Hepatitis C virus infection: Spread and Impact in the Netherlands

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Outcomes of hepatitis C screening programs targeted at risk groups hidden in the general population: a systematic review

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Abstract

Objective: Effective screening programs are urgently needed to provide undiagnosed hepatitis C virus (HCV)-infected individuals with therapy. This systematic review of characteristics and outcomes of screening programs for HCV focuses on strategies to identify HCV risk groups hidden in the general population.

Methods: We conducted a comprehensive search of MEDLINE and EMBASE databases for articles published between 1991-2010, including studies that screened the general population using either a newly developed (nonintegrated) screening program or one integrated in existing health care facilities. Look-back studies, prevalence studies, and programs targeting high-risk groups in care (e.g., current drug users) were excluded.

Results: After reviewing 7052 studies, we identified 67 screening programs: 24 nonintegrated; 41 programs integrated in a variety of health care facilities (e.g., general practitioner); and 2 programs with both integrated and nonintegrated strategies. Together, these programs identified approximately 25,700 HCV-infected individuals. In general, higher HCV prevalence was found in programs in countries with intermediate to high HCV prevalence, in psychiatric clinics, and in programs that used a prescreening selection based on HCV risk factors. Only 6 programs used a comparison group for evaluation purposes, and 1 program used theory about effective promotion for screening. Comparison of the programs and their effectiveness was hampered by lack of reported data on program characteristics, clinical follow-up, and type of diagnostic test.

Conclusions: The published studies identified a relatively small proportion of the estimated HCV-infected population. A prescreening selection based on risk factors can increase the efficiency of screening in low-prevalence populations, and we need programs with comparison groups to evaluate effectiveness. Also, program characteristics such as type of diagnostic test, screening uptake, and clinical outcomes should be reported systematically.
Introduction
Hepatitis C virus (HCV) infection, primarily a blood-borne virus and first identified in 1989, is a major public health problem. Worldwide an estimated 123 million individuals are HCV-antibody positive (1), of whom approximately 75% are chronically infected and at risk for the development of cirrhosis, which can lead to liver cancer and death (2;3). In chronically infected patients, the onset of HCV infection and the development of cirrhosis are usually asymptomatic (2;4); many infections remain undetected or are diagnosed at a late stage. In the United States of America (USA), an estimated 43% to 72% of HCV infections are undiagnosed (5-7). In 2001, successful combination therapy for HCV became widely accessible (8-12) and more effective therapeutic options are becoming available (13;14). Effective screening programs are urgently needed to provide undiagnosed HCV-infected individuals with therapy and to spread information about preventive measures that each person should take (e.g., reducing alcohol intake, other precautionary measures against further spread), thus decreasing future morbidity and mortality.

There are several types of screening strategies such as mass population screening, selective screening, or case finding (i.e., opportunistic screening (15)). Selective screening of risk groups for HCV (see Box 1) has been recommended (16;17). Some of the high risk groups for HCV are relatively easy to reach and have been targeted by screening programs as part of specialized medical care (e.g., current drug users (DUs) on methadone treatment (19;20), hemophiliacs (21;22), and HIV-infected individuals receiving clinical care (23)). However, other risk groups are more difficult to target for screening. For example, persons at risk for HCV infection through occasional IDU in the remote past will not attend programs targeted at active drug users and might not identify themselves as being at risk for HCV infection. The same holds true for individuals who received a blood transfusion before 1992. These groups can be considered as ‘hidden risk groups’ among the general population. The size of this hidden population may be substantial. A recent study estimated that of the total population of HCV-infected individuals in a high-income country, only 34% are in relatively easy to reach high-risk groups such as hemophiliac patients, HIV-infected patients, and current IDU; 41% are first-generation migrants and 25% belong to other risk groups (24).

Finding an effective strategy to identify the hidden population of undiagnosed HCV-infected individuals is challenging. An overview of HCV screening programs provides insight into strategies that have been used so far and their outcomes, and can provide insight into the best way forward. In our review, we systematically review characteristics and outcomes of HCV screening programs targeted at risk groups hidden in the general population. We focused in particular on the promotion of the screening program, whether or not prescreening selection criteria were used, and the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs, since health promotion programs that are based on theory are more likely to be effective than those that are not (25). We discuss the implications of these findings for future HCV screening strategies.

Methods
Search strategy
We searched in the MEDLINE (PubMed) and EMBASE databases for articles published in any language before July 27, 2010. A comprehensive strategy was used to include all possible studies in which individuals were screened for HCV. Search terms included hepatitis C (Medical Subject Headings [MeSH] for PubMed and Explosion search [Exp] for Embase) or HCV or “hepatitis
C” in title or abstract combined with search terms in title or abstract that reflect screening (i.e., mass screening [MeSH/Exp], screen*, “case finding*”, “case identification*”, “case detection*”, “hepatitis C testing”, “HCV testing”) or search terms in title or abstract and/or MeSH/Exp that reflect campaigns or evaluation of health programs (i.e., campaign*, health promotion, health service*, feasibility, pilot*, “program* evaluation*”, “program* effect*”, “*health care quality”). The search was limited to articles published after 1990 since a more sensitive second-generation HCV antibody test was introduced in 1991 (26). The complete search strategy including truncation characters is available from the authors. In addition, we screened the reference lists of the articles that were included in the prefinal selection for potentially relevant publications.

Study selection
Studies were included if they reported screening of individuals in the general population, including screening in primary care facilities that are not related to specific HCV risk groups. Exclusion criteria pertained to ‘look-back’ studies, in which recipients of HCV-infected donor blood are notified and offered screening and studies conducted in specific, identifiable risk groups for HCV that are in specialized care: current drug users, HIV-infected individuals, incarcerated individuals, hemodialysis patients, or multitransfused patients such as hemophiliac patients. In addition, studies were excluded if 1) the study was designed to assess the prevalence in a given population, and/or 2) if the study was undertaken to investigate transmission rates and determinants (e.g., mother-to-child transmission (27)) or the association between HCV infection and another medical condition (e.g., diabetes (28;29)), and/or 3) nothing was reported about notification, referral, or medical follow-up of participants. The latter criterion did not apply to studies describing HCV screening at the general practitioner (GP) clinic, since notification of results in this setting is considered to take place. Articles in languages other than English, French, German, or Spanish were excluded if there was no English abstract or if the English abstract did not yield enough data.

The first selection round was based on title and abstract (if available) only and was done by four authors (FZ, AU, CH, and CvdB). The database including the titles and abstracts obtained through the search was split in four. The reviewers independently screened two of the subdatabases each so that each title/abstract was screened in duplicate. Studies were included in the second screening round if selected by at least one reviewer. The second selection round comprised screening of the full-text articles. Two authors (FZ and AU) independently screened all articles for eligibility using the aforementioned criteria. Any discrepancies were resolved by discussion until consensus was reached, and unresolved discrepancies were arbitrated by a third reviewer (MP).

Data extraction and validity checking
Data regarding program characteristics and program outcomes (see Box 2) were extracted and cross-checked by two reviewers (FZ and AU). We distinguished two types of settings and presented the screening programs according to these: integrated and nonintegrated screening. Integrated screening refers to programs that are integrated within already existing health care facilities, whereas in nonintegrated screening, the program is exclusively set up for the screening. In addition, since screening strategies may differ according to the HCV prevalence in a specific country, data are presented not only by the type of setting, but also separately for low HCV prevalence (<2% according to the Centers for Disease Control and Prevention [CDC] (1)) and intermediate to high HCV-prevalence countries.
Results
The search strategy identified 5,263 records from the MEDLINE database and 6,300 from the EMBASE database. After duplicates were eliminated, 7,052 of 11,563 records remained (see Figure 1). Of those, 737 were selected as potentially relevant to the review, and full-text articles were retrieved and reviewed independently in duplicate. We excluded 677 articles; 652 articles because they did not meet the inclusion criteria (the majority because they were prevalence studies, or studies that only reported statements about HCV screening guidelines and policy, not including any screening results), and 3 Japanese articles and 1 Italian because they did not provide an English abstract. In addition, 20 articles (two Chinese (31;32), eight Japanese (33-40), one Icelandic (41), four Russian (42-45), two Turkish (46;47), one Czech (48), and two Taiwanese (49;50)) seemed relevant on the basis of the English abstracts, but were excluded as the abstracts alone did not yield enough information for review. One article was excluded because the same data were reported in two papers (51;52). Of the 60 studies remaining, references lists were screened yielding an additional 106 potentially relevant records. The full-text articles were retrieved and screened independently in duplicate, and 7 of the 106 studies were selected for inclusion. In total, 67 studies remained in the final selection.

The 67 studies identified were done in the USA (n=27), Europe (n=27; mostly France and the United Kingdom [UK]), Asia (n=4), Australia (n=4), South America (n=3), Egypt (n=1) and Saudi Arabia (n=1). We identified 24 nonintegrated and 41 integrated studies, plus two studies that used both strategies (the latter are shown in Table 1a for the results of the nonintegrated part of their program, and in Table 2b for the results of the integrated part of their program) (53;54). A total of 85% (22/26) of the nonintegrated programs and all of the integrated programs were from low HCV-prevalence countries.

Nonintegrated HCV screening programs in low HCV-prevalence countries (n=22)

Program characteristics: Table 1a presents the 20 nonintegrated HCV screening programs and the 2 programs that combined an integrated and non-integrated screening approach that were performed in low HCV prevalence countries. In total, 12 of the 22 programs were carried out in the USA. The table is sorted by population type; seven studies were aimed at screening the general population; the other 15 studies targeted specific groups in which a higher HCV prevalence might have been expected (e.g., migrants, homeless individuals, firefighters, surgeons). Five of the 22 programs reported the use of personal screening invitations either face to face or by mail, and 12 reported the use of media activities to attract individuals for screening. None of the programs reported the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs. Eight studies reported the possibility for individuals to participate anonymously. Only nine of 22 studies reported the costs for participants to be screened; in all of them, screening was offered free of cost, and one study offered a t-shirt as an incentive for screening (73).

With respect to screening procedures, except for two, all programs used venipuncture to collect serum. A program targeted at firefighters (69) used home specimen collection kits for serum collection. A program targeted at migrants (54) initially used oral fluid HCV antibody tests followed by a blood test for those who tested positive (no further details reported). In the majority (16/22) of the programs, participants were also screened for other infections (mostly HIV and hepatitis B virus [HBV]) or liver enzymes (alanine aminotransferase [ALT], aspartate aminotransferase [AST]).
Program outcomes: In total, the 22 programs screened about 32,000 individuals for HCV antibodies (range: 19,865 to 604) and identified 1,809 HCV-infected individuals (range: 0 to 604). The screening uptake was reported in 13/22 studies, and varied from >20% in a screening program at a local health fair in the USA (62) to 100% in a program that used household visits to identify transfusion recipients and invite them for screening in Cuba (60). The HCV prevalence varied from 0% to 28.3%. The latter was found in a community-based screening program in New York City targeted at migrants from the former Soviet Union. HCV risk-profile data were available for only a subset of the HCV-infected individuals in that study and included intramuscular injections and blood transfusions. Some of the programs among a so-called ‘general population’ (see Table 1a, row 1-7) that found relatively high HCV-prevalence rates (e.g., 10.5% in a walk-in clinic (56)), did not collect risk profile data of their participants, limiting the interpretability of their findings. Two of 22 studies used a prescreening risk assessment in order to limit screening to those with established HCV risk factors: one did not report the prevalence rate nor screening uptake (58); the study in Cuba reported the highest screening uptake (100%) and found relatively high HCV prevalence (8.6%), but absolute numbers were small.

Four of the 22 programs screened primarily people from Asia, either through screening programs in Asia (Japan), or programs in Western countries targeting Asian migrants. In all but one of these programs, relatively high HCV-prevalence rates were found, varying from 5.2% to 19.7%. In contrast, the programs targeting those with occupational risk for HCV (n=7) found relatively low HCV-prevalence rates (all <1.1%, except for 3.6% among firefighters and 5.3% among health care workers involved with liver transplantations).

We did not notice clear differences in screening uptake or HCV prevalence related to the use of personal invitations for screening, the use of media to attract individuals for screening, and whether or not individuals were screened for other infections as well. In general, a lower HCV prevalence was found in the studies (n=8) that provided anonymous screening for HCV; however, most of these studies (6/8) targeted those with occupational risk for HCV, explaining the lower prevalence.

Only one study compared the results of their outreach screening program with data collected in the same period at a screening clinic that is visited by individuals on their own initiative (72). A higher prevalence of HCV was found during outreach screening (4.9% versus 1.6%, respectively). However, the number of individuals that returned to obtain their test results was much lower for the outreach approach (65.8% versus 91.8%, respectively).

Six of the 22 studies reported the proportion of viremic patients, which varied from 50% to 96.5%. Only one study reported the proportion of identified HCV-infected individuals that started treatment (37%) (58), but did not report how many of those reached a sustained virological response (SVR).

Nonintegrated HCV screening programs in intermediate to high HCV-prevalence countries (n=4)

Program characteristics: Table 1b presents the four nonintegrated HCV screening programs that were performed in intermediate to high HCV-prevalence countries (Taiwan [n=2], Pakistan [n=1] and Egypt [n=1]). All studies targeted the general population; one targeted children less than 16 years of age. A study from Egypt reported household visits to personally invite individuals for screening (75); the study among children reported personal invitations (method not specified) (78). All except the study among children reported the use of media activities to attract individuals for screening. None of the programs reported the use of psychosocial theory or knowledge about
determinants facilitating participation in screening programs. A risk-based screening selection was used in the program in Egypt, where screening was limited to those with symptoms and ALT levels \( \geq 2 \) times the upper limit of normal. None of the studies reported the possibility for individuals to participate anonymously. Two studies reported about the costs for participants to be screened; one of them offered screening free of cost, whereas the other program (77) offered screening at 20% of the market value. None of the studies used a comparison group for evaluation purposes. With respect to screening procedures, all four studies used venipuncture for specimen collection. A study from Pakistan (77) used a rapid HCV antibody test. In most (3/4) studies, participants were also screened for other infections (mostly HBV) but not for HIV.

**Program outcomes:** In total, the four programs screened 161,341 individuals for HCV antibodies (range: 47-157,720) and identified 7,488 HCV-infected individuals (range: 11-6,904). The screening uptake was reported in two studies; it was very low (<1%) in a city screening program in Pakistan, and very high (93.6%) in a screening program in kindergartens and schools in Taiwan. Although the screening uptake in the latter was high, the prevalence was low (0.9%). The HCV-prevalence rates in the other programs varied from 4.4% in a community-based screening program in Taiwan up to 78.8% in a program in Egypt that limited screening to those with symptoms and increased ALT levels (75). Two of the four studies reported the proportion of viremic patients, which was relatively low (27.3%) in the study among children, and 70.2% in the Egyptian study. None of the studies reported the proportion of HCV-infected patients that started treatment and/or reached SVR.

**Integrated HCV screening programs in low HCV-prevalence countries (n=41)**

We identified 41 HCV screening programs in the following clinics that offer care not related to liver disease: sexually transmittable diseases (STD) clinics (n=11); GP clinics (n=10, including two programs that also used a nonintegrated approach); Veterans Affairs (VA) health centers (n=5); antenatal/obstetric/fertility clinics (n=5); clinics for psychiatric patients (n=3); and other clinics or services (n=7). Tables 2a-f present the programs separately for each type of setting. All programs were carried out in low HCV-prevalence countries.

**STD clinics (n=11)**

**Program characteristics:** The majority (7/11) of the HCV screening programs in STD clinics were carried out in the USA. None of the studies reported the use of personal invitations or media to promote HCV screening inside or outside the clinic. In five of the 11 programs, screening was limited to high-risk groups for HCV, varying from single groups (e.g., those with a history of IDU (84), or MSM (80)) to individuals from multiple risk groups, such as those who have had body piercing or tattooing in unsanitary conditions, transfusion recipients before 1987, or those who have had a needlestick injury (79). None of the studies reported the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs, and none reported whether or not individuals were charged for screening, or whether anonymous participation in the screening program was possible. None of the programs used a comparison group for evaluation purposes. All programs used venipuncture for specimen collection.

**Program outcomes:** In total, at the STD clinics, the 11 programs screened 150,233 individuals for HCV antibodies (range: 618-90,424) and identified 13,397 HCV-infected individuals (range: 8-8,964). Six of the 11 programs reported the screening uptake, which varied from 14.0% to 95.8%. The HCV prevalence varied from 0.1% to 28.0%. Only one study reported that an opt-out strategy was used, but did not report the screening uptake (88). Of the five studies that limited HCV screening to HCV risk groups, four reported a high prevalence rate (>15%). In contrast, the prevalence rates
in the six studies without a risk selection varied from 0.1% to 4.9%. In all programs at the STD clinics, a history of IDU was found in the risk profile of the identified HCV-infected individuals, or was found associated with HCV infection.

Only three of the 11 programs reported the proportion of viremic patients, varying from 61.7% to 69.3%. None of the studies reported the proportion of HCV-infected patients that started treatment and/or reached SVR.

**GP clinics (n=12)**

*Program characteristics:* The majority (8/12) of the HCV-screening programs in GP clinics were carried out in France. In most programs (9/12), screening was limited to HCV risk groups within the GP-patient population (specific migrant groups [53;54]; risk groups such as those with a history of IDU and recipients of blood transfusions before 1991 [90;92;93;95-98]). One program was carried out in a health care center that attracted people with poor access to health care, mostly migrants [52], and one was carried out in an area of low socioeconomic status [91]. In two of the 12 programs, individuals who were in the GP’s waiting room were approached and invited for screening [52;54], and five programs used media activities to attract individuals for screening. None of the programs reported the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs. Of the 12 studies, four reported that screening was free of cost [90;93;98;119], whereas the others did not report participants’ costs for screening. Only the screening program among people with poor access to health care offered the possibility of anonymous screening [52].

In reference to screening procedures, all but two studies used venipuncture for specimen collection. Two studies used oral fluid HCV antibody tests, followed by blood tests for those who tested positive. The majority (9/12) of the programs focused solely on HCV screening. The three programs that screened predominantly migrants also included HBV screening [52-54].

*Program outcomes:* In total, the 12 programs screened 30,022 individuals for HCV antibodies (range: 117-15,952) and identified 522 HCV-infected individuals (range: 0-276). Six of the 12 programs reported the screening uptake, which varied from 27.8% to 82.5%. The HCV prevalence varied from 0% to 30.8%. Only one study reported an opt-out strategy, with a screening uptake of 59% [94]. Of the 12 programs, three primarily screened migrants (prevalence rates 0%, 1.2% and 5.8%), seven used risk factors other than being a migrant as criteria for screening (prevalence rates 1.4% to 30.8%), and one was performed in an area of low socioeconomic status (prevalence rate 12.8%). In contrast, one program that did not use risk factors as screening criteria, and was not performed in an area of low socioeconomic status, found a relatively low prevalence of 0.4% [94]. We did not notice clear differences in screening uptake or HCV prevalence related to the use of media to attract individuals for screening. Further, we could not assess whether personally inviting individuals for screening or screening for more than just HCV could have influenced the screening uptake, since these studies did not report the screening uptake [52;54].

Four studies checked the results of their screening program against data collected in the same period in comparison clinics or data collected prior to the screening program. A study from the Netherlands concluded that the addition of primary care practice support (e.g. plenary courses for GPs regarding HCV screening) leads to improvements in medical consciousness regarding HCV infection in primary care, which is likely to have a positive effect on case finding (that
HCV screening programs

Effect, however, could not be indisputably demonstrated) (96). A study from France concluded that information and training that is adapted to GPs’ medical practice can lead to more active involvement of GPs in screening for HCV infection (97). During the intervention the number of GPs that prescribed tests increased, and more HCV-infected patients were detected compared with the year before. Another study from France compared two interventions in the GP clinic; GPs in intervention 1 prescribed HCV testing if HCV risk factors were identified during questioning of patients, whereas GPs in intervention 2 placed posters and leaflets on HCV risk factors in their waiting rooms to motivate patients at risk to discuss screening (98). The numbers of tests prescribed by GPs was relatively low in both interventions, and outcomes of the two interventions with regard to the number of tests and the HCV prevalence were comparable. In a study from Scotland that offered screening to all GP visitors aged 30-54 years, 117 were screened for HCV infection (prevalence: 12.8%, 15/117), whereas in a comparison clinic, where no intervention for HCV screening was introduced, no individuals were screened for HCV infection.

Only three of the 12 programs in which HCV-antibody positive individuals were identified reported the proportion of viremic patients, varying from 73.3% to 86.4%. Two of these programs reported the proportion who started treatment (18% and 38%), but only one of these two programs reported the proportion of treated individuals (n=2) who reached SVR (50%, n=1)(91).

VA clinics (n=5)
Program characteristics: All five HCV screening programs in VA clinics were carried out in the USA. No personal invitations or media activities were reported. All screening programs limited the screening to risk groups within the veteran population. In one program, screening was limited to veterans who were admitted for an alcohol and noninjecting drug rehabilitation program (102), while other programs used an extensive list of risk factors, including history of drug use, blood transfusion prior to 1992, and Vietnam veteran. None of the programs reported an opt-out strategy, and none reported the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs, whether or not individuals could participate anonymously, participants’ costs for screening, or a comparison group for evaluation purposes. All programs used venipuncture for specimen collection and screened solely for HCV.

Program outcomes: In total, the five programs screened 31,483 individuals for HCV antibodies (range: 338-12,485) and identified 1,810 HCV-infected individuals (range: 78-681), although in one program (100) a large number of individuals were already aware of their infection (n=152). The screening uptake was described in three of the five programs, varying from 41.9% to 99.4%. The HCV prevalence in most programs was around 5%, but the program among veterans who were admitted to an alcohol and noninjecting drug rehabilitation program was substantially higher (23.1%). Three programs reported the proportion of viremic patients, varying from 47% to 97.4%. The proportion of patients that started treatment was described in three studies and varied from 15% to 38%. Four studies reported the SVR rate among those who started treatment, ranging from 33% to 47%.

Antenatal/obstetric/fertility clinics (n=5)
Program characteristics: Of the five programs, three were carried out in the UK, one in the USA and one in Brazil. The programs targeted pregnant women, except for a British study in a fertility clinic that was targeted at couples. Media activities to promote the screening programs were described in only one of the five studies; this study used information leaflets to inform women about the
screening program, and a personal invitation for participation by the midwife (107). None of the programs reported an opt-out strategy, and none used a risk assessment strategy to limit screening to those at risk, and none reported the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs. The programs did not report the possibility to screen anonymously, or a comparison group for evaluation purposes. The one program reporting screening costs was free of cost to participants (108).

With respect to screening procedures, all but one study used venipuncture for specimen collection. One study used DBS for anti-HCV screening and a second generation ELISA followed by HCV RNA testing using venous blood for confirmation (108). In all but one program, participants were also screened for other infections (mainly HIV and HBV) or liver enzymes (ALT/AST).

Program outcomes: In total, the five programs screened 67,729 individuals for HCV antibodies (range: 1,658-31,081) and identified 283 HCV-infected individuals (range: 9-115). In the two studies reporting screening uptake, rates were very high (≥98%). In all but one program, the HCV-prevalence rates were low, varying from 0.2% to 0.8%. In women at risk for perinatal complications, HCV prevalence was 4.6% (106). In two studies, the proportion of viremic patients was reported, varying from 71% to 73%. In one of the five programs, results of the clinical follow-up and treatment were reported, showing that 67.9% of those identified with chronic HCV started treatment after delivery, and 80% of those who completed treatment achieved SVR (104).

Psychiatric clinics (n=3)

Program characteristics: Of the three HCV screening programs in psychiatric clinics, two were carried out in Australia, and one in the USA. One program aimed to evaluate whether screening by risk factors would be effective, and limited the HCV screening program in one unit to those with a history of IDU and those exposed to contaminated blood products, whereas in the other unit all patients were screened (110). In the other two programs, no risk selection was used for participation in the screening program. One program promoted screening by using media (111). None of the programs reported an opt-out strategy. The programs did not offer the possibility to screen anonymously, and did not report about participants’ costs for screening. Concerning screening procedures, all studies used venipuncture for specimen collection, and all studies exclusively screened for HCV.

Program outcomes: In total, the three programs screened 300 individuals (range: 36-98), and identified 40 HCV-infected individuals (range: 3-15). All programs reported the screening uptake, varying from 20.5% to 100%. The HCV-prevalence rates were varied from 3.2% in the unit without pre-screening risk selection (110), to 41.7% in the unit where screening was limited to those who reported a history of IDU or exposure to contaminated blood products. Noninjecting drug use and history of IDU were reported as the main risk factors among the identified cases. All three programs referred the HCV-infected individuals to a specialist, but only one study (109) reported the outcomes of referral, namely that 50% of patients were viremic, and none had started treatment after two years of follow-up. Of interest, in two programs (110;111), post-test counseling addressing various topics (e.g., education about the illness, risk behavior, safe injection practices, secondary prevention) was also offered to those who reported risk factors but tested HCV negative.

One of the three studies reported that their program was based on psychosocial theory or knowledge about determinants facilitating participation in HCV screening programs. This program promoted
screening by using leaflets outlining HCV, its risk factors, and the importance of screening, and used individually tailored pre- and post-test counseling that was adapted to individual knowledge and cultural understandings where appropriate (111). Although the uptake of screening in that study was relatively low (20.5%), the prevalence was relatively high (19.7%), especially considering the fact that no prescreening risk selection was used.

Other clinics (n=7)

**Program characteristics:** In total, seven HCV screening programs were integrated in other clinics or services. These programs varied widely, from screening patients at an emergency health unit in France (112) to screening couples that wish to get married in Saudi Arabia (113). Two programs targeted MSM; one in an outreach service for HIV point-of-care testing in the UK (115), and another in a community care facility in the USA (116).

The study in the USA reported the use of media activities to attract participants, wherein MSM were recruited through advertisements as well as by referral of medical staff (116). Two of the seven studies used a prescreening selection; a program at an emergency health unit only screened those with a reported risk factor (112), and in France, only those with elevated ALT levels as determined during routine medical check-up were screened for HCV (112). None of the programs reported the use of psychosocial theory or knowledge about determinants facilitating participation in screening programs, and none reported about the possibility of anonymous screening, or a comparison group for evaluation purposes. The one study reporting about participants’ costs for screening mentioned that it was free (116). With respect to screening procedures, all studies used venipuncture for specimen collection. Four of the seven programs also screened for other diseases (mainly HBV).

**Program outcomes:** In total, the seven programs screened 78,377 individuals (range: 55-74,662), and identified 397 HCV-infected individuals (range: 1-250). The screening uptake was reported in three out of seven programs, varying from 66.2% to 77.6%. The HCV prevalence varied from 0.3% in a mandatory premarital screening program in Saudi Arabia (113) to 11.5% in a program for MSM (116). None of the programs reported an opt-out strategy, and one reported that screening was mandatory but did not report the screening uptake (113). Only three studies reported the proportion of viremic patients, varying from 50% to 73%. Only one study reported the number of patients that started treatment, which was zero (112).

**Discussion**

This systematic review describes characteristics and outcomes of HCV screening programs in the general population, and includes 67 programs. In total, 24 of them were exclusively set up for the purpose of HCV screening, whereas 41 were integrated in already existing health care facilities (not aimed at HCV risk groups), and two programs used both an integrated and nonintegrated approach. We identified only four screening programs in countries of intermediate to high HCV prevalence, and all were nonintegrated screening programs. Altogether, the programs that were published identified only approximately 25,700 HCV-infected individuals, a tip of the iceberg considering that HCV affects an estimated 130-170 million individuals worldwide (120), of which the majority is considered to be undiagnosed. Clearly, more-effective, large-scale, and structural screening and referral programs are needed to address the HCV-related burden of disease in an era of potent therapy for HCV.
The programs were highly heterogenic in their organization, recruitment, and screening procedure, and the vast majority did not use a comparison group to assess the effectiveness of their screening program. Hence, we cannot draw firm conclusions as to which screening program strategy, or which program characteristic (e.g., free-of-cost vs. low-cost screening, anonymous vs. nonanonymous screening, use of particular media to promote screening, opt-in vs. opt-out screening) is more effective than another in attracting or motivating individuals for screening or in attracting those at higher risk for HCV. Screening programs that compare different recruitment and screening strategies are needed to gain insight into effectiveness of strategies and program characteristics.

In addition, many studies did not report program characteristics (e.g., the laboratory tests that were used). The same was true for screening uptake and follow-up data, and even if reported, there was not much consistency (e.g., some reported the SVR rate among those who completed treatment, whereas others reported that treatment was ‘rather successful’). The underreporting and the lack of uniformity of data reporting greatly hinder the comparison of screening programs. Data reporting standards (see parameters in Box 2) are needed to be able to compare screening program characteristics and outcomes in order to find out which factors are effective.

With respect to publication bias, programs that were successful in identifying HCV-infected individuals may have been more likely to be published. However, we did identify several programs in which none individuals were diagnosed (54;70). Furthermore, as identification of HCV-infected individuals serves a clinical goal and not necessarily a scientific goal, not all screening efforts have been evaluated or published. Our search identified several announcements of HCV screening activities (e.g., 121-126) or cost-effectiveness evaluations of screening activities (127) that did not provide any further information about the screening program and/or outcomes. Therefore, there may be more screening programs for HCV than those described in this review.

In general, we noticed relatively high HCV-prevalence rates in programs that used a prescreening selection based on HCV risk factors (especially in programs that used elevated ALT or a history of IDU as indications for HCV screening) or migrant status, in programs that were carried out in intermediate to high HCV-prevalence countries or regions, and in programs in psychiatric clinics. Also, relatively high HCV-prevalence rates were found in nonintegrated programs in low HCV-prevalence countries that targeted the general population (see row 1-7 of Table 1a), even without a prescreening risk assessment. These programs screened a self-referred population, and may have attracted those at risk of HCV in the general population (e.g., those with a history of IDU), and therefore observed prevalence rates are higher than those in the general population. For the study by Hayashi et al (61), screening was performed in a specific region in Japan with a presumably high HCV prevalence, explaining the very high prevalence that was found. In most studies, a history of IDU was the main risk factor among the identified HCV-infected individuals. In general, low HCV-prevalence rates were found in programs that targeted health care workers, and in programs that were carried out in antenatal clinics. Programs in STD and GP clinics that did not use a prescreening risk selection also found relatively low HCV-prevalence rates.

Only one study reported that the promotion of the screening program was based on theoretical insights or knowledge about determinants facilitating participation in screening programs. None of the studies reported the use of simple tools that may increase the screening uptake, such as reminder messages (128;129), or support with planning of when and how to get screened (i.e., creating implementation intentions (130)). In many studies, and especially those describing nonintegrated
programs, the uptake of screening was not reported. Only a few studies reported that individuals could be screened anonymously; in the nonintegrated programs, only those targeted at health care workers organized the screening in a way that people could stay anonymous. The fact that HCV might be associated with drug use may pose a barrier for individuals and health care providers when deciding for or against screening. Hence, anonymous screening may increase screening uptake, especially among those at high risk of infection.

Surprisingly, none of the programs reported the use of the Internet to attract or inform individuals about screening (data not reported). Even programs that were carried out in recent years when Internet use in high-income countries was widespread did not report the use of this medium. Since Internet use in most high-income countries is relatively common, and the Internet is a relatively anonymous medium, it may fit into HCV-screening programs very well. Two programs that were from 2011 and 2012, and therefore not included in this review, used an Internet-based HCV risk-assessment questionnaire and an Internet referral service for blood testing for those at risk of HCV (131;132). These programs concluded that such a Web-based and anonymous questionnaire might be useful to detect undiagnosed HCV infections.

We found that integrated screening programs in general screened a larger number of individuals than did nonintegrated screening programs in low HCV-prevalence countries. Integrated screening programs have three advantages in that they do not have to attract their target population for screening, and they can use a facility that is familiar to the public. In addition, they can facilitate continuous screening and follow-up of individuals at relatively low cost, whereas nonintegrated programs offer screening usually for a limited period. On the other hand, integrated screening programs only reach those who have a reason to visit such facilities (unless media campaigns have been used to attract more people), whereas nonintegrated programs may attract a different risk population that otherwise would not be screened and do not perceive themselves at risk for HCV (i.e., the hidden population). We believe that both approaches are useful and complementary. In addition, since nonintegrated screening in general is more complex to organize, it may be efficient to screen for other diseases (e.g., HBV) simultaneously, when risk groups overlap (e.g., in migrant populations).

We identified several studies that did not confirm HCV antibody test results. Many of the identified programs targeted asymptomatic individuals in the general population with a relatively low HCV prevalence. In such populations, unconfirmed HCV antibody test results may include 35% (range: 15%–60%) false-positive test results (133). Hence, the program outcomes that are reported may include a substantial degree of uncertainty, and should be interpreted with care. We like to emphasize that HCV screening programs should use screening methods that are in line with recommendations for confirmation testing of all anti-HCV screening-test positive results (133), and describe the tests that were used when publishing the results of their screening projects.

Our review describes several screening programs, but it cannot determine the efficiency and effectiveness of these screening programs in preventing future HCV-related morbidity and mortality. Measuring these effects of HCV screening programs is a challenge because randomized, controlled trials or comparison groups and decades of follow-up time are required. As an alternative method, mathematical modelling studies might be useful. In addition, the efficiency and effectiveness of screening depends not only on the number of individuals screened and the number of individuals identified, but also on the uptake and outcomes of therapy and other preventive measures (e.g.,
lowering alcohol intake) that may follow from diagnosis. Efficiency relates to the number needed to be screened to identify a treatable case of HCV. Surprisingly, most studies did not report such data, and merely mentioned that HCV-infected individuals were notified of their test result and referred for clinical care. Following Wilson and Jungner's third screening principle (134), facilities for diagnosis and treatment should be available. This means that the screening program itself is as important as the efforts that are undertaken to bring identified patients into care and have them benefit from preventive measures and/or treatment. Hence, evaluation reports of screening programs should include clinical follow-up and systematically report outcomes.

A recent systematic review by Jones et al. on the effectiveness and cost-effectiveness of interventions aimed at raising awareness of and/or increasing engagement in case finding and testing with high-risk groups for HCV and HBV and practitioners included only programs with a comparison group (e.g., randomized controlled trials, pre- and postintervention data, repeated cross-sectional studies) (135). About half of the studies (12/25) included in that review were aimed at high-risk groups for HCV that are relatively easy to target, such as current IDU and incarcerated individuals, whereas our review includes studies that aimed to identify the hidden population of HCV-infected individuals. Jones et al. identified drug services and primary care as settings in which interventions could effectively increase screening uptake. They also found that DBS testing in addition to venipuncture might increase HCV screening uptake in drugs services or prisons. In our review, a few studies reported the use of home collection tests, DBS, or oral fluid tests, but these studies did not demonstrate high screening uptake. Further insight into the effect of alternative noninvasive testing procedures on screening uptake is needed. As in our review, Jones et al. concluded that improvement of health outcomes following diagnosis for those identified with chronic HCV deserves careful attention.

In conclusion, HCV infection has serious health implications and, at the start of the era of potent therapy for HCV, screening programs are not yet reaching all potentially infected individuals worldwide. Therefore more effective programs are urgently needed. This review identified 67 screening programs that targeted HCV risk groups that are hidden in the general population. Relatively high HCV-prevalence rates were found in programs that used a prescreening selection based on a HCV risk profile or migrant status, in programs that were carried out in intermediate to high HCV-prevalence countries or regions, and in programs in psychiatric clinics. In general, low HCV-prevalence rates were found in programs that targeted health care workers and pregnant women. The reported use of motivational communication based on theory and/or determinants facilitating screening, and tools to increase HCV screening uptake were virtually absent. Comparison of the screening programs was strongly hindered by the lack of reported data on screening uptake, program characteristics, the type of diagnostic tests used, and clinical outcomes. In addition, only a few programs used a comparison group to evaluate program effectiveness.

We suggest that screening programs should be theory-based and provide tools to increase screening uptake. For low HCV-prevalence populations, the use of prescreening selection criteria should be considered to increase efficiency. In addition, to be able to assess screening program effectiveness, programs using a comparison group are needed. To improve comparability of screening programs and outcomes, it is necessary for all programs to systematically report program characteristics, screening uptake, the type of diagnostic tests that were used, as well as clinical outcomes.
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HCV screening programs


(34) Fukui M. [Natural history of HCV seropositive cases found in health screening]. Hokkaido Igaku Zasshi 1995 January;70(1):69-82.


Eilks R. Hepatitis C testing should be performed routinely in all patients attending sexual health services. Abstract for the 2nd Joint Conference of the British HIV Association and the British Association for Sexual Health and HIV Manchester United Kingdom. HIV Medicine 2010;59.


(113) Alsawai FM, O’Brien SS. Is there a need to include HIV, HBV and HCV viruses in the Saudi premarital screening programme on the basis of their prevalence and transmission risk factors? J Epidemiol Community Health 2009 October 12.
HCV screening programs


(115) Roberts J, Cull M, Dean G, Richardson D, Fisher M. Improved but still suboptimal uptake of STI testing and vaccination in the outreach setting. Abstract for the 2nd Joint Conference of the British HIV Association and the British Association for Sexual Health and HIV Manchester United Kingdom. HIV Medicine 2010;118.


Box 1: Risk groups for HCV infection (16, 17)

- Individuals with a history of injecting drug use (IDU), including those who injected only a limited number of times many years ago and do not consider themselves to be drug users
- Individuals who received clotting factor concentrates produced before 1987 or a blood transfusion or an organ transplant before 1992 including hemophiliac patients (systematic screening of blood donors for HCV antibodies was introduced in 1991) (18)
- Individuals with occupational exposure to infected blood
- HIV-infected men who have sex with men (MSM)
- Chronic hemodialysis patients
- Children born to HCV-infected mothers
Box 2: Parameters of screening programs

Program characteristics
- Country (and region, if applicable) of the study
- Estimated HCV antibody prevalence in the country
- Calendar year(s) of data collection
- Duration of enrolment/screening period
- Setting (i.e., whether HCV screening was integrated within already existing health care facilities or whether the program was exclusively set up for the screening [i.e., nonintegrated screening])
- Use of psychosocial theory or previous research findings as a basis for communicating the screening and for stimulating screening uptake
- Size of the targeted population
- Use of media activities and/or personal invitations to promote screening
- Use of screening criteria based on HCV risk factors
- Incentive or participant’s costs for screening
- Anonymous or nonanonymous participation
- Type of HCV test(s) that was used for screening
- Screening for other diseases performed
- Use of a comparison group for evaluation purposes

Program outcomes
- Response rate (i.e., proportion of the target population that was screened)
- Number of participants (i.e., number of individuals that were screened)
- Number of HCV cases identified
- Number of HCV cases already known
- HCV-antibody prevalence
- Risk profile of identified cases
- Proportion of HCV-antibody positives with detectable HCV RNA
- Number of referrals to specialist
- Start and outcomes of treatment
Since the introduction of the first HCV antibody test in 1991, several improvements have been made in HCV diagnostics. Anti-HCV and HCV-RNA prevalence rates of studies were considered suboptimal 1) if data was collected prior to 1994 when sensitivity and specificity of tests were not optimal (18, 30)) or 2) if studies did not confirm reactive HCV antibody test results by immunoblot or PCR to eliminate false positives. Tests were considered valid if performed after 1993 and if 1) second- or higher- generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Innogenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0) were used to confirm HCV antibody reactive results or 2) PCR was used to confirm HCV- antibody reactive results. The validity of outcomes of studies that did not indicate which test was used, and studies that used dried blood spot (DBS), oral fluid screening, or immunoblot assays different from those indicated above, was considered undecided.

If the study reported HCV prevalence, but without specifying whether it concerned HCV-antibody or HCV-RNA prevalence, and if information about the test that was used was lacking, we assumed it to be HCV-antibody prevalence.

**Figure 1.** Overview of search strategy, data collection, and data review and extraction processes.
<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Population</th>
<th>Country and HCV prevalence according to CDC (1)</th>
<th>Setting of screening</th>
<th>Duration of screening program</th>
<th>Other tests</th>
<th>Prescreening selection</th>
<th>Media activities</th>
<th>Screening uptake and anti-HCV prevalence (95% CI)</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
<th>Follow-up of HCV-infected individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaur, S, 1996 (55)</td>
<td>1992</td>
<td>General population</td>
<td>USA (1.9%): throughout the country</td>
<td>Mainly urban hospital centres</td>
<td>4 days</td>
<td>HBV, ALT</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: approx. 90%</td>
<td>Multivariable regr. analysis - History of IDU - Hemodialysis - Sex with IDU - Blood transfusion - Male gender - Non-white/non-Hispanic - Not vaccinated for HBV</td>
<td>Patients were referred to their physicians for further follow-up. Of 604 anti-HCV positives, 380 (62.9%) had elevated ALT levels. No results were reported.</td>
</tr>
<tr>
<td>D'Souza, RFC, 2004 (56)</td>
<td>2003</td>
<td>General population</td>
<td>UK (1.1%): London</td>
<td>Walk-in clinic at the minor injuries unit at hospital</td>
<td>4 days</td>
<td>Liver function tests</td>
<td>No</td>
<td>Yes</td>
<td>NR</td>
<td>NR</td>
<td>Patients were informed in person of the test results. No further follow-up data reported.</td>
</tr>
<tr>
<td>Bellentani, S, 1994 (57)</td>
<td>1994</td>
<td>General population aged 12-65 yrs</td>
<td>Italy (1.1%): Northern Italy, cities Campogalliano and Cormons</td>
<td>Community-based screening</td>
<td>2 years</td>
<td>ALT, AST, gamma-glutamyltranspeptidase, mean cell volume, platelet, erythrocyte and leukocyte counts, HBV</td>
<td>No</td>
<td>Yes</td>
<td>NR</td>
<td>NR</td>
<td>Patients with HCV antibodies underwent additional procedures (e.g., ultrasonography of the liver, liver biopsy when indicated). At the time of the writing, 10% had undergone liver biopsy. No results were reported.</td>
</tr>
<tr>
<td>Trepka, M.J, 2007 (58)</td>
<td>2001-2003 General population</td>
<td>USA (1.9%): Miami</td>
<td>Hepatitis screening clinic</td>
<td>2.5 year</td>
<td>HBV</td>
<td>Yes, if traditional risk factors applyb</td>
<td>NR</td>
<td>Yes</td>
<td>NR</td>
<td>NR</td>
<td>Most common risk factor (%) - History of IDU (54.7)</td>
</tr>
</tbody>
</table>

* CI: Confidence interval
** CI: Confidence interval
*** NR: Not reported

Note: The table represents nonintegrated screening programs in low HCV-prevalence countries (≤2%).
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Population</th>
<th>Country</th>
<th>Methodology</th>
<th>Screening</th>
<th>History of blood transfusion</th>
<th>Outcome</th>
<th>Prevalence</th>
<th>Risk factors</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fagundes, GD, 2008 (59)</td>
<td>2005</td>
<td>General adult urban population</td>
<td>Brazil (1%): Santa Catarina, Criciuma</td>
<td>Public health campaign event</td>
<td>1 day</td>
<td>None</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: NR</td>
<td>Prevalence: 2.2% (10/457; 95% CI: 1.2-4.0) *</td>
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<td>Univariable regr. analysis: - High number of sex partners</td>
<td>In HCV-RNA positive samples, genotyping was performed for therapeutic reasons. No data about therapy reported.</td>
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<td>Outcomes: RNA rate: 70.0% (7/10)</td>
<td>Start treatment: NR</td>
</tr>
<tr>
<td>Jimenez, FP, 2000 (60)</td>
<td>1997-1998</td>
<td>General population 15-70 years</td>
<td>Cuba (1.9%): Havana</td>
<td>House visits of all patients registered at a GP clinic</td>
<td>17 months</td>
<td>None</td>
<td>Yes, history of blood transfusion</td>
<td>No</td>
<td>Scr. uptake: 100% (35/35)</td>
<td>Prevalence: 8.6% (3/35; 95% CI: 3.0-22.4) *</td>
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<td>Outcomes: RNA rate: NR</td>
<td>Start treatment: NR</td>
</tr>
<tr>
<td>Hayashi, J, 1995 (61)</td>
<td>1993</td>
<td>General population</td>
<td>Japan (2%): Kyushu Island, Fukuoka Prefecture, ‘H Village’</td>
<td>Village screening program</td>
<td>NR</td>
<td>HBV</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: 48.1% (2046/4250)</td>
<td>Prevalence: 19.7% (403/2046; 95% CI: 18.0-21.5) *</td>
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<td>Most common risk factor (%) - History of blood transfusion (11.9)</td>
<td>NR - the authors write that it is necessary to work out a strategy for the care of the many HCV-infected individuals in this village.</td>
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<td>Outcomes: RNA rate: 82.9% (334/403)</td>
<td>Start treatment: NR</td>
</tr>
<tr>
<td>Uddin, G, 2010 (54) *</td>
<td>NR</td>
<td>Immigrants from the Indian sub-continent (India, Bangladesh or Pakistan)</td>
<td>UK (1.1%): East London, West London, Walsall, Sandwell, Bradford</td>
<td>Public meetings and testing sessions in community centers (and GP clinic, see Table 2b)</td>
<td>NR</td>
<td>Oral fluid HCV, HBV</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: NR</td>
<td>Prevalence: 1.6% (75/4,833; 95% CI: 1.2-1.9) at community centers **</td>
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<td>Multivariable regr. analysis: - Shorter length of stay in the UK - Being tested in East London</td>
<td>Patients were offered an appointment with the local treating physician for confirmation blood testing; 57/75 attended.</td>
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<td>Outcomes: RNA rate: 96.5% (55/57)</td>
<td>Start treatment: NR</td>
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<tr>
<td>Kallman, JB, 2010 (53) *</td>
<td>NR</td>
<td>Immigrants from Vietnam</td>
<td>USA (1.9%): Northern Virginia</td>
<td>General health screening at Asian health fairs (and GP clinic, see Table 2b)</td>
<td>NR</td>
<td>HBV</td>
<td>No</td>
<td>NR</td>
<td>Scr. uptake: NR</td>
<td>Prevalence: 5.2% (4/77; 95% CI: 2.0-12.6) at health fairs **</td>
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<td>Univariable regr. analysis: - Elevated AST</td>
<td>Patients were seen by their primary care givers for further management, or referred for further follow-up and treatment (no results were reported).</td>
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<td>Outcomes: RNA rate: NR</td>
<td>Start treatment: NR</td>
</tr>
<tr>
<td>First author, year of publication</td>
<td>Calendar or data collection</td>
<td>Population</td>
<td>Country and HCV prevalence according to CDC (1)</td>
<td>Setting of screening</td>
<td>Duration of screening program</td>
<td>Other tests</td>
<td>Prescreening selection</td>
<td>Media activities</td>
<td>Screen uptake and anti-HCV prevalence (99% CI)</td>
<td>Risk profile of identified HCV cases / Risk factors associated with HCV</td>
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<tr>
<td>Hwang, JP, 2010 (62)</td>
<td>2006</td>
<td>Asian Americans (predominantly)</td>
<td>USA (1.9%): Houston</td>
<td>Local community health fair</td>
<td>1 day</td>
<td>HBV</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: &gt;20% (202/1000, of whom 118 Asian Americans) Prevalence: 5.9% (7/118, 95% CI: 2.9-11.7) *</td>
<td>Vietnamese: 15.4% other Asian: 1.3%</td>
</tr>
<tr>
<td>Batash, S, 2008 (63)</td>
<td>NR</td>
<td>Immigrants in NYC from former Soviet Union</td>
<td>USA (1.9%): NYC</td>
<td>Community-based screening</td>
<td>3 days</td>
<td>None</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: NR Prevalence: 28.3% (90/283, 95% CI: 23.0-33.5) *</td>
<td>Only available for small subset of cases (97/283) Multivariable regr. analysis: - intramuscular injections - blood transfusions</td>
</tr>
<tr>
<td>ARAS 92, 2004 (64)</td>
<td>2004</td>
<td>Guest workers from Africa</td>
<td>France (1.1%): Hauts-de-Seine</td>
<td>Health check in rental apartments for guest workers</td>
<td>3 days</td>
<td>Clinical and dental examination, a chest X-ray and blood tests: fasting glucose, cholesterol, triglycerides, and serologies: HBV, syphilis and HIV</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: 35.6% (110/310) Prevalence: 0.9% (1/110; 95% CI 0.04-5.0) **</td>
<td></td>
</tr>
<tr>
<td>Goetz, AM, 1995 (65)</td>
<td>NR</td>
<td>Health care workers (physicians, dentists, nurses and laboratory personnel) with very high, high, and low risk for potential exposure to hepatitis C through the handling of blood and body fluids.</td>
<td>USA (1.9%): Pittsburgh</td>
<td>Two hospitals that do liver transplantations: the Veterans Affairs Medical Center and the Presbyterian University Hospital</td>
<td>NR</td>
<td>None</td>
<td>No</td>
<td>NR</td>
<td>Scr. uptake: NR Prevalence: Overall: 1.2% (3/241): 95% CI: 0.4-3.6 CHCV. **** In HCV involved with liver transplantations: 5.3% (3/57; 95% CI: 1.3-15.3%) versus 0% in the HCV at lower risk.</td>
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</tr>
<tr>
<td>Authors</td>
<td>Year</td>
<td>Study Population</td>
<td>Location</td>
<td>Type of Screening</td>
<td>Hospital</td>
<td>Duration</td>
<td>AHB</td>
<td>NAI</td>
<td>SCA</td>
<td>SCU</td>
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<tr>
<td>Thomas, DL, 1993 (66)</td>
<td>1991</td>
<td>Health care personnel</td>
<td>USA (1.9%): East Baltimore Hospital</td>
<td>9 months</td>
<td>HBV</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: &gt;90%</td>
<td>Most common risk factor (%) - Blood transfusion (14.3)</td>
<td>Patients were offered consultation (results were not reported).</td>
</tr>
<tr>
<td>Panfilo, AL, 1995 (67)</td>
<td>1992</td>
<td>Surgeons</td>
<td>USA (1.9%): throughout two metropolitan areas</td>
<td>7 months</td>
<td>HBV, HIV</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: 26.7% (7/28)</td>
<td>None identified</td>
<td>Patients were offered post-test counseling (results were not reported).</td>
</tr>
<tr>
<td>Upfal, MJ, 2001 (68)</td>
<td>NR</td>
<td>Firefighters, police and EMS</td>
<td>USA (1.9%): Detroit</td>
<td>Survey among firefighters, police, emergency medical service (EMS) personnel</td>
<td>NR</td>
<td>None</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: 42.9% (247/5700)</td>
<td>Multivariable regr. analysis: - EMS personnel, fire fighters</td>
</tr>
<tr>
<td>Datta, S, 2003 (69)</td>
<td>1999</td>
<td>Active and retired firefighters from local union</td>
<td>USA (1.9%): Philadelphia</td>
<td>Home testing screening project</td>
<td>NR</td>
<td>None</td>
<td>No</td>
<td>NR</td>
<td>Scr. uptake: 48.3% (2127/4400)</td>
<td>Multivariable regr. analysis: - Blood transfusion before 1992 - History of illegal drug use</td>
</tr>
<tr>
<td>Gershon, RNM, 1995 (70)</td>
<td>NR</td>
<td>Funeral service practitioners</td>
<td>USA (1.9%): Maryland</td>
<td>Testing on appointment</td>
<td>NR</td>
<td>HIV, HBV</td>
<td>No</td>
<td>NR</td>
<td>Scr. uptake: 49.6% (130/262)</td>
<td>Not applicable (none identified)</td>
</tr>
<tr>
<td>Torda, AJ, 2008 (71)</td>
<td>2002-2005</td>
<td>First-year medical students</td>
<td>Australia (2%): New South Wales</td>
<td>Mandatory vaccination and screening program in a vaccination clinic</td>
<td>4 years</td>
<td>HIV, HBV, measles, Mumps, rubella, and varicella-specific IgG antibodies</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>Scr. uptake: 85.0% (7/3/82)</td>
</tr>
</tbody>
</table>
Table 1a cont’d

<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Country and HCV prevalence according to CDC (1)</th>
<th>Setting of screening</th>
<th>Duration of screening program</th>
<th>Other tests</th>
<th>Prescreening selection</th>
<th>Media activities</th>
<th>Screening uptake and anti-HCV prevalence (95% CI)</th>
<th>Program outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plard, C, 2007 (72)</td>
<td>2005</td>
<td>Underprivileged people at risk of HIV: IDU, illegals, etc.</td>
<td>Outreach screening compared with records of individuals that came to a free and anonymous hospital-based HIV testing clinic</td>
<td>1 year</td>
<td>HIV, HBV, syphilis</td>
<td>No</td>
<td>NR</td>
<td>Scr. uptake outreach: 98.6% (427/433)</td>
<td>Risk profile of identified HCV cases / Risk factors associated with HCV</td>
</tr>
<tr>
<td></td>
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<td>France (1.1%): Paris</td>
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<td>Prevalence (outreach): 4.9% (21/427; 95% CI: 3.2-7.4)</td>
<td>Outcomes: RNA rate: NR</td>
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<td>Prevalence (clinic): 1.6% (7/427; 95% CI: 0.8-3.3)</td>
<td>Start treatment: NR</td>
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<td>Prevalence (clinic): 2.2% (9/427; 95% CI: 0.60-7.66)</td>
<td>SVR: NR</td>
</tr>
<tr>
<td>Boyce, DEC, 2009 (73)</td>
<td>2006</td>
<td>Homeless individuals</td>
<td>Hepatitis health fair organized in a shelter for homeless people</td>
<td>1 day</td>
<td>HBV</td>
<td>No</td>
<td>NR</td>
<td>SCR. uptake: unclear</td>
<td>Most common risk factor (%) Participants were provided with information about available health care resources in the event that they tested positive (results were not reported).</td>
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<tr>
<td></td>
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<td>USA (1.9%): Hawai‘i, Oahu</td>
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<td>Prevalence: 7.5% (3/40; 95% CI: 2.6-19.9) **</td>
<td>Outcomes: RNA rate: NR</td>
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<td>- Jail time (100)</td>
<td>Start treatment: NR</td>
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<td></td>
<td>- History of IDU (67)</td>
<td>SVR: NR</td>
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<td>- Tattoos (67)</td>
<td>SVR: NR</td>
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<td>- Piercings (67)</td>
<td>SVR: NR</td>
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<td>- Snorting drugs (33)</td>
<td>SVR: NR</td>
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<td>- Blood transfusion (33)</td>
<td>SVR: NR</td>
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<td>- Sex partner with HCV</td>
<td>SVR: NR</td>
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<td></td>
<td></td>
<td></td>
<td>infection (33)</td>
<td>SVR: NR</td>
</tr>
<tr>
<td>Anumainayagam J, 2009 (74)</td>
<td>2007</td>
<td>Asymptomatic MSM (and symptomatic MSM who declined referral to the genitourinary medicine clinic)</td>
<td>Outreach sessions at the sauna</td>
<td>1 year</td>
<td>HBV, HIV, syphilis, chlamydia, gonorrhea</td>
<td>No</td>
<td>NR</td>
<td>SCR. uptake: NR</td>
<td>Patients were referred to and attended their local genitourinary medicine clinic (results were not reported).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UK (1.1%): Walsall</td>
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<td>Prevalence: 2.2% CHCV (2/91; 95% CI: 0.60-7.66) **</td>
<td>Outcomes: RNA rate: NR</td>
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<td>Start treatment: NR</td>
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<td>SVR: NR</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; NR = not reported; IDU = injecting drug use; HCV = hepatitis C virus; CHCV = chronic hepatitis C virus; HBV = hepatitis B virus; HIV = human immunodeficiency virus; ALT = alanine aminotransferase; AST = aspartate aminotransferase; MSM = men who have sex with men; HCW = health care worker; SVR = sustained virological response; PCR = polymerase chain reaction

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).
** The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below, or dried blood spots or oral fluid samples were used).
*** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Innogenetics (LiaTek), Pasteur (DEISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).
**** HCV-antibody prevalence is considered valid, but reflecting chronic HCV infection (data were collected after 1993, and reactive HCV antibody test results were confirmed by PCR).
*a These programs combined a nonintegrated screening approach with integrated screening at the GP clinic (see Table 2b). Here only results of the nonintegrated screening are presented.
** History of IDU, receiving blood transfusions or organ transplants prior to July 1992, clotting factor concentrates produced before 1987, being notified to have received HCV-positive blood, ever on chronic hemodialysis, persistently elevated ALT levels, ever exposed to HCV-positive blood through needlestick injuries, born to an HCV-positive woman.
<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Population</th>
<th>Country and HCV prevalence according to CDC (1)</th>
<th>Setting of screening</th>
<th>Duration of screening program</th>
<th>Other tests</th>
<th>Pre-screening selection criteria</th>
<th>Media activities</th>
<th>Screening uptake and anti-HCV prevalence (95% CI)</th>
<th>Program outcomes</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meky, FA, 2006 (75)</td>
<td>2002-2005 General population</td>
<td>Egypt (6.6%): Two rural villages in the Nile Delta</td>
<td>Community health clinic and private clinics for acute cases</td>
<td>29 months</td>
<td>HAV, HBV, HEV, CMV, Epstein-Barr</td>
<td>Only those with symptoms and ALT levels &gt;=2 times the upper limit of normal were tested</td>
<td>Yes</td>
<td>Scr. uptake: NR Prevalence: 78.7% (37/47; 95% CI: 65.1-88.0 *)</td>
<td>NR</td>
<td>At 2 and 6 months following initial examination, follow-up testing was done to confirm or reclassify the diagnosis (i.e., viral clearance or persistent infection). No data was reported about medical follow-up of chronically infected patients.</td>
<td></td>
</tr>
<tr>
<td>Chen, C-H, 2007 (76)</td>
<td>1996-2005 General population aged ≥18 yrs</td>
<td>Taiwan (2.1% *): Outreach community-based screening</td>
<td>10 years</td>
<td>HBV, ALT, AST</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: NR Prevalence: 4.4% (6904/157720; 95% CI: 4.3-4.5 **)</td>
<td>NR</td>
<td>Patients were requested to return to the collaborating hospitals for subsequent management (results were not reported).</td>
<td></td>
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</tr>
<tr>
<td>Aslam, M, 2001 (77)</td>
<td>2000 General population</td>
<td>Pakistan (6.6%): City screening program Lahore and Gujranwala</td>
<td>NR</td>
<td>None</td>
<td>No</td>
<td>Yes</td>
<td>Scr. uptake: Lahore: 0.01% (48/5063500); Gujranwala: 0.2% (192/1124800) Prevalence: Lahore: 16% (78/488; 95% CI: 13.0-19.5); Gujranwala: 23.8% (498/1922; 95% CI: 22.0-25.8) *</td>
<td>Listed risk factors: Blood transfusion, Surgery/dental work, Multiple factors, Mostly other, non-specified risk factors</td>
<td>Patients were informed about the possibility of eradication of the virus, and treatment in its early stages (further data not provided).</td>
<td>NR</td>
<td>Patients were requested to return to the collaborating hospitals for subsequent management (results were not reported).</td>
</tr>
</tbody>
</table>
**Table 1b cont’d**

<table>
<thead>
<tr>
<th>Program characteristics</th>
<th>Program outcomes</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
<th>Follow-up of HCV-infected individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>First author, year of publication</td>
<td>Calendar year of data collection</td>
<td>Population</td>
<td>Country and HCV prevalence according to CDC (1)</td>
</tr>
<tr>
<td>Lu, SN, 1998 (78)</td>
<td>1994</td>
<td>General population &lt; 16 yrs</td>
<td>Taiwan (2.1%) (^{a}): Kindergartens and schools</td>
</tr>
</tbody>
</table>

\(^{a}\) HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).

\(^{b}\) The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below (see **), or dried blood spots or oral fluid samples were used).

\(^{c}\) HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Innogenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).

\(^{d}\) HCV prevalence based on prevalence of country neighbours.
<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Population</th>
<th>Country and HCV prevalence according to CDC (1)</th>
<th>Setting of screening</th>
<th>Duration of screening program</th>
<th>Prescreening selection</th>
<th>Media activities</th>
<th>Screening uptake and anti-HCV prevalence (95% CI)</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
<th>Follow-up of HCV-infected individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>D’Souza, G, 2003 (79)</td>
<td>2001</td>
<td>STD clinic clients</td>
<td>USA (1.9%): Houston</td>
<td>STD clinic</td>
<td>9 months</td>
<td>STD</td>
<td>Yes, risk assessment questionnaire, screening offered to high-risk groups *</td>
<td>Scr. uptake: 95.8% (892/899)</td>
<td>Prevalence: 15.3% (126/822; 95% CI:12.7-17.7) *</td>
<td>Patients were referred to appropriate settings for follow-up (no results were reported).</td>
</tr>
<tr>
<td>Scott, C, 2010 (80)</td>
<td>2007</td>
<td>STD clinic clients</td>
<td>UK (1.1%): London, Chelsea and Westminster Hospital</td>
<td>STD clinic in hospital</td>
<td>6 months</td>
<td>STD</td>
<td>Yes, MSM</td>
<td>Scr. uptake: 68.6% (2309/3365)</td>
<td>Prevalence: 0.6% (15/2309; 95% CI:0.4-1.1%) **</td>
<td>Outcomes: RNA rate: 69.2% (9/13)</td>
</tr>
<tr>
<td>Weisbord, JS, 2003 (81)</td>
<td>2001</td>
<td>STD clinic clients</td>
<td>USA (1.9%): Miami</td>
<td>STD clinic</td>
<td>3 months</td>
<td>HAV, HBV</td>
<td>No</td>
<td>Scr. uptake: 50.3% (687/1365)</td>
<td>Prevalence: 4.7% (32/687; 95% CI: 3.3-6.5) ***</td>
<td>Outcomes: RNA rate: NR</td>
</tr>
<tr>
<td>Gunn, RA, 1999-2000</td>
<td>1999-2000</td>
<td>STD clinic clients</td>
<td>USA (1.9%): San Diego</td>
<td>STD clinic</td>
<td>8 months</td>
<td>STD</td>
<td>No</td>
<td>Scr. uptake: NR</td>
<td>Prevalence: 4.9% (165/3367; 95% CI: 4.2-5.7) ***</td>
<td>Outcomes: RNA rate: NR</td>
</tr>
<tr>
<td>Mapagu, M, 2008 (83)</td>
<td>2000-2002</td>
<td>STD clinic clients</td>
<td>Australia (2%): Canberra</td>
<td>STD clinic</td>
<td>3 years</td>
<td>STD, BBV</td>
<td>No</td>
<td>Scr. uptake: 46.0% (3113/6774)</td>
<td>Prevalence: 3.1% (95/3113; 95% CI:2.5-3.7%) **</td>
<td>Outcomes: RNA rate: 61.7% (29/47)</td>
</tr>
<tr>
<td>First author, year of publication</td>
<td>Program characteristics</td>
<td>Program outcomes</td>
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<tr>
<td>Zimmerman, R, 2007 (84)</td>
<td>2001-2005 STD clinic clients USA (1.9%): Illinois excluding Chicago STD clinics 5 years HBV (only 2001), STD</td>
<td>Scree. uptake: NR</td>
<td>Listed risk factors: - Mainly IDU</td>
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<tr>
<td>Subiadiur, J, 2007 (85)</td>
<td>2000-2005 STD clinic clients USA (1.9%): Denver STD clinics 6 years STD, HIV</td>
<td>Scree. uptake: NR</td>
<td>NR</td>
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<tr>
<td>Heseltine, G, 2007 (86)</td>
<td>Not specified; clients of the various settings USA (1.9%): Texas Several HIV/STD service providers: HIV counseling and testing sites; drug treatment facilities, correctional facilities, field visits’ outreach sites (e.g., bars, adult bookstores, homeless shelters), STD clinics, family planning clinic, primary healthcare facility 6 years STD, HIV</td>
<td>Scree. uptake: NR</td>
<td>Listed risk factors: - History of IDU (main risk factor) - Risky tattoo/piercing - Risky sex - Blood or medical exposure - Sharing snorting equipment - Occupational exposure</td>
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<tr>
<td>Gunn, RA, 2001 (87)</td>
<td>1998 STD clinic clients USA (1.9%): San Diego STD clinic 6 weeks HBV</td>
<td>Scree. uptake: NR</td>
<td>Listed risk factors: - History of IDU - Among non-IDU: age ≥30 yrs</td>
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</table>

**Table 2a cont’d**

**Program characteristics**
- First author, year of publication
- Calendar year of data collection
- Population
- Country and HCV prevalence according to CDC (1)
- Setting of screening
- Duration of screening program
- Other tests
- Prescreening selection
- Media activities

**Program outcomes**
- Screening uptake and anti-HCV prevalence (95% CI)
- Risk profile of identified HCV cases / Risk factors associated with HCV
- Follow-up of HCV-infected individuals
- Outcomes:
  - RNA rate: NR
  - Start treatment: NR
  - SVR: NR

**Program characteristics**
- Program characteristics
- Calendar year of data collection
- Population
- Country and HCV prevalence according to CDC (1)
- Setting of screening
- Duration of screening program
- Other tests
- Prescreening selection
- Media activities

**Program outcomes**
- Screening uptake and anti-HCV prevalence (95% CI)
- Risk profile of identified HCV cases / Risk factors associated with HCV
- Follow-up of HCV-infected individuals
- Outcomes:
  - RNA rate: NR
  - Start treatment: NR
  - SVR: NR
<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Setting</th>
<th>Prevalence</th>
<th>Risk Factors</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK (1.1%): Crewe</td>
<td>2008</td>
<td>STD and reproductive Health Service (integrated service)</td>
<td>1 year</td>
<td>HIV, syphilis, HBV</td>
<td>No</td>
</tr>
<tr>
<td>UK (1.1%): Throughout the country</td>
<td>2002-2007</td>
<td>STD clinics, contraception and sexual health clinics, specialist HIV services</td>
<td>6 years</td>
<td>Likely STD/HIV</td>
<td>No</td>
</tr>
<tr>
<td>UK (1.1%): Throughout the country</td>
<td>2002-2007</td>
<td>STD clinics, contraception and sexual health clinics, specialist HIV services</td>
<td>6 years</td>
<td>Likely STD/HIV</td>
<td>No</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; NR = not reported; STD = sexually transmitted disease; BBV = blood-borne virus; IDU = injecting drug use; HCV = hepatitis C virus; HBV = hepatitis B virus; HAV = hepatitis A virus; HIV = human immunodeficiency virus; MSM = men who have sex with men; SVR = sustained virological response.

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).

** The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below, or dried blood spots or oral fluid samples were used).

*** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Innogenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).

** History of IDU, body piercing/tattooing in unsanitary conditions, transfusion recipients before 1987, needlestick injury, hemodialysis patients, those born to mothers with documented HCV infection, individuals who reported ever having been told that they were infected with HCV yet lacked supporting documentation.
<table>
<thead>
<tr>
<th>First author, year of publication</th>
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<th>Pre-screening selection criteria</th>
<th>Media activities</th>
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<th>Follow-up of HCV-infected individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monnet, E, 2000 (90)</td>
<td>1997-1998</td>
<td>Patient of GP clinics, health centres, occupational physicians, prison health service, public laboratories</td>
<td>GP clinics, health 1 year centre, occupational physicians, prison health service, public laboratories</td>
<td>None</td>
<td>Yes, no previous positive HCV serology, and at least having one risk factor: transfusion before 1991, (ex-)IDU, (ex-)snorting cocaine, tattoo, HCV diagnosis in living environment</td>
<td>Scr. uptake: 82.9% (782/948)</td>
<td>Prevalence: 4.0% (31/782; 95% CI: 2.8-5.6)</td>
<td>Multivariable regr. analysis: - Age 30+ - Drug use</td>
<td>70.9% (22/31) attended the hepatologist for HCV RNA testing. Of those who tested HCV RNA positive, 10 had elevated ALT of which 8 had a biopsy. Based on the results, 5 were indicated for treatment (no results reported).</td>
<td></td>
</tr>
<tr>
<td>Anderson, EM, 2009 (91)</td>
<td>2003-2004</td>
<td>GP patients aged 30-54 yrs</td>
<td>GP clinics (intervention clinic and comparison clinic)</td>
<td>6 months</td>
<td>No; in intervention practice all individuals aged 30-54 yrs who attended non-urgent appointments were offered HCV screening. In comparison practice, no intervention was carried out.</td>
<td>Scr. uptake: Intervention clinic: 27.8% (117/421) Comparison clinic: not applicable</td>
<td>Prevalence: Intervention clinic: 12.8% (15/117; 95% CI: 7.9-20.0) Comparison clinic: No individuals were tested during study period. **</td>
<td>Multivariable regr. analysis: - History of IDU</td>
<td>HCV RNA positive patients (n=11) were referred to a specialist and all attended ≥1 appointment. Four years later, 8 were lost to follow-up, 2 started treatment, and 1 achieved an SVR.</td>
<td></td>
</tr>
<tr>
<td>Pauti, M-D, 2008 (52)</td>
<td>2007</td>
<td>People with poor access to health care, mostly migrants</td>
<td>Health care and advice centers of Médecins du Monde **</td>
<td>4 years</td>
<td>No</td>
<td>Scr. uptake: NR</td>
<td>Prevalence: 5.9% (70/1196; 95% CI: 4.7-7.3) **</td>
<td>Listed risk factors: - North and Middle Africa - Sub-Saharan Africa - Eastern Europe</td>
<td>The objective of the project was to offer full access to treatment, but actual results are not reported.</td>
<td></td>
</tr>
</tbody>
</table>

Table 2b. Integrated screening programs at general practitioner (GP) clinics
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Location</th>
<th>Setting</th>
<th>Age</th>
<th>Duration</th>
<th>Screening Reason</th>
<th>intercepted HCV</th>
<th>Previous HCV</th>
<th>Scr. uptake</th>
<th>Prevalence</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uddin, G.</td>
<td>2010</td>
<td>UK</td>
<td>GP clinic and at community centers</td>
<td>18-70 yrs</td>
<td>NR</td>
<td>NR</td>
<td>Yes, immigrants from the Indian sub-continent (India, Bangladesh or Pakistan)</td>
<td>No</td>
<td>Not applicable</td>
<td>0% (0/171; 95% CI: 0-2.19) **</td>
<td>NR for newly identified</td>
</tr>
<tr>
<td>Kallman, JB</td>
<td>2010</td>
<td>USA</td>
<td>Community centers</td>
<td>18-70 yrs</td>
<td>NR</td>
<td>NR</td>
<td>Yes, Vietnamese</td>
<td>NR</td>
<td>Univariable reg. analysis: Elevated AST</td>
<td>1.2% (3/245; 95% CI: 0.4-3.5) at GP clinic **</td>
<td>NR</td>
</tr>
<tr>
<td>Ouzan, D.</td>
<td>2003</td>
<td>France</td>
<td>GP clinic</td>
<td>18-70 yrs</td>
<td>1 month</td>
<td>None</td>
<td>Yes: unknown HCV serology status, and at least one risk factor: blood transfusion before 1991, injecting or nasal DU, incarceration. Previously diagnosed HCV positives that visited the GP in the screening period were also followed-up.</td>
<td>No</td>
<td>Not applicable</td>
<td>3.9% (9/233; 95% CI: 2.0-7.02)</td>
<td>NR</td>
</tr>
<tr>
<td>Josset, V.</td>
<td>1997</td>
<td>France</td>
<td>GP clinic</td>
<td>18-70 yrs</td>
<td>10 days</td>
<td>None</td>
<td>Yes, no previous HCV serology performed, and at least one of the traditional risk factors present</td>
<td>No</td>
<td>Not applicable</td>
<td>72.7% (355/4883)</td>
<td>NR</td>
</tr>
<tr>
<td>Pradat, P.</td>
<td>1997</td>
<td>France</td>
<td>GP clinic</td>
<td>18-69 yrs</td>
<td>6 months</td>
<td>None</td>
<td>Listed risk factors: - History of IDU - Transfusion &lt;1990 - Other risk factors</td>
<td>No</td>
<td>Not applicable</td>
<td>0.4% (30/6876; 95% CI: 0.3-0.6) ***</td>
<td>NR</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td>First author, year of publication</td>
<td>Calendar year of data collection</td>
<td>Population</td>
<td>Country and HCV prevalence according to CDC (1)</td>
<td>Setting of screening</td>
<td>Duration of screening program</td>
<td>Pre-screening selection</td>
<td>Media activities</td>
<td>Screening uptake and anti-HCV prevalence (95% CI)</td>
<td>Risk profile of identified HCV cases / Risk factors associated with HCV</td>
<td>Follow-up of HCV-infected individuals</td>
<td></td>
</tr>
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<td>----------------------------------</td>
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<td></td>
</tr>
<tr>
<td>Altman, C, 1999 (95)</td>
<td>1997</td>
<td>GP patients</td>
<td>France (1.1%): Val-de-Marne and Hauts-de-Seine</td>
<td>GP clinics</td>
<td>2 weeks</td>
<td>None</td>
<td>No</td>
<td>Scr. uptake: NR</td>
<td>Outcomes: RNA rate: NR</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Helsper, CW, 2010 (96)</td>
<td>2007-2008</td>
<td>GP patients</td>
<td>Netherlands (1.1%): Amersfoort and Apeldoorn</td>
<td>GP clinics in intervention region with primary care practice support, and GP clinics in control region without practice support</td>
<td>4 months</td>
<td>None</td>
<td>Yes, individual risk estimation by GP</td>
<td>Scr. uptake: NR</td>
<td>Data not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sahajian, F, 2000-2001 (97)</td>
<td>2000-2001</td>
<td>GP, private practitioners, and specialist patients</td>
<td>France (1.1%): Lyon area</td>
<td>GP clinics Intervention: A campaign including training aimed at GPs was designed to improve screening practices. The campaign also reached the public. Data were compared to the 12-months period preceding the campaign.</td>
<td>12 months</td>
<td>None</td>
<td>Yes, history of IDU, blood products before 1991, or elevated serum transaminase levels</td>
<td>Scr. uptake: NR</td>
<td>Outcomes: RNA rate: NR, Start treatment: NR, SVR: NR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *NR* indicates not reported.
HCV screening programs

Note: CI = confidence interval; NR = not reported; IDU = injecting drug use; HCV = hepatitis C virus; HBV = hepatitis B virus; HIV = human immunodeficiency virus; ALT = alanine aminotransferase; AST = aspartate aminotransferase; SVR = sustained virological response

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).

** The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below, or dried blood spots or oral fluid samples were used).

*** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).

a These programs combined a nonintegrated screening approach with integrated screening at the GP clinic (see Table 2b). Here only results of the nonintegrated screening are presented.

b Médecins du Monde (‘Doctors of the World’) is an international humanitarian organization providing medical care to vulnerable populations.

c Transfusion before 1991, history of drug use, history of gastroscopy, contact with HCV infected person (spouse or other family member, occupational exposure, active or former imprisonment, history of invasive procedures (catheterism, fluid aspiration/cytology, biopsy), history of colonoscopy, history of surgery.
<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Population and HCV prevalence according to CDC (1)</th>
<th>Setting of screening</th>
<th>Duration of screening program</th>
<th>Other tests</th>
<th>Prescreening selection</th>
<th>Media activities</th>
<th>Screening uptake and anti-HCV prevalence (95% CI)</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
<th>Follow-up of HCV-infected individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groom, H, 2008 (99)</td>
<td>2000 - 2001 Veterans</td>
<td>USA (1.9%): Minneapolis Veterans Affairs Medical Center</td>
<td>2 years None</td>
<td>Yes, only those with a risk factor were screened (risk factors not specified)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>Prevalence: 5.5% (681/12485; 95% CI: 5.1 - 5.9) *</td>
<td>In total, 520/681 were HCV RNA positive of which 430 referred to a specialist, of which 88.8% (382/430) attended an appointment. Of those, 32.5% (124/382) received treatment which was successful in 37.0% (46/124) (SVR).</td>
<td>Outcomes: RNA rate: 78.4% (520/681) Start treatment: 32.5% (124/382) SVR: 37.1% (46/124)</td>
</tr>
<tr>
<td>Mallette, C, 1998 - 2004 Veterans 2008 (100)</td>
<td>1998 - 2004 Providence</td>
<td>USA (1.9%): Providence General patients presenting to VA facilities</td>
<td>5 years and 8 months None</td>
<td>Yes, only those with a risk factor were screened a</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>Prevalence: 7.3% (412/5646; 95% CI: 6.6 - 8.0); without already known positives: 260/5646 = 4.6% (95%CI=4.1 - 5.2%) ***</td>
<td>Of the newly diagnosed, 46.9% (122/260) had chronic HCV, of which 46.7% (57/122) were treatment eligible. Of those, 31.6% (18/57) received treatment and 33.3% (6/18) reached an SVR.</td>
<td>Outcomes: RNA rate: 46.9% (122/260) Start treatment: 14.8% (18/122) SVR: 33.3% (6/18)</td>
</tr>
<tr>
<td>Cheung, RC, 2006 (101)</td>
<td>2000 - 2001 Veterans</td>
<td>USA (1.9%): Palo Alto VA medical center</td>
<td>12 months None</td>
<td>Yes, if not previously tested, and if one or more risk factors were reported b</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>Prevalence: 5.0% (536/10751; 95% CI: 4.6 - 5.4) ***</td>
<td>In total, 362/536 patients were evaluated of which 84.8% (307/362) had chronic HCV. Of those, 18.6% (57/307) were treatment eligible of whom 24.6% (14/57) completed treatment with long-term follow-up, and 35.7% (5/14) achieved SVR.</td>
<td>Outcomes: RNA rate: 84.8% (307/362) Start treatment: NR SVR: 35.7% (5/14)</td>
</tr>
<tr>
<td>Rifa, M, 2000-2001 Veterans USA (1.9%): Virginia</td>
<td>Rural VA Medical Centre</td>
<td>Yes, only non-IDU substance NR using veterans who were admitted to a substance use residential and rehabilitation treatment program were tested</td>
<td>Sor. uptake: 99.4% (338/340)</td>
<td>Prevalence: 23.1% CHCV (78/338; 95% CI: 18.9-27.9)</td>
<td>Univariate regres. analysis: - Cocaine snorting - History of IDU</td>
<td>NR</td>
<td>Scr. uptake: 99.4% (338/340)</td>
<td>Prevalence: 23.1% CHCV (78/338; 95% CI: 18.9-27.9)</td>
<td>Univariate regres. analysis: - Cocaine snorting - History of IDU</td>
<td>In total, 48.7% (38/78) of the patients remained abstinent for 6 months and 30 were indicated for treatment and received treatment. In 46.7% (14/30) treatment was successful (SVR).</td>
</tr>
<tr>
<td>Zuniga, IA, 2001-2003 Veterans USA (1.9%): Suffolk County, Long Island</td>
<td>Primary care outpatient departments of the Northport VA Medical Center (suburban VA hospital)</td>
<td>Yes, only those with a risk factor were screened c</td>
<td>Sor. uptake: 41.9% (2263/5400)</td>
<td>Prevalence: 4.6% CHCV (103/2263; 95% CI: 3.8-5.5)</td>
<td>Multivariable regres. analysis: - Age 40-54 yrs - Black race - History of IDU - Service during Vietnam era - Blood transfusion prior to 1992 - Tattoo or repeated body piercing - History of abnormal LFTs</td>
<td>NR</td>
<td>Scr. uptake: 41.9% (2263/5400)</td>
<td>Prevalence: 4.6% CHCV (103/2263; 95% CI: 3.8-5.5)</td>
<td>Multivariable regres. analysis: - Age 40-54 yrs - Black race - History of IDU - Service during Vietnam era - Blood transfusion prior to 1992 - Tattoo or repeated body piercing - History of abnormal LFTs</td>
<td>Outcomes: RNA rate: n/a Start treatment: NR SVR: NR</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; NR = not reported; VA = veterans affairs; IDU = injecting drug use; HCV = hepatitis C virus; CHCV = chronic hepatitis C virus; HIV = human immunodeficiency virus; LFT = liver function test; SVR = sustained virological response; PCR = polymerase chain reaction

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).

** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Imgenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).

*** HCV-antibody prevalence is considered valid, but reflecting chronic HCV infection (data were collected after 1993, and reactive HCV antibody test results were confirmed by PCR).

* Vietnam-era veteran, transfusion of blood or blood products before 1992, history of IDU, history of snorting cocaine, history of 5 or more drinks a day for 10 or more years in your lifetime, history of multiple (10 or more) sexual partners in your lifetime, a man who has sex with men, history of exposure to blood on skin or mucous membranes, required chronic hemodialysis, have a tattoo or body piercing, have had a positive test for HIV or hepatitis B, have been told that you have unexplained liver disease.

** Vietnam-era veteran, transfusion of blood products prior to 1992, history of IDU, blood exposure in or through skin or mucous membranes, multiple sexual partners (past or present), hemodialysis, tattoo or repeated body piercing, intranasal cocaine use (past or present), unexplained liver disease, having been told that he/she has abnormal liver function tests, interepate alcohol use (more than seven alcoholic beverages per week).
<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Population</th>
<th>Country and HCV prevalence according to CDC (1)</th>
<th>Setting of screening</th>
<th>Duration of screening program</th>
<th>Other tests</th>
<th>Prescreening selection</th>
<th>Media activities</th>
<th>Screening uptake and anti-HCV prevalence (95% CI)</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
<th>Follow-up of HCV-infected individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexanian, AA, 2009 (abstract)</td>
<td>NR</td>
<td>Pregnant women</td>
<td>UK (1.1%): London</td>
<td>Antenatal clinic</td>
<td>8 years, Hospital records search</td>
<td>HBV, HIV</td>
<td>No</td>
<td>NR</td>
<td></td>
<td>Prevalence: 0.4 (115/31081; 95% CI: 0.3-0.4) *</td>
<td>In total, 73.0% (84/115) of patients had chronic HCV, of whom 55.9% (47/84) were lost to follow-up, 10.7% (9/84) deferred treatment, 4.8% (4/84) were on treatment, and 17.9% (15/84) completed treatment. Of these 15, 12 achieved SVR, 1 relapsed, and two failed to respond.</td>
</tr>
<tr>
<td>Abusheikha, N, 1999 (105)</td>
<td>1996-1998</td>
<td>Couples receiving fertility treatment</td>
<td>UK (1.1%): Cambridge</td>
<td>Bourn Hall clinic, 3 years infertility hospital</td>
<td>HIV, HBV</td>
<td>No</td>
<td>NR</td>
<td></td>
<td>Prevalence: 0.5% (9/1658; 95% CI: 0.3-1.0) **</td>
<td>All patients were counseled by senior medical staff.</td>
<td></td>
</tr>
<tr>
<td>Leikin, EL, 1994 (106)</td>
<td>1991-1992</td>
<td>Pregnant women who are at risk for perinatal complications</td>
<td>USA (1.9%): Valhalla</td>
<td>Hospital (obstetric)</td>
<td>19,5 months ALT</td>
<td>No</td>
<td>NR</td>
<td></td>
<td>Prevalence: 4.6% (78/1700; 95% CI: 3.7-5.7) *</td>
<td>In total, 96.2% (75/78) of the patients returned for follow-up. No further details reported.</td>
<td></td>
</tr>
<tr>
<td>Ward, C, 2000 (107)</td>
<td>1997-1999</td>
<td>Pregnant women</td>
<td>UK (1.1%): London</td>
<td>Antenatal clinic</td>
<td>18 months HBV</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td>Univariate regr. analysis: - History of IDU - HCV-infected partner - Tattoo - Partner IDU</td>
<td>In total, 71.1% (27/38) had chronic HCV, and 82.6% (19/23) attended for further investigations.</td>
<td></td>
</tr>
</tbody>
</table>

*95% CI: 0.3-0.4
**95% CI: 0.3-1.0
***95% CI: 3.7-5.7
****95% CI: 0.6-1.1
<table>
<thead>
<tr>
<th>Country</th>
<th>Year(s)</th>
<th>Setting</th>
<th>Prevalence (HCV-antibody)</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil, Central</td>
<td>2004-2005</td>
<td>Antenatal clinics</td>
<td>NR</td>
<td>Pregnant women</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.2% CHCV (43/28561; 95% CI:0.1-0.2%)</td>
<td>Multivariable regression analysis: Older age, &gt;3 pregnancies (no data on risk factors collected)</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; NR = not reported; IDU = injecting drug use; HCV = hepatitis C virus; CHCV = chronic hepatitis C virus; HIV = human immunodeficiency virus; HBV = hepatitis B virus; ALT = alanine aminotransferase; SVR = sustained virological response; PCR = polymerase chain reaction

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).

** The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below, or dried blood spots or oral fluid samples were used).

*** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Imugenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).

**** HCV-antibody prevalence is considered valid, but reflecting chronic HCV infection (data were collected after 1993, and reactive HCV antibody test results were confirmed by PCR).
Table 2e. Integrated screening programs in psychiatric clinics

<table>
<thead>
<tr>
<th>Program characteristics</th>
<th>Program outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First author, year of publication</strong></td>
<td><strong>Screening uptake and anti-HCV prevalence (95% CI)</strong></td>
</tr>
<tr>
<td>Freudeneich, O, 2007 (109)</td>
<td>Scr. uptake: 100% (98/98)</td>
</tr>
<tr>
<td></td>
<td>Prevalence: 8.2% (8/98); 95% CI: 4.2-15.3 (incl the one known before)</td>
</tr>
<tr>
<td></td>
<td>Unit A: No; Unit B: Yes (IDU, exposure to contaminated blood products)</td>
</tr>
<tr>
<td></td>
<td>Scr. uptake: Unit A: 79.8% (95/119) Unit B: 90.0% (38/40)</td>
</tr>
<tr>
<td></td>
<td>Prevalence: Unit A: 3.2% (3/95; 95% CI: 1.1-8.9); Unit B: 41.7% (15/36; 95% CI: 27.1-57.8)</td>
</tr>
<tr>
<td>Gunewardane, R, 2010 (110)</td>
<td>Scr. uptake: 20.5% (20/99)</td>
</tr>
<tr>
<td></td>
<td>Prevalence: 19.7% (14/71; 95% CI: 12.1-30.4)</td>
</tr>
<tr>
<td></td>
<td>All patients were referred to a specialist; after two years, none had started treatment. One patient became unstable psychologically after the discovery of his infection.</td>
</tr>
<tr>
<td>Lacey, C, 2007 (111)</td>
<td>Scr. uptake: Yes; Patients admitted with psychotic or affective disorders, &gt;18 yrs, inpatient stay &gt;2 days, and did not have known HCV infection</td>
</tr>
<tr>
<td></td>
<td>Prevalence: 50.0% (4/8)</td>
</tr>
<tr>
<td></td>
<td>Start treatment: NR</td>
</tr>
<tr>
<td></td>
<td>SVR: NR</td>
</tr>
<tr>
<td></td>
<td>All positive patients received post-test counseling and were referred to a specialist (no results reported).</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; NR = not reported; IDU = injecting drug use; HCV = hepatitis C virus; SVR = sustained virological response

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).

** The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below (see ***) , or dried blood spots or oral fluid samples were used).

*** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chiron, Novartis (RIBA), Innogenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomBlot HCV IgG 2.0).
### Table 2f. Integrated screening programs integrated in other clinics or services

<table>
<thead>
<tr>
<th>First author, year of publication</th>
<th>Calendar year of data collection</th>
<th>Program characteristics</th>
<th>Program outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>First author, year of publication</strong></td>
<td><strong>Population</strong></td>
<td><strong>Country and HCV prevalence according to CDC (1)</strong></td>
<td><strong>Setting of screening</strong></td>
</tr>
<tr>
<td><strong>Capron, D, 1999 (112)</strong></td>
<td>Patients &gt; 14 y admitted to an emergency unit</td>
<td>France (1.1%): Picardy</td>
<td>Emergency health unit</td>
</tr>
<tr>
<td><strong>Alswaidi, FM, 2010 (113)</strong></td>
<td>Individuals from the general population who wish to get married</td>
<td>Saudi Arabia (0.9%): throughout the country</td>
<td>Mandatory premarital national screening program</td>
</tr>
<tr>
<td><strong>Dubois, F, NR 1994 (114)</strong></td>
<td>Healthy subject of routine medical check up</td>
<td>France (1.1%): Western part</td>
<td>Routine medical check up</td>
</tr>
<tr>
<td><strong>Roberts, J, 2010 (115) (abstract)</strong></td>
<td>MSM attending service and who were tested for HIV</td>
<td>UK (1.1%): Brighton</td>
<td>Local outreach services for HIV point of care testing</td>
</tr>
</tbody>
</table>

*Note: CDC - Center for Disease Control and Prevention, HBV - Hepatitis B virus, HIV - Human Immunodeficiency Virus, HAV - Hepatitis A virus, HDV - Hepatitis D virus, MSW - Men who have sex with men, ALT - Alanine transaminase, HCV - Hepatitis C virus, SCR - Screening, SVR - Sustained virological response.*
Table 2f cont’d

<table>
<thead>
<tr>
<th>Program characteristics</th>
<th>Program outcomes</th>
<th>Risk profile of identified HCV cases / Risk factors associated with HCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>First author, year of publication</td>
<td>Calendar year of data collection</td>
<td>Population</td>
</tr>
<tr>
<td>Country and HCV prevalence according to CDC (1)</td>
<td>Setting of screening</td>
<td>Duration of screening program</td>
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<tr>
<td>Cohen, DE, 2006 (116)</td>
<td>MSM USA (1.9%); Greater Boston area</td>
<td>Community care facility</td>
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<tr>
<td>Campello, C, 2002 (117)</td>
<td>Individuals ages 17-67 years, currently employed in the processing and/or trade of food and beverages Italy (1.1%): Lombardia region, administrative boundary of the former USL 22 (local health unit)</td>
<td>Periodic compulsory health check for the surveillance and control of diseases transmitted by the fecal-oral route as well as tuberculosis</td>
</tr>
<tr>
<td>Tafuri, S, 2010 (118)</td>
<td>Asylum seekers without signs or symptoms in recent or remote past Italy (1.1%): Bari Asylum seeker center</td>
<td>HBV, HIV, syphilis</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval; NR = not reported; IDU = injecting drug use; HCV = hepatitis C virus; CHCV = chronic hepatitis C virus; HBV = hepatitis B virus; HAV = hepatitis A virus; HDV = hepatitis delta virus; HIV = human immunodeficiency virus; ALT = alanine aminotransferase; MSM = men who have sex with men; SVR = sustained virological response; PCR = polymerase chain reaction

* HCV-antibody prevalence is considered suboptimal (data were collected before 1994 when sensitivity/specificity of tests was not optimal, or reactive HCV-antibody test results were not confirmed by immunoblot).
** The reliability of the reported HCV-antibody prevalence is undecided (data were collected after 1993, but the diagnostic tests are unspecified, or other than described below, or dried blood spots or oral fluid samples were used).
*** HCV-antibody prevalence is considered valid; data were collected after 1993, and reactive HCV-antibody test results were confirmed by second or higher generation immunoblot assays from Ortho, Chron, Novartis (LiaTek), Immogenetics (LiaTek), Pasteur (DECISCAN HCV), Genelabs Diagnostics (HCV BLOT), or Mikrogen (recomblot HCV IgG 2.0).
**** HCV-antibody prevalence is considered valid, but reflecting chronic HCV infection (data were collected after 1993, and reactive HCV antibody test results were confirmed by PCR).