

# BMJ Open Quality Improving hepatitis A vaccination rates in hospitalised patients with cirrhosis: insights and lessons learnt

Ryan Jean Kronen ,<sup>1</sup> Madeleine Haff,<sup>2</sup> Vilas Patwardhan,<sup>3</sup> Mary LaSalvia<sup>4</sup>

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<sup>1</sup>Department of Medicine, University of Washington, Seattle, Washington, USA

<sup>2</sup>Division of Gastroenterology, Internal Medicine, Boston University, Boston, Massachusetts, USA

<sup>3</sup>Division of Gastroenterology and Hepatology, Internal Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

<sup>4</sup>Division of Infectious Diseases, Internal Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

**Correspondence to**  
Dr Ryan Jean Kronen;  
ryan.j.kronen@gmail.com

## INTRODUCTION

Vaccine uptake has been a long-standing challenge in public health spanning a wide array of patients and diseases,<sup>1</sup> but the need to identify and address barriers to vaccine utilisation has never been more apparent for our generation than during the COVID-19 era. Even when effective vaccines are available, challenges surrounding implementation can lead to failure of disease control and eradication. Hepatitis vaccination serves as a telling example of this implementation gap and presents an important opportunity for learning. In patients with cirrhosis, the Centers for Disease Control and Prevention recommends hepatitis A and B vaccination, since hepatitis infection in those with liver disease is associated with increased morbidity and mortality.<sup>2</sup> Despite this recommendation, hepatitis vaccination rates in this vulnerable population remain low.<sup>3</sup> In this study, we chose to focus on hepatitis A for several reasons: the propensity for outbreaks among unvaccinated individuals,<sup>4</sup> the association with other markers of social vulnerability<sup>5</sup> and the relative simplicity of serology interpretation. While there are multiple points of contact between patients and the health-care system which represent opportunities for improving uptake, the inpatient setting provides a unique environment where vulnerable patients have extended contact with providers and care bundles are already commonplace.<sup>6</sup> Furthermore, few quality initiatives in the field of liver disease have focused on inpatient vaccination despite the opportunities for improvement.<sup>7</sup> We implemented and evaluated a quality improvement (QI) initiative to increase hepatitis A vaccination rates in an inpatient population with cirrhosis.

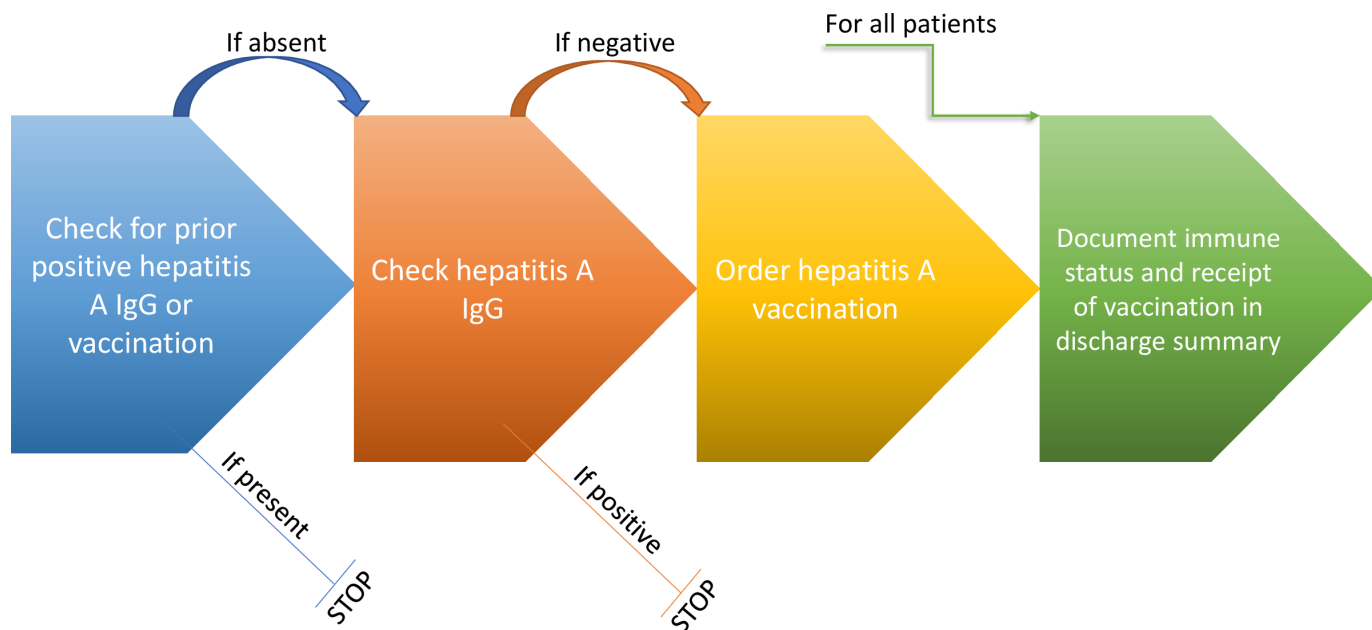
## METHODS

In April 2019, we implemented a two-step QI initiative targeted to the provider level

at Beth Israel Deaconess Medical Center (Boston, Massachusetts). Step 1 altered note templates to include a checklist for hepatitis serologies and vaccination. These templates are commonly used by residents to write admission notes and include generic treatment plans for common diseases as a reminder to place frequently used orders. Specifically, a step was added to the generic plan for 'cirrhosis' which prompted the provider to review prior records for any positive hepatitis A antibodies or documentation of vaccination, order hepatitis A serologies if these were not present and order vaccination if serologies were consistent with non-immunity (figure 1). Providers were additionally instructed to include immune and vaccination status in the discharge summary. Step 2 was a brief educational session for residents promoting hepatitis vaccination in patients with cirrhosis. We identified patients with cirrhosis who were admitted to the hepatology service during a 6-month window prior to (October 2018 to March 2019, group 1) and following (May 2019 to October 2019, group 2) the intervention. The primary outcomes were serology testing, administration of the hepatitis A vaccine to non-immune patients during hospitalisation and documentation of hepatitis A immune status in the discharge paperwork. We used the Pearson  $\chi^2$  test to evaluate for differences between the groups. We also collected data on demographics, cause of cirrhosis, characteristics of responsible providers, and receipt of hepatitis B, pneumococcal and influenza vaccinations, although primary outcomes were not adjusted for these variables. Patient data were captured using REDCap 10.0.19 and analysed using SAS V.9.4 (SAS Institute).

## RESULTS

A total of 381 patients were included in the study: 187 patients in the preintervention group and 194 patients in the postintervention



**Figure 1** Schematic of stepwise instructions prompting providers to review and evaluate hepatitis A immune status, vaccinate when applicable and document adequately.

group. Patient characteristics by group are presented in [table 1](#).

Demographics were similar between groups, as were the cause of cirrhosis, severity of illness as measured by

**Table 1** Select patient characteristics for patients with cirrhosis admitted to the inpatient hepatology service, by preintervention and postintervention groups

Characteristic	Preintervention	Postintervention
Age (median), IQR	58 (48, 65)	58 (48, 64)
Sex (F), n (%)	71 (38.0)	73 (37.6)
Race, n (%)		
White	141 (75.4)	140 (72.2)
Black/African American	16 (8.6)	13 (7.3)
Hispanic	10 (5.3)	11 (5.7)
Asian	5 (2.7)	6 (3.4)
Primary care visit within 2 years of admission, n (%)	24 (12.9)	25 (12.9)
Have outpatient Gastrointestinal doctor, n (%)	158 (89.8)	179 (93.2)
Cause of cirrhosis, n (%)		
Alcohol	107 (57.2)	115 (59.3)
Non-alcoholic steatohepatitis (NASH)	39 (20.9)	33 (17.0)
Autoimmune	7 (3.7)	7 (3.6)
HCV	35 (18.7)	36 (18.6)
Other	30 (16.0)	35 (18.0)
Unknown	7 (3.7)	0
MELD-Na† (median), IQR	21 (15, 26)	20 (15, 27)
Length of stay in days (median), IQR	6 (3, 13)	5 (3, 10)
Immune to hepatitis A*, n (%)*	27 (48.2)	23 (46.9)

\*Percentage is based on the subset of patients whose serologies were checked.

†Model for Endstage Liver disease: prognostic scoring system for liver cirrhosis incorporating renal function, bilirubin, INR, and sodium  
HCV, hepatitis C virus.

the MELD-Na,<sup>8</sup> utilisation of the healthcare system as measured by recent primary care visit and association with an outpatient gastroenterologist, length of stay and rates of immunity to hepatitis A in those who were tested. Although we did not detect a statistically significant difference in rates of hepatitis A serology testing between groups, non-immune patients admitted after the intervention were more likely to be vaccinated (21.7% vs 2.2%;  $p=0.008$ ) during their inpatient stay ([table 2](#)).

Additionally, in the postintervention group there was a trend towards increased reporting of hepatitis A immune status in the discharge paperwork ( $p=0.0855$ ).

## DISCUSSION

We implemented a QI initiative targeted at physician education and workflow with the goal of improving hepatitis A vaccination rates in hospitalised patients with cirrhosis. Several important points can be highlighted from this work. First, baseline rates of hepatitis A vaccination in the subset of eligible patients in our cohort were low. Multiple barriers likely contribute to this implementation failure, including lack of a protocolised inpatient approach, imperfect medical record-provider interfaces, delays in serology testing and competing priorities in a sick population. However, while absolute rates of vaccination preintervention and postintervention remained low, we demonstrated a 10-fold improvement in hepatitis A vaccination from the preintervention group (2.2%) to the postintervention group (21.7%; OR 12.5 (1.5, 102.3)), as well as a suggestive trend towards increased awareness by treating physicians. This is encouraging given the low-effort, easy-to-implement and generalisable nature of the intervention which signals that ongoing utilisation and even scale-up would be cost-effective.

**Table 2** Primary outcomes for patients with cirrhosis admitted to the inpatient hepatology service

Outcome	Preintervention n (%)	Postintervention n (%)	P value	OR (95% CI)
Hepatitis A serologies checked	56 (30.0)	49 (25.3)	0.3590	0.79 (0.50 to 1.24)
Hepatitis A vaccination administered (non-immune patients only)	1 (2.2)	10 (21.7)	0.0075	12.5 (1.5 to 102.3)
Hepatitis A immune status discussed in discharge paperwork	17 (9.1)	29 (15.0)	0.0855	1.8 (0.93 to 3.32)

However, interpretation of these results is limited by the lack of randomisation and possibility of confounding by unmeasured factors. Additionally, significant improvement in hepatitis A vaccination rates above those measured in our study is still needed, which will require further examination of the complex barriers to vaccination and development of additional implementation strategies.<sup>9</sup> One future direction at our institution is development of a standardised order set for patients with cirrhosis which would aggregate and serve as a reminder for common practices, including vaccination. Ultimately, dissemination and application of successful implementation strategies to other vaccine uptake gaps, including the looming example of COVID-19, is paramount to achieving efficient and comprehensive vaccination in our patient populations.

**Contributors** RJK and MH performed the QI intervention described herein and performed data collection. Statistical analysis was performed by RJK with ML and VP advising. All authors contributed to the writing of the manuscript.

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#### ORCID iD

Ryan Jean Kronen <http://orcid.org/0000-0003-4455-0699>

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