes

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

	Value
2,693	Positive Viral Load Test
2,210	Positive Antibody Test
703	Negative VL Test First
264	SVR
2	Reinfection

Total Individuals:

2,693

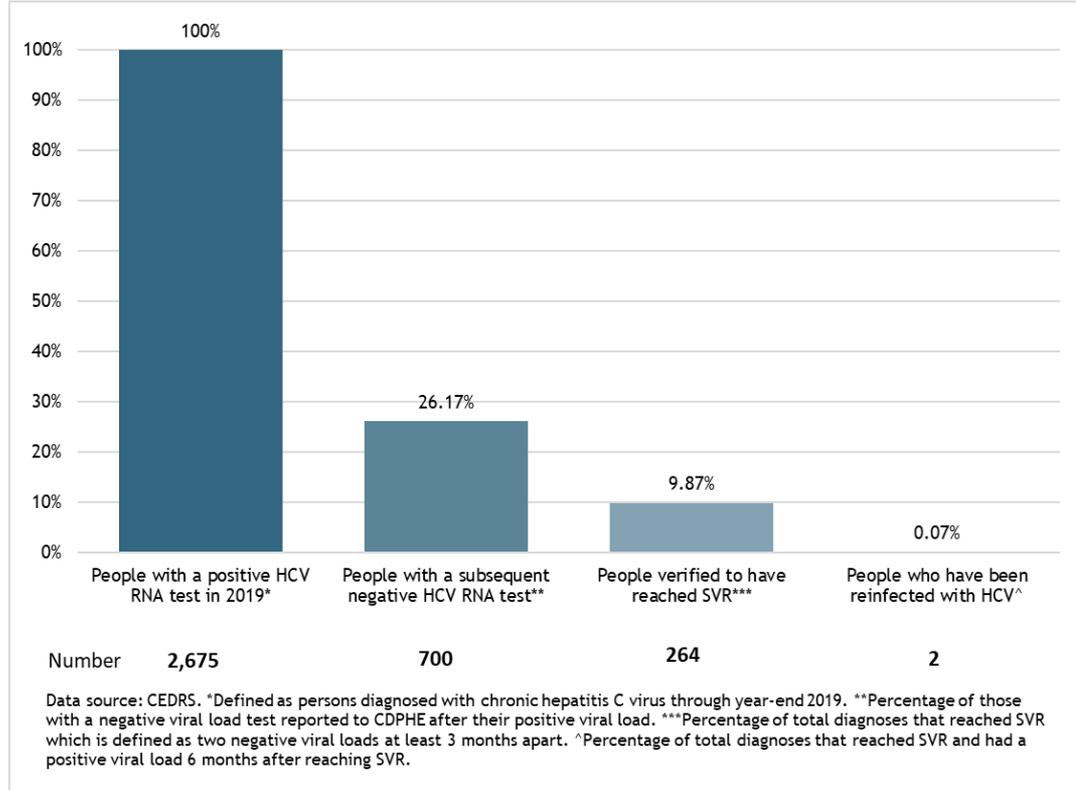| %	Description
82.06%	% of total with a reactive antibody test
100.00%	% of total with a positive HCV RNA
26.10%	% of total with an initial negative HCV RNA
9.80%	% of total with SVR
0.07%	% of total with a reinfection of HCV

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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 in to 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

	People with a positive HCV RNA test in 2019*	People with a subsequent negative HCV RNA test**	People verified to have reached SVR***	People who have been reinfected with HCV^
	100%	26.17%	9.87%	0.07%
Number	2,675	700	264	2

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.

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Acknowledgements

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