

Healthcare Goal

Our goal is to reduce the number of people with chronic hepatitis C virus (HCV) infection who receive care in the Mount Sinai Health System by 90%.

Background and Aim

Chronic HCV infection can lead to liver failure and liver cancer. Highly effective direct acting antiviral (DAA) drugs are now available to cure HCV, but many HCV+ patients are not being treated. Innovative case-finding and care coordination strategies are needed to identify patients and transition them into care. The Aims of this study are to develop a multidisciplinary strategy for identifying HCV-infected patients across a large urban healthcare system and for linking them to HCV treatment.

Methods

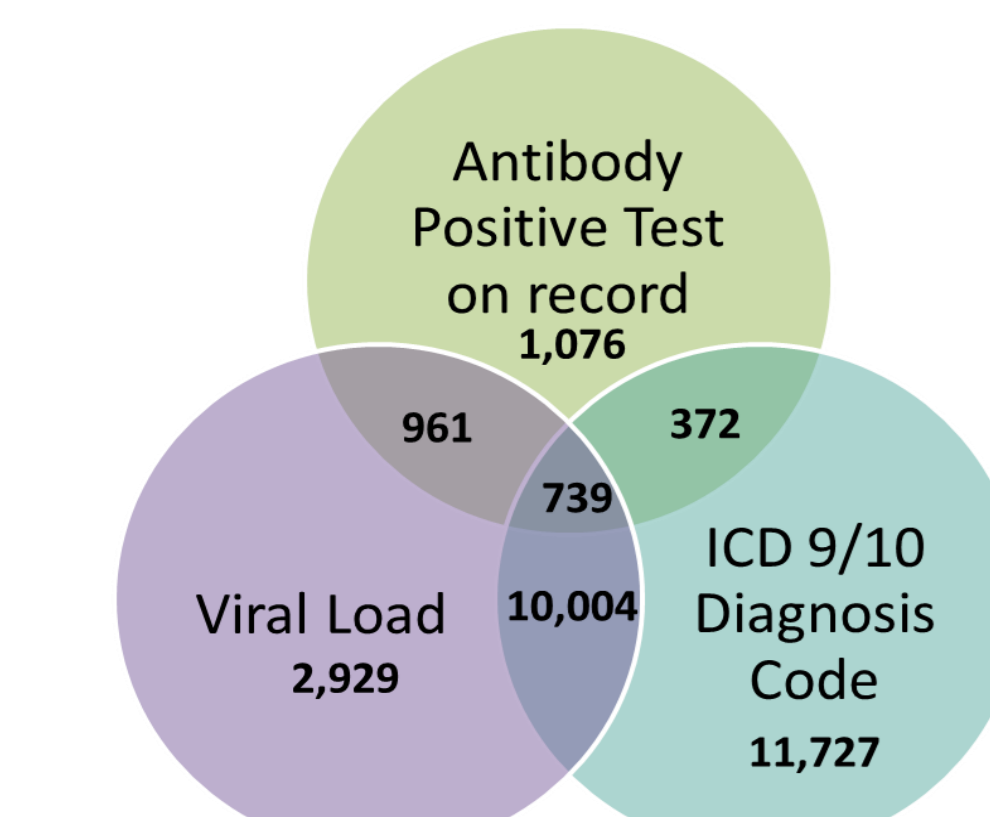
- 1) Electronic health records (EHR) of ~ 7.6 million people in the Mount Sinai Health System (2000–2017) were queried to identify patients with and International Classification of Diseases (ICD) 9/10 diagnosis code for HCV and/or a positive HCV antibody or HCV RNA test, which generated a list of **27,808** patients with possible HCV.
- 2) Custom software was written to identify patients with chronic infection and distinguish them from patients likely to have been cured of HCV. Chart review was used to validate the algorithm and determine a patient's true status. The software used a previously validated algorithm developed by the NYC DOH¹ that used reported lab results as a starting point.
- 3) A team of providers, care coordinators, patient navigators, and others are contacting patients considered most likely to benefit from HCV treatment by phone, offering navigation into care and care coordination when appropriate.
- 4) Results of HCV treatment are being monitored by a combination of artificial intelligence (AI) and traditional EHR review.

Identification of 27,808 Patients with Possible HCV

ICD 9/10 Code	HCV Diagnosis Description(s)	N
B17.10	Acute HCV; Acute HCV infection; Acute HCV infection w/ wo hepatic coma	192
B17.11	Acute HCV infection w hepatic coma	6
B18.2	Chronic HCV; Chronic HCV during pregnancy, antepartum; Chronic HCV infection; Chronic HCV w/ cirrhosis; Chronic HCV w/ wo hepatic coma; Chronic viral HCV; Cirrhosis of liver due to HCV; Cirrhosis, HCV; HCV w/ coma, chronic; Hep C w/o coma, chronic; Hepatic cirrhosis due to chronic HCV infection; HCV, chronic; HCV; chronic w/ coma; Maternal HCV, chronic, antepartum; Pregnancy complicated by chronic HCV, antepartum; Recurrent HCV	11,572
B19.10	Hepatitis B infection w HCV infection	1
B19.20	Compensated cirrhosis related to HCV (HCV); Decompensated cirrhosis related to HCV; HCV; HCV infection; HCV infection w/ hepatic coma; HCV infection w/o hepatic coma; unspecified chronicity HCV w/o hepatic coma; HCV w/o mention of hepatic coma; Unspecified viral HCV w/o hepatic coma; Viral HCV; Viral HCV w/o coma	8,053
B19.21	HCV infection w/ hepatic coma; HCV infection w/ hepatic coma, unspecified chronicity; Unspecified viral HCV w/ hepatic coma; Viral HCV w/ coma	20
K73.2	Chronic active HCV	2
K74.60	Chronic HCV w/ cirrhosis; Cirrhosis of liver due to HCV; Cirrhosis; HCV; Hepatic cirrhosis due to chronic HCV infection	182
K74.69	Compensated cirrhosis related to HCV;	219
R76.8	HCV antibody positive	1,996
Z86.19	History of HCV	599
HIV Diagnosis Description(s)		
079.53	Human immunodeficiency virus ; Type 2 (HIV 2)	1
B20	AIDS; HIV; Neuroopathy due to HIV	3,592
B97.35	HIV; type 2 (HIV 2) as the cause of diseases classified elsewhere	3
V08	Human immunodeficiency virus (HIV) infection	5
Z21	Asymptomatic (HIV) infection status	1,320

The list contains all patients with an EHR HCV Diagnosis at a visit or recorded in their problem list **OR** HCV viral load (RNA) \geq 15 IU/mL **OR** HCV Antibody is Positive or Reactive at any time.

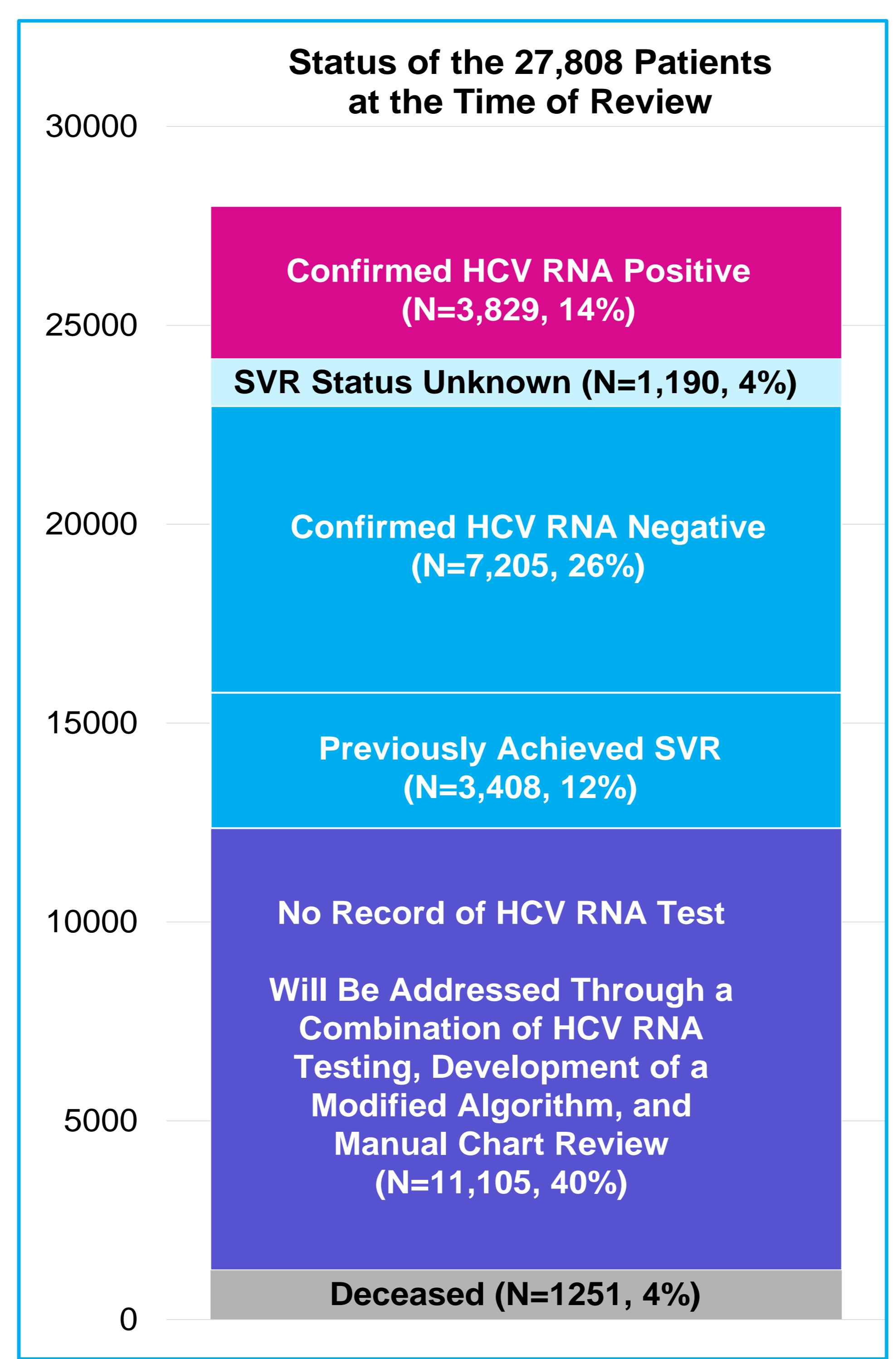
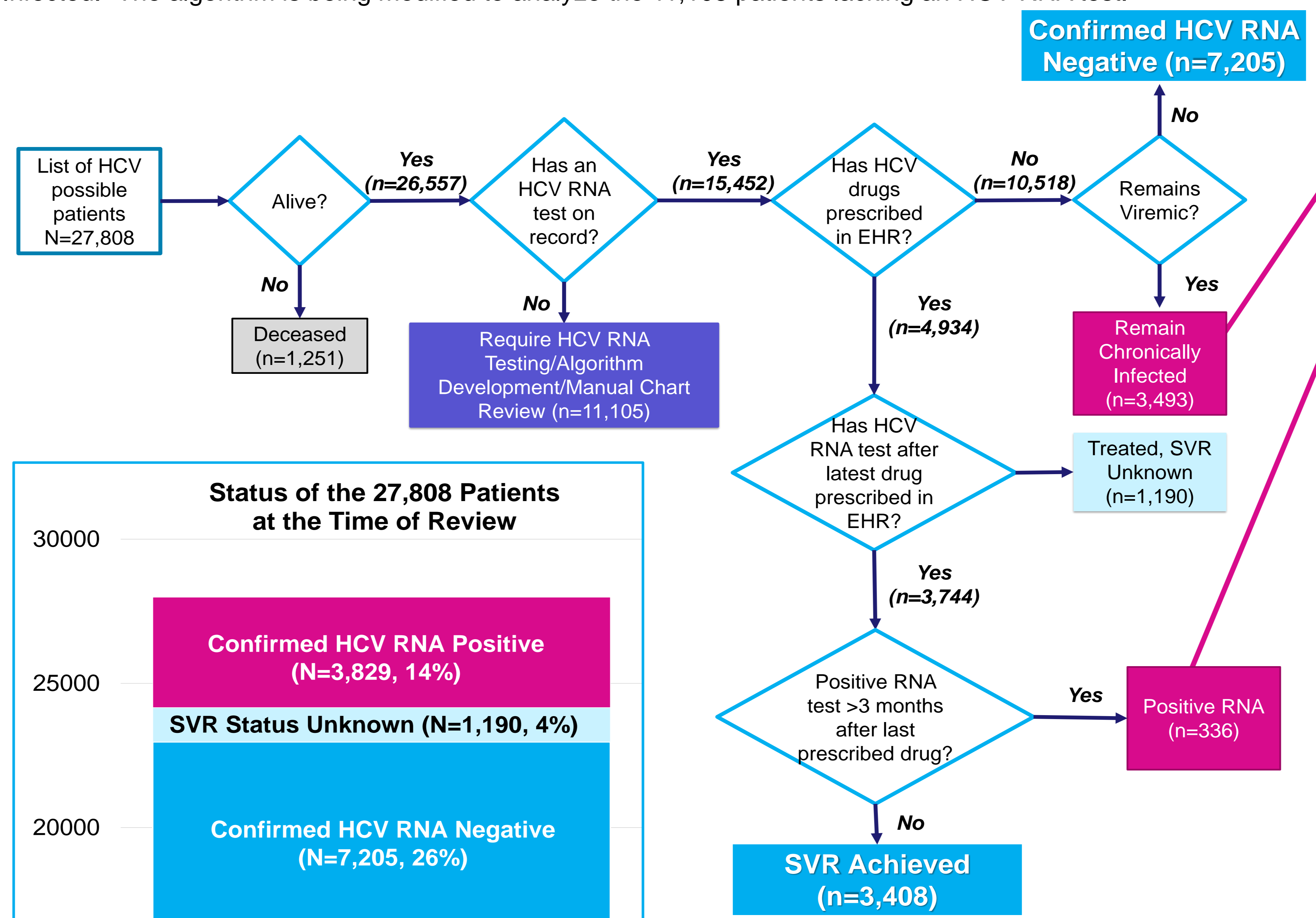
The report on the 27,808 patients provides information about HIV status.



Algorithm: Artificial Intelligence (AI)-assisted Classification of HCV Status

From a list of 27,808 "HCV Possible" patients, the algorithm removed deceased patients and then selected patients who had an HCV RNA test. It divided them into those with/without a prescription for an HCV drug (see Table below). Patients prescribed a HCV drug were classified "Remain Chronically Infected" if they had a positive HCV RNA test > 3 months after the last prescription. If the date of the last prescription was followed by a negative RNA test > 3 months later and HCV RNA remained negative, the patient was classified "SVR Achieved". If there were no tests after the last prescription, patients were classified "Treated, SVR Unknown". If a positive RNA test were reported after a negative test, the anchor date was reset to capture the most recent status.

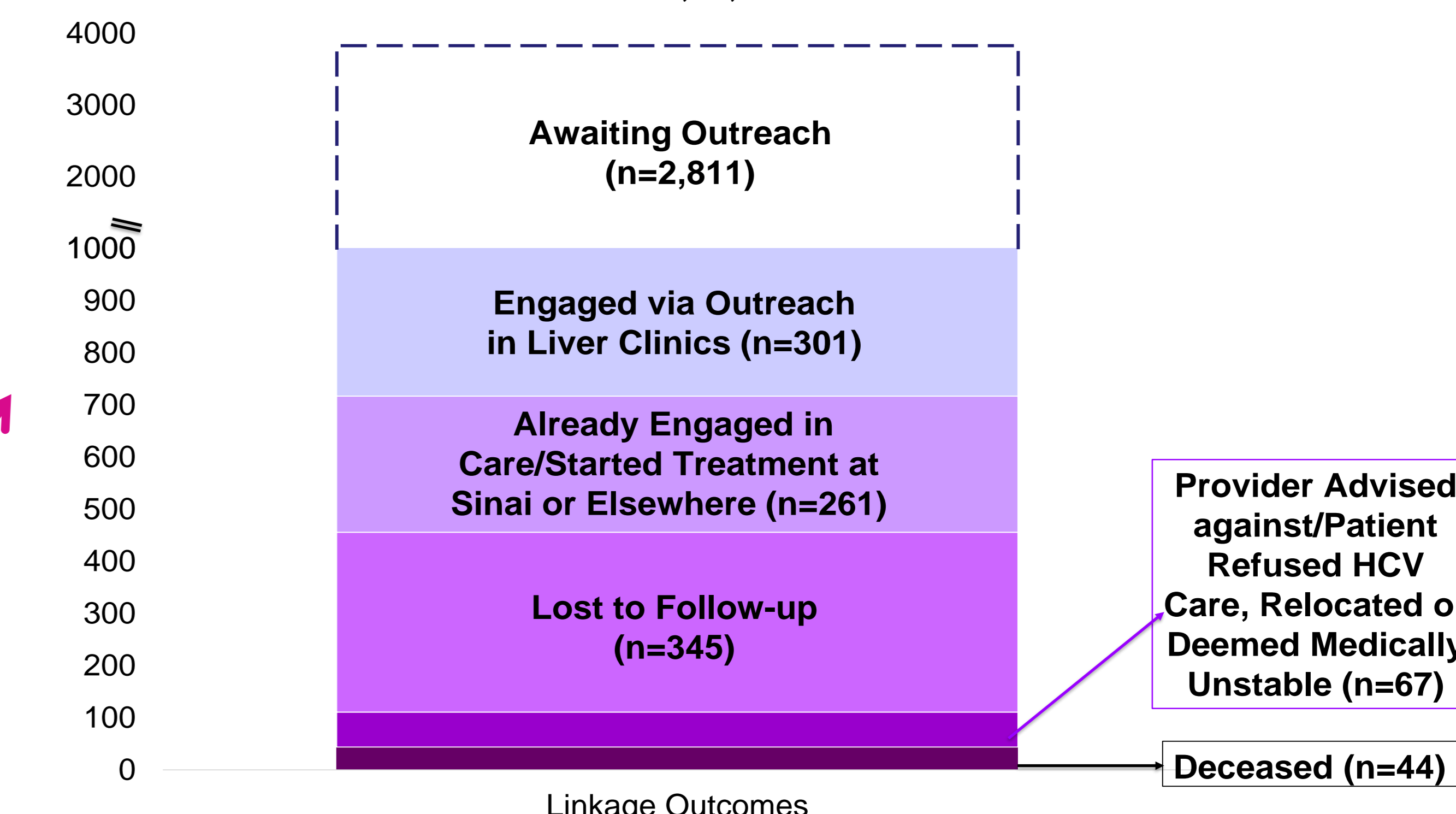
For patients with no record of an HCV drug prescription, serial viral load values were used to determine HCV status. For the classification "Confirmed HCV negative", the algorithm identified the date of the first negative, indeterminate, or low viral load (<1000 IU/mL) after the most recent positive RNA test. Using this anchor date, the algorithm then looked for a negative RNA test \geq 4 months later. Patients without a negative test were classified "Remain Chronically Infected." The algorithm is being modified to analyze the 11,105 patients lacking an HCV RNA test.



HCV Drugs Included in the Algorithm
Daclatasvir (Daklinza)
Elbasvir-Grazoprevir (Zepatier)
Ombitasvir-Paritaprevir-Ritonavir (Technivie)
Ribavirin (Copegus, Rebetol, Ribasphere, Ribapak)
Ombitasvir-Paritaprevir-Ritonavir and Dasabuvir (Viekira Pak)
Sofosbuvir-Velpatasvir-Voxilaprevir (Vosevi)
Simeprevir (Olysio)
Glecaprevir-Pibrentasvir (Mavyret)
Ledipasvir-Sofosbuvir (Harvoni)
Sofosbuvir (Sovaldi)
Sofosbuvir-Velpatasvir (Epclusa)
Interferon alpha-2b
Interferon alphacon-1 (Infergen)
Pegylated Interferon alpha-2a
Pegylated Interferon alpha-2b

Progress on Outreach to 3,829 Potential Treatment Candidates

Patients with \geq 15 IU/mL HCV RNA were entered into a database of candidates for outreach and transitioning into HCV care. By chart review and phoning, information was collected on basic demographics and HCV status of 1,018 patients. Thus, far 301 have been entered into HCV care via outreach; 2,811 charts await review.



Roadblocks and Corrective Strategies

Barriers to Engagement	Mitigation Strategies to Improve Engagement
Incorrect/outdated contact information	Attempt phone call at least 3 times at various times of the day. If no success, re-engagement letters sent by mail.
Failure of patients to keep appointments	Overbook patients for appointments within 1-2 weeks of initial outreach. After 3 no-shows schedule a meeting with a care coordinator before another appointment is booked.
No death record in EHR	Link to national death records.
No HCV test results	Provide house staff and providers with HCV testing guidelines. Perform universal HCV testing in the Emergency Department.
Address psychosocial and behavioral problems prior to starting DAAs	Multidisciplinary care coordination program ² implementation to optimize patients readiness for treatment.
Lack of insurance	Provide care coordination program.
Provider engagement	Give providers the names of their eligible patients

Summary and Conclusions

- A newly-developed algorithm that integrates ICD 9/10 codes, clinical lab results, and pharmaceutical data was used to identify a) candidates for HCV outreach and treatment, and b) patients who are deceased (about 4% of the population).
- Chart review and phone calls were used to classify potential treatment candidates into several categories: a) ready for entry into the HCV treatment pipeline, b) already engaged in care, and c) lost to follow up.
- Over 1,000 Mount Sinai patients could be engaged in HCV care with adequate support.
- **Many patients in our urban healthcare system who had EHR data consistent with HCV infection remained chronically infected at the end of 2017(26%).** Our findings highlight the urgent need for large-scale HCV case finding and they demonstrate the benefits of care coordination.

Acknowledgements & References

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- References:
1. Moore, Miranda S., et al. *Journal of Public Health Management and Practice* 24.6 (2018): 526-532.
 2. Laraque, F., et al. *Hepatology*.63.1 (2016, October). 95A-95A.

