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Hepatitis C Virus Testing for Case Identification in Persons Born During 1945–1965: Results From Three Randomized Controlled Trials

Anthony K. Yartel[1], **David B. Rein**[2], **Kimberly Ann Brown**[3], **Katherine Krauskopf**[4], **Omar I. Massoud**[5], **Cynthia Jordan**[5], **Natalie Kil**[4], **Alex D. Federman**[4], **David R. Nerenz**[3], **Joanne E. Brady**[6], **Danielle L. Kruger**[2], **Bryce D. Smith**[1]

[1]Centers for Disease Control and Prevention, Atlanta, GA

[2]NORC at the University of Chicago, Atlanta, GA

[3]Henry Ford Hospital, Detroit, MI

[4]Icahn School of Medicine at Mount Sinai, New York, NY

[5]University of Alabama at Birmingham, Birmingham, AL

[6]NORC at the University of Chicago, Bethesda, MD

Abstract

The Centers for Disease Control and Prevention and US Preventive Services Task Force recommend one-time hepatitis C virus (HCV) testing for persons born during 1945–1965 (birth cohort). However, few studies estimate the effect of birth cohort (BC) testing implementation on HCV diagnoses in primary care settings. We aimed to determine the probability of identifying HCV infections in primary care using targeted BC testing compared with usual care at three academic medical centers. From December 2012 to March 2014, each center compared one of three distinct interventions with usual care using an independently designed randomized controlled trial. Across centers, BC patients with no clinical documentation of previous HCV testing or diagnosis were randomly assigned to receive a one-time offering of HCV antibody (anti-HCV) testing via one of three independent implementation strategies (repeated-mailing outreach, electronic medical record–integrated provider best practice alert [BPA], and direct patient solicitation) or assigned to receive usual care. We estimated model-adjusted risk ratios (aRR) of

ADDRESS CORRESPONDENCE AND REPRINT REQUESTS TO: Anthony K. Yartel, M.P.H., Lilburn, GA 30047, 4313 Kenion Forest Drive, akyartel@gmail.com.

Two nonprofit organizations, the Association of State and Territorial Health Officials and the National Viral Hepatitis Roundtable, and a representative from the US Department of Health and Human Services, Office of HIV/AIDS and Infectious Disease Policy, continued to participate in Coalition activities.

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Supporting Information

Additional Supporting Information may be found at onlinelibrary.wiley.com/doi/10.1002/hep.29548/suppinfo.

anti–HCV-positive (anti-HCV+) identification using BC testing versus usual care. In the repeated mailing trial, 8992 patients (intervention, n = 2993; control, n = 5999) were included in the analysis. The intervention was eight times as likely to identify anti-HCV+ patients compared with controls (aRR, 8.0; 95% confidence interval [CI], 2.8–23.0; adjusted probabilities: intervention, 0.27%; control, 0.03%). In the BPA trial, data from 14,475 patients (BC, n = 8928; control, n = 5,547) were analyzed. The intervention was 2.6 times as likely to identify anti-HCV+ patients versus controls (aRR, 2.6; 95% CI, 1.1–6.4; adjusted probabilities: intervention, 0.29%; control, 0.11%). In the patient-solicitation trial, 8873 patients (BC, n = 4307; control, n = 4566) were analyzed. The intervention was five times as likely to identify anti-HCV+ patients compared with controls (aRR, 5.3; 95% CI, 2.3–12.3; adjusted probabilities: intervention, 0.68%; control, 0.11%).

Conclusion: BC testing was effective in identifying previously undiagnosed HCV infections in primary care settings.

Approximately 2.7 million persons in the United States have active hepatitis C virus (HCV) infection and are at risk for cirrhosis, decompensated cirrhosis, hepatocellular carcinoma, liver transplantation, and death.[1–6] HCV infection is a direct or contributing cause of more than 18,000 deaths annually in the United States,[7,8] and this number is projected to double over the next 10–20 years in the absence of increased HCV case identification and treatment of eligible persons.[9,10]

Recent advances in HCV antiviral therapy have substantially increased treatment effectiveness across genotypes and clinical subgroups of patients.[11–19] However, the benefits of these treatment advances are currently limited by the fact that an estimated 50% −80% of HCV-infected persons are unaware of their infections and therefore cannot benefit from treatment.[20–22]

Persons born during 1945–1965 (birth cohort) are four times as likely to be infected with HCV compared to other adults, largely due to previous history of injection drug and blood transfusion prior to 1992,[23,24] and this birth cohort accounts for approximately 67%−76% of adult HCV infections, more than 66% of health care use, and 75% of deaths in a cohort of HCV patients.[25–27] To increase testing and identification among this population, the Centers for Disease Control and Prevention (CDC) and the US Preventive Services Task Force have each recommended that all persons born during 1945–1965 receive a one-time HCV antibody test without the need for additional HCV risk assessment.[28,29]

Given that these recommendations are relatively new, few data exist on effective implementation of such birth cohort (BC) testing in the primary care setting. In a previous cross-sectional evaluation, researchers found that whereas targeted BC testing (versus usual care) significantly increased the proportion of primary care patients tested for HCV, it did not result in significantly higher HCV identification rates.[30] However, this study was not experimental by design and did not employ a concurrent control group.

We performed three independent randomized controlled trials in primary care settings to determine the probability of identifying HCV infections using targeted BC testing compared with usual care in each trial.

Patients and Methods

OVERVIEW OF DESIGN, PARTICIPANTS, AND SETTING

From December 2012 to March 2014, three large academic medical centers independently implemented HCV BC testing trials (described below). Each center was empowered to develop an individualized BC testing intervention tailored to their setting, under the conditions that the intervention targeted patients in primary care, used a randomized controlled design, reported common data elements (including patient year of birth [age], sex, race/ethnicity, and health insurance status and type, extracted from electronic medical records), and developed a plan to meet those conditions approved by the Coordinating Center (NORC at the University of Chicago) and CDC. Before and during the study period, both CDC (August 2012) and US Preventive Services Task Force (June 2013) released BC testing recommendations.[28,29] Therefore, the control (usual care) arms represent testing that occurred under a mixture of routine testing practices before and immediately after the release of BC testing guidelines. During the trials, no health centers implemented BC testing policies outside of those occurring in the intervention, and although the BC guidelines were released before implementation of this study, public health testing guidelines often take many years to gain widespread adoption.[31,32] The CDC Foundation, the funding agency, had no role in the design, conduct, and analysis of this study, nor was the foundation involved in the decision to submit the manuscript for publication.

Repeated Mailing Outreach—Center 1 conducted a stratified, individually randomized trial of a repeated-mailing intervention between February 2013 and October 2013. The center identified 18,897 patients representing nine clinics in the electronic medical record (EMR) system who were born during 1945–1965, had made at least one primary care visit within the previous 12 months, and had no EMR evidence of prior HCV testing or diagnosis. A sample of 9000 patients was selected for inclusion and stratified by clinic to ensure proportionate representation from each clinic in the system. The 9000 patients were randomly assigned in a 1:2 ratio, stratified by clinic, to receive repeated mailing invitations for a one-time anti-HCV testing (intervention arm) or to receive no outreach (control arm). The intervention used the Dillman Total Design Method[33] to invite patients to receive HCV antibody (anti-HCV) testing at the nearest affiliated laboratory. At week 0, intervention patients received a packet containing information about HCV and the rationale for BC testing, a preregistered and prepaid laboratory form, and a list of the closest laboratories. The packets sent to patients identified 17 specific clinic locations scattered around the metropolitan area, any of which could be used for the recommended HCV testing. For the vast majority of patients, the clinic site that they were already using for primary care was on the list, so they would have been familiar with the location and how to get there. Repeat mailings with reminders (or replacement preregistration packets as appropriate) were sent at weeks 1, 4, 8, and 12 (Supporting Fig. S1). At week 16, 4 weeks after the last repeat mailing, the intervention was declared over for the purpose of the trial. To avoid the potential of overwhelming laboratory staff and resources, patients were divided into four batches of approximately equal size to receive repeat mailings in staggered waves separated by approximately 1-month intervals, with the four batches initiated in February, March, April, and May 2013. Primary care providers whose patients were selected for the intervention

were notified and oriented on BC testing and billing protocols. Laboratory personnel were instructed on how to process the preregistered, prepaid laboratory form and how to bill the test to the appropriate research account. Acceptance of intervention constituted patient consent. Patients assigned to the control group received usual care and any testing that would have occurred would have been initiated by the primary care physician, normally during an office visit, based on previous guidelines linked to risk factors. Testing would have been recommended, but not ordered or mandated.

EMR-Integrated Provider Best Practice Alert—Center 2 implemented a cluster-randomized trial between April 2013 and March 2014. Cluster randomization was used to minimize contamination risk. Ten clusters (defined as primary care clinics) were randomly assigned in a 1:1 ratio to implement BC testing with an EMR-integrated provider best practice alert (BPA) or to provide usual care with cluster-randomization stratified by region to ensure urban and suburban balance. Eligible patients were defined as those born during 1945–1965, with a primary care visit, and no EMR evidence of HCV testing or diagnosis. During a primary care visit by an eligible patient, the BPA was triggered for the medical assistant measuring and documenting the patient's vital signs in the EMR before the patient–physician interaction. When the medical assistant accepted the BPA, an order for anti-HCV testing automatically populated the physician's list of orders. The physician could sign or delete the order at their discretion at any time during or after their encounter with the patient. In the event that the medical assistant bypassed the prompt, it went directly to the physician. When the physician received the BPA directly, the page detailed the CDC birth cohort recommendation and provided a link to the appropriate anti-HCV test order (Supporting Fig. S2). Targeting the medical assistant with the BPA first was designed to address alert fatigue commonly reported in studies of EMR-embedded alerts.[34] The center obtained signed consent from the providers in all participating primary care practices before randomizing them to BPA implementation or usual care. Clusters assigned to the control provided usual care, although providers in both intervention and control clusters received an educational presentation on birth cohort testing guidelines.

Direct Patient Solicitation After Outpatient Visit—Center 3 conducted a cluster-randomized, cluster-crossover trial between December 2012 and January 2014, involving four internal medicine clinics. Four clinics were randomly assigned in a 1:1 ratio to perform BC testing with direct patient solicitation by trained recruiters or to provide usual care. Halfway through the trial, after achieving sample size targets, the intervention and control arms were switched such that each clinic served as its own control; because clinics (but not patients) crossed over, different groups of patients were enrolled during the two time periods. Patients born during 1945–1965 who had made at least one previous primary care visit and had no prior evidence of HCV testing or diagnosis in the EMR were eligible. Immediately after outpatient visits, recruiters approached eligible patients and invited them for HCV testing by explaining the rationale for testing; patients were also given copies of CDC informational handouts (Supporting Fig. S3). Patients who agreed to be tested provided written consent and were escorted to the laboratory for a one-time anti-HCV test. Clinics assigned to the control arm at any stage during the trial (i.e., before or after cluster-crossover) provided usual care to eligible patients. However, before the first period of patient

enrollment, educational sessions were conducted at all four participating clinics to inform providers and staff about BC testing and the trial implementation process. Cluster randomization was employed for the same reason as in the BPA trial. However, the cluster crossover component was added to partly mitigate the statistical inefficiency induced by cluster randomization, especially in light of the small and fixed number of clusters.

RANDOMIZATION AND IMPLEMENTATION

Intervention assignments for all trials were performed at CDC using Proc SurveySelect in SAS 9.3 (SAS Institute, Cary, NC). Each trial was approved by the Institutional Review Board of the participating institution and implemented by institution staff and providers with technical support from CDC and NORC at the University of Chicago. Neither research staff nor providers were blinded to intervention assignments.

ASSESSMENT OF PRIMARY OUTCOME

The primary outcome for each trial was the probability of identifying anti–HCV-positive (anti-HCV+) patients using BC testing intervention versus usual care. We defined the probability of anti-HCV+ identification as the number of patients testing positive for HCV antibodies by enzyme-linked immunoassay during the study period divided by all eligible patients (whether or not they received anti-HCV testing). The primary care provider of each patient who tested anti-HCV+ in the BC group was notified. In the repeated mailing and BPA trials, anti-HCV+ patients were expected to be contacted by their primary care providers and referred to HCV specialty care; in the patient solicitation trial, anti-HCV+ patients were contacted and referred to specialty care by a nurse coordinator. Across the three trials, patients in the control group were tracked by EMR for evidence of anti-HCV testing and test results.

STATISTICAL ANALYSIS

We performed separate sample size calculations for each trial based on different assumptions and to accommodate the unique designs (Supporting Fig. S4).

Statistical significance for all tests was set at a two-tailed P value of 0.05. We used Wald chi-square test for categorical variables to examine differences in baseline patient characteristics. Analysis of the primary outcome was by intention-to-treat with patient as the unit of inference. Patients were analyzed according to original randomized assignments; for the cluster-randomized trials, this means a patient's assigned clinic was the first clinic they encountered during the study. For all trials, we modeled the effect of the intervention on the probability of anti-HCV+ identification using multivariable logit models implemented within SAS-callable SUDAAN version 10.0.1 (RTI International, Research Triangle Park, NC).[35,36] For each model, the dependent variable was the probability of being identified as anti-HCV+ and we added patient-level sex, race/ethnicity, age group (derived from birth year), and insurance type as covariates to adjust for imbalances in distributions of patient characteristics between the intervention groups. For all three models, we included clinic as a nesting (cluster) variable to account for clustering of patients within clinics and to ensure appropriate standard errors.[37–39] For the patient solicitation trial, we also added an indicator variable (period) as a covariate to adjust for patient enrollment before or after

cluster crossover.[36,40] We estimated adjusted probabilities for trial arms and obtained corresponding model-adjusted risk ratios and 95% confidence intervals (CIs).[35] Except where indicated, analyses were performed with SAS 9.3 (SAS Institute, Cary, NC).

Results

PARTICIPANT FLOW

A summary of key design features for all three trials is presented in Table 1. In the repeated mailing trial, a total of 9000 patients were allocated to intervention (n = 3000) or control (n = 6000). Prior to the first mailing, eight patients (BC, n = 7; control, n = 1) were excluded after further review indicated that they did not have primary care visit within the previous year. A total of 8992 patients were included in the analysis (Table 1, Fig. 1A). In the BPA trial, the 10 clusters contributed a total of 14,475 eligible patients (BC, n = 8928; control, n = 5547) during the study. All 14,475 patients were included in the analysis (Table 1, Fig. 1B). In the patient solicitation trial, the four clinics contributed a total of 8873 patients (BC, n = 4307; control, n = 4566). All 8873 patients were included in the analysis (Table 1, Fig. 1C).

BASELINE PATIENT DEMOGRAPHIC CHARACTERISTICS

In the repeated mailing trial, the treatment groups were balanced with respect to baseline patient characteristics (Table 2). However, there were some imbalances in the BPA trial (by sex and race/ethnicity) and in the patient solicitation trial (by sex, age, race/ethnicity, and insurance type).

IDENTIFICATION OF ANTI-HCV+ PATIENTS

Repeated Mailing Trial—In the intervention group, 805 (26.9%) of eligible patients were tested for anti-HCV. In the control group, 84 (1.4%) patients were tested. Of the 805 patients who received anti-HCV testing in the intervention group, 1.0% (n = 8) tested positive. The anti-HCV+ identification probability in the intervention group was 0.27% (n = 8/2993). In the control group, 2.4% (n = 2) of the 84 patients tested for anti-HCV were identified as positive, and the anti-HCV+ identification probability was 0.03% (n = 2/5999). We estimated from multivariable-adjusted modeling that the intervention was eight times as likely to identify anti-HCV+ patients compared with usual care (adjusted risk ratio [aRR], 8.0; 95% confidence interval [95%CI], 2.8–23.0; adjusted probabilities: intervention, 0.27%; usual care, 0.03%) (Table 3). Sensitivity analysis accounting for mailing batch did not change the estimate.

BPA Trial—In the intervention group, 2757 (30.9%) eligible patients were tested for anti-HCV. In the control group, 197 (3.6%) patients were tested. Among the 2757 patients tested for anti-HCV in the intervention group, 1.0% (n = 27) tested positive. The anti-HCV+ identification probability in the intervention group was 0.30% (n = 27/8,928). In the control group, 3.0% (n = 6) of the 197 patients tested for anti-HCV were identified as positive, and the anti-HCV+ identification probability was 0.11% (n = 6/5547). Following multivariable modeling, the intervention was 2.6 times as likely to identify anti-HCV+ patients compared

with usual care (aRR, 2.6; 95% CI, 1.1–6.4; adjusted probabilities: intervention, 0.29%; usual care, 0.11%) (Table 3).

Patient Solicitation Trial—In the intervention group, 2736 (63.5%) were tested for anti-HCV. In the control group, 92 (2.0%) patients were tested. Of the 2736 patients who received anti-HCV testing in the intervention group, 1.2% (n = 34) tested positive. The anti-HCV+ identification probability in the intervention group was 0.79% (n = 34/4307). In the control group, 5.4% (n = 5) of the 92 patients tested for anti-HCV were identified as positive, and the anti-HCV+ identification probability was 0.11% (5/4566). After multivariable modeling, the intervention was five times as likely to identify anti-HCV+ patients compared with usual care (aRR, 5.3; 95% CI, 2.3–12.3; adjusted probabilities: intervention, 0.68%; usual care, 0.13%) (Table 3).

Discussion

We present experimental evidence to indicate that targeted testing of persons born during 1945–1965 for HCV in the primary care setting is an effective strategy for identifying previously undetected anti-HCV+ patients. The findings from these trials demonstrate that, overall, targeted BC testing was 2.6 to eight times as effective in identifying persons with previous or current HCV infection compared with usual care.

A key rationale for BC testing is the premise that usual care is ineffective in identifying HCV infections, because nearly half of adults (including those born in 1945–1965) do not report exposure risk factors.[6,28,41] Our results are consistent with this rationale and bolster current public health recommendations for targeted HCV testing among persons born during 1945–1965.[28,29] Because HCV testing by the BC strategy does not require patients to disclose HCV risk factors, more eligible patients can be tested by ascertainment of birth year alone. Increased testing rates can lead to identification of anti-HCV+ patients that may have otherwise gone undetected. In turn, more anti-HCV+ patients can be referred to specialty care for appropriate follow-up (e.g., HCV-RNA testing) and treatment as indicated. Although this study was not originally designed to examine linkage to care outcomes, including HCV-RNA detection, treatment initiation, treatment completion, and achievement of sustained viral response, we recognize that such data are clinically important for evaluating the overall success of HCV testing and identification interventions. Equally important, increased testing rates translate into more patients that are aware of their HCV status (positive or negative), and previous research has shown that awareness of an individual's HCV status can beneficially influence risk-reduction choices.[42]

The results of HCV testing rates from these trials are substantially higher than rates reported from other targeted testing interventions previously conducted in the primary care setting in the United States. In a study involving primary care patients from urban clinics, researchers used targeted BC testing and risk-based testing, respectively, to achieve testing rates of 9.9% and 13.1%.[30] In comparison, we accomplished testing rates of 26.9%−63.5% across the three trials. This degree of success likely depended, at least in part, on the staff and resources dedicated specifically to the trials. The trial that reported the highest testing rate did not integrate BC testing into the normal workflow but instead used a dedicated recruiter to

perform direct patient invitation, an approach that may be less cost-effective over a longer period.[43] However, while the use of a recruiter dedicated to implementing a single health screening recommendation may represent a potentially prohibitive resource expense, population management (which often involves an assigned health professional working with patients) is increasingly being used in health systems to achieve population health goals.[44] Nonetheless, it is important to note that the BPA trial successfully incorporated a provider alert for BC testing into the normal workflow, achieved a considerably higher testing rate than the control arm and other testing interventions noted in the literature, and may be more sustainable.[30,43] Whereas BPA implementation integrates BC testing into routine care, it can be both administratively and technically complex,[45] and some health care systems may lack the ability to implement a similar system in the short term.

We also observed that among patients who received HCV testing, anti-HCV positivity rates in the control groups (2.4%−5.4%) were consistently higher than rates in the BC testing groups (1.0%−1.2%). This is to be expected, as testing in the control groups would have likely consisted primarily of risk-based testing which targets persons with specific risk factors and medical indications including previous injection drug use, history of blood transfusion before 1992, clotting factor concentrates before 1987, long-term hemodialysis, and elevated alanine aminotransferase levels.[46] On the other hand, BC testing by definition targets a large cohort of patients for HCV testing without solicitation of risk factors and consequently many more patients are tested to identify one case of HCV.[28,29]

There are limitations to this study. Overall, the timing of the release of CDC and US Preventive Services Task Force recommendations[28,29] represents a potential source of confounding to the primary estimate. However, in the worst case scenario, usual care would have likely consisted of a hybrid between risk-based and BC testing resulting in a more conservative estimate that is shifted toward the null. Additionally, there were imbalances in baseline patient characteristics among intervention groups in both the BPA and patient solicitation trials. This outcome was predictable due to cluster randomization,[47] and we sought to limit bias due to confounding by adjusting for relevant demographic variables, although estimates from the adjusted analyses were not notably different. Nevertheless, confounding from unmeasured patient characteristics cannot be discounted. In the repeated mailing trial, mailings were staggered by dividing patients into four groups due to limited laboratory resources. Although different groups of patients received testing invitations at different times, sensitivity analysis suggests no impact of timing on the primary outcome. In the BPA trial, providing education on the BC recommendations to both intervention and control clusters may have diluted the magnitude of effect of BC testing versus usual care. However, this was an Institutional Review Board requirement justified on the basis that the CDC birth cohort policy was already the “standard of care.” Nevertheless, the BPA trial was arguably the most pragmatic trial—in that BC testing was fully integrated into routine care.

In conclusion, our results show that BC testing in primary care settings of persons born during 1945–1965 is more effective in identifying HCV infections compared with usual care. The findings also demonstrate that BC testing in primary care is feasible and amenable to a variety of implementation strategies, although implementation costs would likely vary by strategy and need to be considered.[43]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Abbreviations:

anti-HCV+	anti–HCV-positive
aRR	adjusted risk ratio
BC	birth cohort
BPA	best practice alert
CDC	Centers for Disease Control and Prevention
CI	confidence interval
EMR	electronic medical record
HCV	hepatitis C virus

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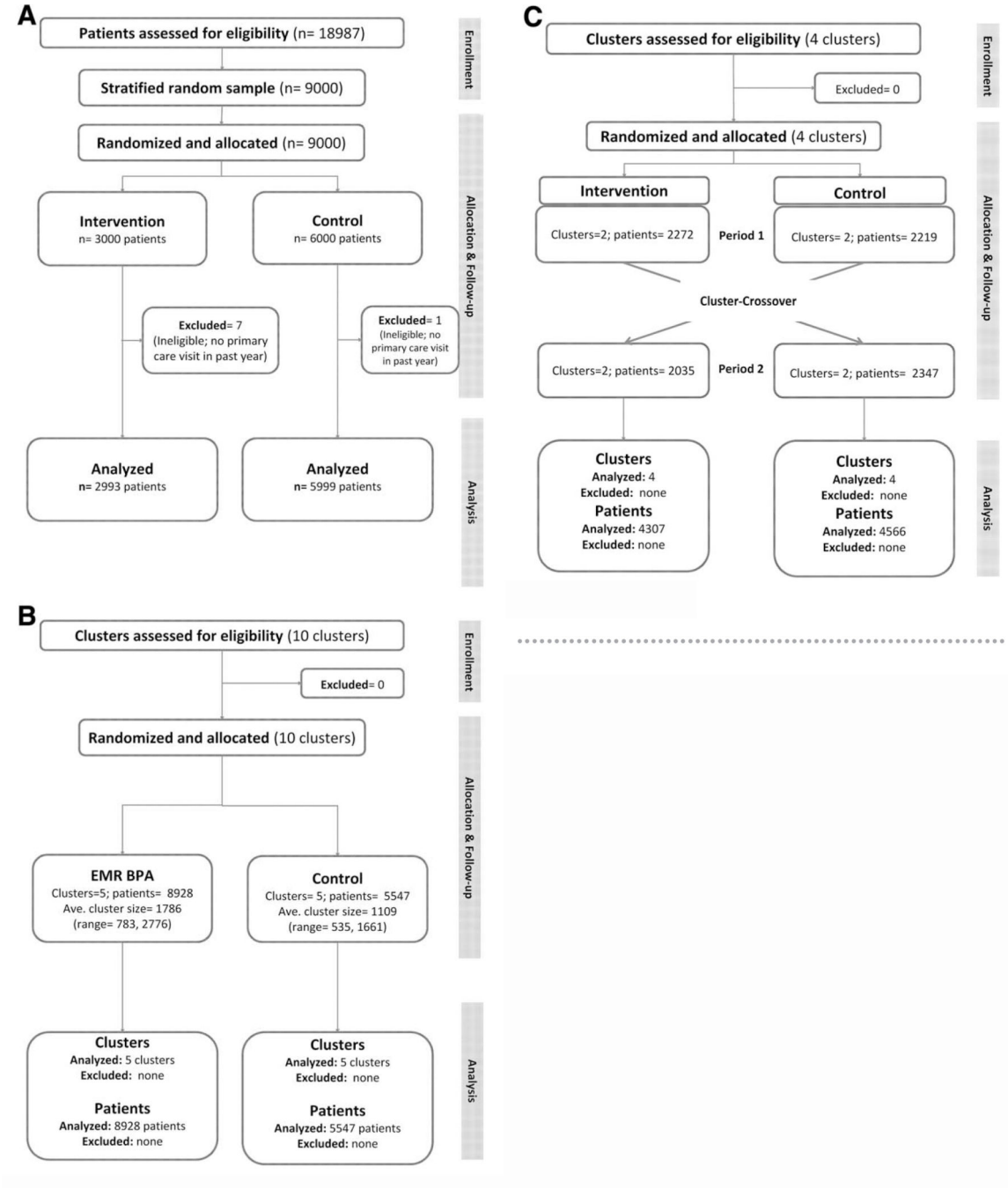

FIG. 1.

(A) Repeated-mailing outreach: participant flow. (B) Electronic medical record-integrated provider best practice alert: cluster and participant flow. (C) Patient solicitation after outpatient visit: cluster and participant flow.

TABLE 1.

Summary of Key Trial Information

Center	Intervention	Trial Design	No of Clinics	Allocation		Patients Analyzed
				Intervention	Control	
Henry Ford	Repeated mailing outreach	Individually randomized controlled trial (stratified by clinic)	9	3000 patients	6000 patients	8992
Mt. Sinai	EMR-integrated provider BPA	Cluster-randomized controlled trial	10	Five clinics	Five clinics	14,475
University of Alabama-Birmingham	Direct patient solicitation after outpatient visit	Cluster-randomized cluster crossover controlled trial	4	Four clinics *	Four clinics *	8873

Abbreviations: BPA, best practice alert; EMR, electronic medical record.

* All four clinics were exposed to intervention after cluster-crossover.

TABLE 2.

Baseline Patient Characteristics

	Repeated Mailing Outreach		EMR-Integrated Provider BPA		Direct Patient Solicitation After Outpatient Visit	
Characteristics	**Intervention (n = 2993)**	**Control (n = 5999)**	**Intervention (n = 8928)**	**Control (n = 5547)**	**Intervention (n = 4307)**	**Control (n = 4566)**
Sex						
Men	43.7 (1307)	43.8 (2627)	37.1 (3309)	41.2 (2285)	40.6 (1747)	42.8 (1952)
Women	56.3 (1686)	56.2 (3372)	62.9 (5619)	58.8 (3262)	59.4 (2560)	57.2 (2614)
Birth year						
1945–1949	24.1 (722)	23.8 (1425)	22.7 (2030)	22.4 (1240)	25.0 (1077)	21.7 (993)
1950–1954	25.1 (752)	24.1 (1443)	22.9 (2043)	22.7 (1258)	27.4 (1182)	27.0 (1231)
1955–1959	24.5 (732)	26.2 (1571)	25.0 (2236)	24.8 (1375)	25.6 (1103)	24.2 (1106)
1960–1965	26.3 (787)	26.0 (1560)	29.3 (2619)	30.2 (1674)	21.9 (945)	27.1 (1236)
Race/ethnicity						
White	50.9 (1523)	50.1 (3008)	62.6 (5587)	70.9 (3931)	46.3 (1993)	55.7 (2541)
Black	30.8 (923)	31.2 (1872)	11.2 (1002)	6.6 (366)	50.9 (2194)	40.4 (1846)
Hispanic	1.2 (36)	1.5 (89)	10.1 (899)	8.4 (467)	0.4 (19)	0.6 (26)
Asian	2.8 (83)	3.8 (226)	1.7 (154)	1.9 (104)	1.7(73)	2.0 (92)
Other	0.7 (22)	0.7 (41)	5.3 (471)	4.1 (226)	0.6 (24)	0.4 (20)
Unknown	13.6 (406)	12.7 (763)	9.1 (815)	8.2 (453)	0.1 (4)	0.9 (41)
Insurance type						
Private	84.3 (2522)	84.1 (5043)	65.0 (5807)	65.1 (3610)	64.7 (2788)	74.0 (3377)
Public	15.2 (455)	15.6 (934)	20.8 (1858)	18.5 (1026)	33.5 (1444)	25.0 (1141)
Uninsured/Unknown	0.5 (16)	0.4 (22)	14.2 (1263)	16.4 (911)	17 (75)	1.1 (48)

All data are presented as % (n).

Abbreviations: BPA, best practice alert; EMR, electronic medical record.

TABLE 3.

Adjusted Probabilities and Risk Ratios of Identfying Anti-HCV+ Patients

	Eligible Patients, n	Patients Tested for Anti-HCV+, % (n)	Adjusted* Probability of Anti-HCV+ Identification, %	aRR* (95% CI)
Repeated mailing				
Intervention	2993	26.9 (805)	0.27	8.0 (2.8–23.0)
Usual care	5999	1.4 (84)	0.03	Reference
BPA				
Intervention	8928	30.9 (2757)	0.29	2.6 (1.1–6.4)
Usual care	5547	3.6 (197)	0.11	Reference
Patient solicitation				
Intervention	4307	63.5 (2736)	0.68	5.3 (2.3–12.3)
Usual care	4566	2.0 (92)	0.13	Reference

Abbreviations: anti-HCV+, anti-hepatitis C virus (HCV)-positive; aRR, adjusted risk ratio; BPA, best practice alert; CI, confidence interval; EMR, electronic medical record.

*Adjusted for sex, age, race/ethnicity, and insurance type.