Hepatitis C virus infection: Spread and impact in the Netherlands
Urbanus, A.T.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
CHAPTER 6
GENERAL DISCUSSION
Chapter 6

General discussion

The work presented in this thesis provides insight into the hepatitis C virus (HCV) epidemiology in the Netherlands, including new high risk groups. Through the outcomes of this thesis improved screening strategies could be set up specifically aimed at risk groups, including those hidden among the general population, in order to prevent secondary transmission and a high burden of disease in the future. The studies in this thesis are performed within the framework of the Amsterdam Academic Collaborative on Public Health GGD Amsterdam/AMC (Sarphati initiative, see introduction), and provide an optimal structure for more evidence-based service practices in prevention and control programmes for infectious diseases.

1. Changing HCV epidemiology in the Netherlands

Based on extrapolation of a selected group, HCV prevalence in the Netherlands was estimated at 0.1-0.4% in 1997, which corresponds to 15,000-65,000 HCV infected people among the general population (1). In 2012, using data from surveys including the studies described in chapter 3.1.3 and 4.1 of this thesis, prevalence was estimated to be slightly lower (0.22%, min. 0.07-max. 0.37) corresponding to 28,100 (min. 9,600- max. 48,000) HCV infected people in the Netherlands (2).

In this recent estimation first-generation migrants account for most infections in the risk groups, followed by injecting drug users (IDU), individuals at low risk of HCV infection and HIV-infected men who have sex with men (MSM). Individuals at low risk of HCV infection are a combined group of those who not belong to the IDU, MSM, migrants, or haemophilic group (e.g. receiving a single blood transfusion). This large group of about 7100 HCV-infected individuals could also be defined as the hidden population and is hard to reach.

When in 1989 HCV was discovered as a blood-borne disease it mainly affected the people who received contaminated blood donations and products, and IDU who shared injecting equipment. After donor testing became available in 1991, receiving donor blood or products was not a risk factor anymore for new HCV infections in high-income countries and IDU accounted for most new infections in high-income countries (3). However, due to comprehensive harm reduction programs and the declined popularity of injecting, the incidence of HCV infection among IDU has started to decline in the Netherlands since the late 1990s (4). In addition, a new risk group of HIV-infected MSM emerged and incidence increased substantially from 2000-2002 onwards (5). Hence, HIV-infected MSM now account for most new HCV infections in the Netherlands (6). Moreover, increasing migration flows have resulted in a larger number of migrants infected with HCV in the Netherlands.

1.1 Risk groups: MSM

Around the year 2000 the first HCV cases among HIV-positive MSM were reported (7-9) and HCV infection subsequently appeared on the increase (10-15). We found an alarming HCV prevalence of 17% among HIV-infected MSM in a biannual cross-sectional survey conducted in 2007/2008 at a
large STI outpatient clinic in Amsterdam (see chapter 3.1.2). Multiple MSM-specific HCV clusters of genotypes 1a and 4d were revealed through phylogenetic analysis and HCV infection was independently associated with high (sexual) risk behaviour (see chapter 3.1.2). Molecular typing of HCV isolates confirmed the presence of an MSM-specific European transmission network (11;14-16). Difficult-to-treat HCV genotypes 1 and 4 were primarily detected in about 83% of European MSM with acute HCV. In several high income countries, particularly in large cities in Western Europe, a high HCV prevalence among HIV positive MSM was also found (5;7;9;10;13;15;17).

The reported high sexual risk behaviour, in combination with the MSM-specific clustering and the absence of traditional risk factors such as IDU, suggests that HCV among HIV-infected MSM is transmitted sexually. Identification of recent clusters and the present findings of recent acute HCV infection in already established HCV clusters (see chapter 3.1.3) demonstrate the ongoing transmission of HCV. As multiple strains of different HCV genotypes circulate among HIV-positive MSM, this suggests a behavioural change in MSM rather than the evolution of the virus into a more virulent variant (5).

Unfortunately, how and when HCV is introduced is still not fully understood. Although HIV is not an absolute prerequisite for sexual transmission in MSM (18), nearly all HCV infected MSM were found to be co-infected with HIV. HIV transmission through the mucosa is more efficient than HCV transmission, and since HIV was circulating more among MSM than HCV, it is more likely that HIV is acquired before HCV (19). Also, HIV infection increases the viral infectiousness through higher HCV viral loads in blood and semen (20). Furthermore HIV-positives may be more susceptible due to the HIV-induced mucosal damage in the gut which is especially (but not exclusively) associated with HIV disease progression (21;22).

Although molecular clock analysis confirms that HCV infection was most likely introduced into the MSM population through the IDU scene in the early 1980s, its actual spread only started after 1996 following the introduction of cART and the subsequent rise in sexual risk behaviour and STI in the late 1990s (5;16). This, however, cannot explain why there is no evidence for permucosal transmission of HCV in the 1980s, a period in which STI and sexual risk-taking were highly prevalent among MSM (5). After 2002 the HCV incidence substantially increased (5;23;24). The larger pool of sexually active HIV-infected MSM might partly explain how HCV could spread exponentially.

The HCV prevalence among HIV-negatives remains low and stable in Amsterdam as described in chapter 3.1.2 and 3.1.3. However, because HIV is not a prerequisite for acquiring HCV, we cannot yet exclude HIV-negative MSM as a risk group for HCV. Monitoring of HCV prevalence and incidence in both HIV-positives and HIV-negatives remains important, in order to intervene in this group in a timely manner and halt the epidemic.

**1.2 Risk groups: Migrants**

Another risk group are first-generation migrants from intermediate- to high-prevalence countries, living in the Netherlands (see chapter 3.2). HCV prevalence and the related burden of disease in high-income countries is likely to have increased over the past decades as a result of the growing number of people immigrating from low- and middle-income countries (25-28). In the Netherlands,
being a low-prevalence country, we hypothesized that migrants living in the Netherlands had a higher HCV prevalence than the general Dutch population, but a lower prevalence than that of the country of origin. Indeed, our studies (see chapter 3.2) support this hypothesis. However, the two large migrant groups in the Netherlands (first-generation Turkish and Moroccan) were at relatively low risk for HCV with prevalence levels comparable to the Dutch population. In all large second-generation migrant groups, prevalence is comparable to that found among the general Dutch population. Phylogenetic analysis showed that HCV sequences obtained from first-generation non-European, non-Western migrants had a high degree of phylogenetic clustering with HCV strains circulating in their country of origin. This suggests that the participants acquired their infection in their country of origin, possibly through parenteral transmission via unsterile medical equipment or through contaminated blood transfusions (see chapter 3.2). The fact that second-generation migrants as well as the native Dutch population are unaffected by these typical HCV migrant strains suggests that no (or only sporadic) HCV transmission occurs once first-generation migrants live in low-endemic countries. This finding was confirmed in a recent study among migrants originating from the country with the highest prevalence worldwide due to its schistosomiasis treatment campaigns in the past; Egypt, (29).

1.3 Risk groups: IDU
The HCV prevalence among IDU ranges from 60-80% worldwide and is therefore one of the groups at highest risk (30). Whether this risk group is a major problem, however, depends on the rate of drug injection in the general population (6;30). In many countries, most HCV infections are found among this group. In Amsterdam, the HCV prevalence peaked in the 1980s, when approximately 80% of IDU tested positive for HCV antibodies (see chapter 4.2). With HIV emerging, and with the introduction of harm reduction programs, risk behaviour declined in combination with the HIV and HCV incidence (4;31-33). Also, the Amsterdam IDU population decreased in the early 1990s due to limited numbers of new injectors, mortality, and selective emigration (34). HCV incidence dropped from 27.5/100 person years in the late 1980s to 2/100 person years in 2005 and has remained low. However due to the high incidence in the past and therefore the current high prevalence in IDU, the burden of disease of HCV is estimated to increase until 2025 (see chapter 4.2).

1.3 Other risk groups
Some potential risk groups described elsewhere (35) were not confirmed in our study, such as people with multiple tattoos and/or piercings (see chapter 3.3). It has been suggested that people with multiple tattoos and/or piercings are at increased risk for HBV and HCV. However, the association between HCV and tattoos has been inconsistent, (36-40), and mainly observed among HCV high-risk populations (36). People with multiple tattoos and piercings living in the Netherlands, where strict hygiene guidelines for tattoo and piercing practices have been implemented, appeared not to be at increased risk for HCV (see chapter 3.3). The low HCV prevalence found in our study could be due to the fact that HCV is not circulating among tattoo parlours in the Netherlands, and that hygiene guidelines have been implemented in Amsterdam since the late 1980s and subsequently nationwide. Based on our study, we recommend that low- and high-endemic countries implement
hygienic guidelines for tattoo and piercing shops, including permanent make-up salons, to decrease the potential risk of HBV and HCV transmission. Other risk groups such as haemodialysis patients and recipients of blood and blood products before 1991 were not included in this thesis. Data reports that 46.6% of treated haemodialysis patients in 2009 were HCV-infected, however, the group that received treatment before 1992 and is still alive today was very small (n=1120) (2). The HCV prevalence of people who received blood products in the Netherlands incidentally before 1992 and is still alive is estimated to be very low (1).

2. Public health response: screening the undiagnosed population

Recently the FDA approved a new and more effective treatment (see introduction) for mono-infected patients. The first reports on this newer treatment for HIV-positives are promising. Other new treatments are continuously under development and within a few years improved treatment options are anticipated, providing higher rates of sustained virological response (SVR) occurring within a shorter time period and with reduced side effects. Because of these anticipated improvements in the coming years, identification of undiagnosed infections has become very important.

As described above, the HCV-infected population presumably at low risk for HCV accounts for a large proportion of those infected in the Netherlands (2). A few years ago different (pilot) screening programs were set up aimed at the general population to identify HCV-infected individuals who do not consider themselves at risk and/or are not aware of their risk (e.g. hidden population). One program was aimed at the general population in the Netherlands and evaluated in two pilot regions. In one of these two regions GPs were offered plenary courses about HCV, whereas the information campaign for the public was nationwide. This information campaign used several media tools, including distribution of specially designed posters and brochures in public areas where individuals at potential risk were expected to congregate (41). In the area where plenary courses for GPs were conducted, only three extra HCV cases (3/172) were found compared with the same period in the previous year (0/57). Extrapolating these numbers nationwide resulted in an extra 146 identified HCV cases. Although these results were disappointingly low, the campaign that included additional support for primary care was moderately cost-effective, whereas the campaign aimed at the general public without support for primary care was not (41). However, it should be noted that the national information campaign was hindered by the outbreak of H1N1 in 2009. Another screening program aimed at the general population used an internet-based risk assessment and anonymous screening procedure, and identified 15 cases (3.6% of all tested for HCV), in two pilot regions, all belonging to hard to reach populations (42). Although no cost-effectiveness analysis was performed, internet-mediated testing, which can be set up at low cost, seems a promising future measure. Importantly, both campaigns ran only for a limited period of time or in restricted areas of the Netherlands, limiting estimations on the impact of such programs at a national level.

In our systematic review on characteristics and outcomes of HCV screening programs (see chapter 2.1) we conclude that screening programs up till now only identified a small proportion of the estimated population of HCV-infected individuals worldwide. The programs that were included in
the review were very heterogenic in their organization, recruitment and screening procedures 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 is more effective than another in attracting or motivating individuals for screening, or in attracting those at higher risk for HCV. Although a high number of screening programmes have been initiated over the past 20 years for different risk groups and in different settings, it is clear that an optimal HCV screening program targeting the general population has not yet been established. However, our review indicates that some strategies might increase the efficiency of screening; low-prevalence countries should consider a pre-screening selection tool such as liver function tests or risk assessments (e.g. questionnaires which identifies risk factors). Furthermore screening programs should be theory-based and provide tools such as risk assessments to increase the efficiency of screening. Importantly, to be able to assess screening program effectiveness and to improve comparability of screening programs and outcomes, programs should be evaluated using a control region or comparison group for evaluation purposes. Finally, programs should systematically report program characteristics, including the type of diagnostic tests that were used and clinical outcomes.

2.1 Screening the undiagnosed MSM
Following our preliminary analysis on HCV infections among MSM, the STI clinic in Amsterdam introduced HCV antibody screening in order to trace undiagnosed HCV infections (43;44). Nowadays all HIV-infected MSM with an unknown or negative HCV status and all MSM who opt out of HIV testing are routinely offered HCV antibody testing at the Amsterdam STI clinic. Following the reports on HCV outbreaks, HIV specialists started to routinely test MSM for HCV infection when showing elevated ALT levels. The comparison of the time between first HCV diagnosis at the HIV treatment centre and our STI clinic, indicates that the introduction of routine anti-HCV screening at our STI-clinic increased earlier diagnosis of HCV infection in MSM, especially in those newly diagnosed with HIV (45), and therefore is useful.
In contrast to HCV screening of the general population, HCV screening of groups with an elevated risk, like HIV-positive MSM and IDU, is cost-effective (46;47). Preferably an STI clinic should test HIV-positive MSM for both anti-HCV and HCV RNA instead of only anti-HCV in order to detect acute infections, especially because HCV antibody development might be delayed in HIV infected individuals (48). Unfortunately HCV RNA tests are too costly to be used for screening purposes. ALT/ALAT or antigen/core testing could be used to optimize screening in public health and primary care settings (49). Early diagnosis can provide for early treatment with improved outcome, which can also prevent secondary transmission. Interestingly, mathematical modelling suggest that HCV treatment could also be used as a prevention measure to stop further transmission (50;51), such as has been recently recommended for HIV treatment (52).

2.2 Screening the undiagnosed migrants
Because non-Western migrants were at higher risk in their country of origin and often immigrate to the Netherlands undiagnosed, several independent (pilot) screenings programs were set up in
the last decade, most of which were regional. These screening programs were targeted at various specific migrant groups.

One of the largest outreach screening programs rolled out for migrants in the Netherlands is aimed at Chinese people and initially set up for HBV screening (53). In this program Chinese are reached through their own people and in their own language in four of the largest cities in the Netherlands. HCV screening was added to the program in Amsterdam and Utrecht, the two most recently screened cities. Only 2/613 (0.3%) individuals in Utrecht and 1/733 (0.1%) of those who participated in Amsterdam were identified with HCV infection, which is in line with our hypothesis (see chapter 3.2) of a lower HCV prevalence among migrants than in the country of origin. Other outreach screening programs have been aimed at Turkish migrants (HBV and HCV screening) (54) in Arnhem, and Egyptian migrants (HBV and HCV screening) (29) in the Amsterdam region. In addition, outreach screening programs of still unpublished studies targeted first-generation migrants in Groningen (only HBV screening), Vietnamese migrants in the region of Alkmaar and Purmerend (HBV screening), and Asian people, including people from Iraq, Iran and Afghanistan, in Arnhem (HBV and HCV screening) (55). Unfortunately, all programmes were initiated and performed in isolation. Because each migrant group needs its own approach adapted to language barriers and cultural background (56), it is very costly and time consuming to set up such screening programs, especially when not integrated into already existing health care facilities. These (pilot) programs have and will provide valuable information that can be used for future screening programmes. It would be efficient to implement a universal screening program in the Netherlands and offer first-generation non-Western migrants originating from intermediate- to high-endemic countries HCV screening. It is important to take all lessons learned and consider the use of information materials already developed for the separate migrant groups in the previous independent screenings. To increase efficiency, a screening policy should be implemented that combines HBV and HCV screening.

Pregnant women are already routinely screened for several infectious diseases including HBV, therefore we hypothesized that adding HCV screening in settings where screening for other issues already exists might be cost-effective (see chapter 5.1). We explored our hypothesis for all pregnant women, as well as for first-generation non-Western women only, since they are at a higher risk (see chapter 3.2). We found that adding HCV screening is not cost-effective for all pregnant women, probably due to the low prevalence in this group. However, adding HCV screening for first-generation non-Western women shows a modest cost-effectiveness outcome. In the best case analysis, when all parameters are optimal, a cost-effective outcome was found for both groups. Since first-generation non-Western migrants comprise a large proportion of the undiagnosed HCV-infected population in the Netherlands, this risk group should be targeted for screening (2). This, together with the high screening uptake in the existing routine screening should argue for the implementation of HCV screening for first-generation non-Western women. Additionally, improved treatment outcomes with shorter treatment duration are expected in the coming years, further enhancing cost-effectiveness.

In general, more cost-effectiveness analyses are needed, in particular to discern which migrant groups to screen, since studies indicate that not all first-generation non-Western migrants are at increased risk (see chapter 3.2 and (29)).
3. Public health response: preventive measures

Besides screening the already infected, preventive measures should also be introduced or continued. The tattoo guidelines implemented in the late 1980s in the Netherlands and the low HCV prevalence rate among this group suggest that preventive measures are effective. Also, high uptake of harm reduction programmes combining opiate substitution therapy and needle exchange programs for IDU are considered effective as a result of a declining HCV incidence in recent years (57-59). Especially medium- to high-endemic countries should consider implementing or improving uptake of guidelines for the tattoo and permanent makeup industry, as well as comprehensive harm reduction programs for IDU. Targeted prevention measures for migrants might not be needed in addition to general prevention advice for identified HCV cases, since migrants are mainly infected in their country of origin (see chapter 3.2). However, (frequent) travelling between the country of residence and the country of origin might increase the risk of acquiring HCV, especially when undergoing medical procedures in the country of origin. This preventive information to travellers might be useful.

Because HIV-positive MSM now account for most new HCV infections in the Netherlands and IDU for most new infections worldwide, preventive measures should be taken in order to prevent new HCV infections through these groups.

3.1 Preventive measures for MSM

Since the early reports on HCV infection among HIV-infected MSM in the Netherlands, an information campaign about HCV infection was developed and organised by Schorer (a former NGO providing education and information about health and wellbeing of homosexual men and women) among the MSM group in order to raise awareness. In addition, HCV antibody testing was implemented at the STI clinic in Amsterdam as a routine screening for HIV-positive MSM and MSM who opt out of HIV testing and is now also implemented in Rotterdam. At the same time HIV specialists used ALT/ALAT results to test for HCV RNA in MSM in order to identify HCV infected men at an early stage.

Recently we found that MSM are at a high risk for reinfection (60). Therefore prevention measures should focus on raising awareness for HCV infection in both co-infected MSM and in HIV-positive MSM without HCV. Only providing treatment for these (re)infected MSM is not enough and reaching this hard core group of MSM and their undiagnosed sexual partners will require a multidisciplinary approach. Prevention measures should also be aimed at HIV-negative MSM. With effective prevention messaging, both HIV and HCV transmission can be prevented.

In our most recent study among MSM (see chapter 3.1.3), we provided some evidence that the HCV epidemic, at least in HCV naïve MSM, might be levelling off. Increased awareness, reduced risk behaviour, earlier testing and treatment, or perhaps saturation within the highest-risk group could explain this finding. Continuation of the already taken measures and focussing on new measures, such as informing the already infected about transmission routes and measures to prevent secondary transmission, could make the incidence and prevalence decline.
3.2 Preventive measures for IDU
Prevention of HCV but also HIV among IDU started in the 1980s when comprehensive harm
reduction programs were introduced in the Netherlands. However, the burden of disease of HCV
is expected to increase by 36% over the next decade (see chapter 4.2), because many IDU were
infected 20-30 years ago. Fortunately, we (see chapter 4.2) and others (61) have demonstrated that
treatment can reduce the burden of disease in IDU in the future, especially when new treatment
options are also introduced for this group. Due to the complex lifestyle of IDU, they are hard to reach
for treatment, since treatment can cause severe side effects which make it hard to comply. However,
treatment using a multidisciplinary approach to reach and motivate the IDU to comply has proven
successful (see chapter 4.1 and (62)). HIV-negative IDU can reach the same rate of sustained
virological response (SVR) as people who do not inject drugs (see chapter 4.1). Furthermore, the
rate of reinfection is low in countries with widespread harm reduction programs (63). Therefore, all
HCV-infected IDU should be considered for treatment in order to decrease the burden of disease in
the future, especially since Martin et al. showed that treatment can prevent secondary transmission
and decrease the prevalence in IDU populations (51)

4. Future directions
4.1 Screening
For those who were infected 20-30 years ago, the HCV infection is starting to manifest itself in
a severe way. Although treatment is still possible at this stage, it has more favourable outcomes
when it is started earlier following infection. Because of the relatively long incubation period
and incidence pattern, the burden of disease will rise in the next decade. Identifying persons with
HCV infection has become even more important with the recent availability of more effective
therapy (64). Because the (pilot) screening programmes performed in the Netherlands so far were
separate initiatives (except the national information campaign in 2009 (41)), often conducted
regionally and all running for a limited period of time, screening programs have not yet been
highly successful in identifying persons with HCV. Since GPs reach a substantial proportion of
the general population already and are in the best position to do so, they should play a key role in
identifying the undiagnosed population (65). Also, additional screening might be needed for some
risk groups such as migrants. Using the internet to reach hidden groups seems promising but needs
further research. Implementing a risk assessment before screening in any screening program with
an expected low prevalence rate seems feasible, as demonstrated in several studies.
In the United States it has recently been recommended that all people born between 1945 and 1965
should be offered a one-time screening without prior risk assessment (66), since HCV prevalence
in this group is four times greater than in younger people, and identifying this group through a high
risk profile has been unsuccessful so far. More importantly, this screening strategy is estimated
to be cost-effective assuming an uptake of 15% (67). This approach might be considered for the
Netherlands. However the HCV prevalence in the Netherlands is lower than in the US (0.22%
versus 1.8%).
Although a relatively low uptake of 15% was assumed in the cost-effectiveness model in the USA,
those who participate may not be representative for the total population of baby boomers. It may
be that those at lower risk for HCV (i.e., the worried-well) could be more likely to respond. From the population-based screening administration for cervical cancer in the Netherlands, it is known that those who respond more often are at lower risk than those who do not respond, and those with lower socioeconomic status (SES) and migrants are less likely to participate (68). Thus, although it may be promising, the effectiveness of such an intervention needs to be demonstrated in practice. Nevertheless, because older age is often associated with HCV infection, it should be examined whether it is feasible and cost-effective to implement such a birth cohort screening in the Netherlands. Also, as the Netherlands has a lower HCV prevalence compared with the US, the feasibility and cost-effectiveness of risk assessment should be explored when applying such a screening to the Dutch context. A birth cohort screening would also comprise non-Western migrants and special attention should be paid to language and cultural barriers to increase screening uptake in this group. Also cost-effectiveness analyses are needed to find out which specific migrant groups to screen for HCV infection, as not every migrant group is at increased risk for HCV infection (see chapter 3.2).

4.2 Prevention
With a new era of treatment coming up more people at risk to transmit the virus should receive treatment in order to prevent further transmission. For marginalized groups, such as IDU, treatment should be organized and delivered with attention to the needs of these groups in order to increase uptake and adherence. Preventive measures should be continued for IDU and HIV-infected MSM, and implemented for the MSM who are at risk of reinfection. Preventive measures for migrants are not proposed for the Netherlands, since migrants are mainly infected in their country of origin. Therefore preventive measures should be taken in the country of origin instead (e.g. improving hygiene in hospitals to prevent nosocomial transmission). In addition, migrants should be aware that (frequent) travelling might increase the risk for HCV infection, especially when undergoing medical procedures in the country of origin.

4.3 Research
Although much research on HCV has been conducted in recent years, public health research is still needed. We still have not found the optimal screening strategy and therefore more research is required, especially to evaluate the usefulness of combining several approaches (e.g. screening by GP in combination with outreach screening by public health services or internet). Research of screening programs must meet certain conditions as described in chapter 2.1 and cost-effectiveness studies should be part of the evaluation of programs. HIV-infected MSM are the group at highest risk for HCV infection in the Netherlands, but risk groups may change over time just as has been observed in the past decade. We must remain alert for new risk groups in the future. Especially HIV-negative MSM should be closely monitored as well as (young) IDU and non-injecting DU, as the popularity of injecting might increase again in groups who are not yet visible or reached by harm reduction programs, or for groups whose needs are not met through the programs. To gain more insight into which migrant groups are at increased risk for HCV infection more (cost-effective) research is needed. Also cheaper and easier tests should be further developed and/or implemented in order to identify
those with an acute infection. When identified in the early stages of acute infection, treatment has more favourable outcomes and secondary transmission could be prevented. Finally, current knowledge on the proportion of undiagnosed individuals in the Netherlands is lacking. This information is needed to gain more insight into the people groups that need to be reached for screening and can indicate the design and size of the program to be implemented (e.g. only aimed at targeted risk groups or at (a part of) the general population).

5. Concluding remarks
The epidemiology of HCV has changed over time. In the Netherlands most new infections are acquired in HIV-infected MSM and many infections can today be found among first-generation migrants originating from endemic countries, while in the past most new infections were identified in IDUs and haemophiliac patients. Furthermore, individuals who were at risk once in the remote past (e.g. receiving blood or blood products once) and are therefore at low risk also account for a large part of HCV-infected individuals. Risk groups should be targeted for screening. However, in the Netherlands data on the diagnosed population per risk group are scarce and research is needed to gain more insight into the number of undiagnosed people in order to set up more efficient and targeted screening programmes. Recent screening programs aimed at the general population have proven to be suboptimal, partly because of the regional and temporal context. Separate screening programs aimed at different migrant groups should congregate and a universal screening program for both HCV and HBV targeting, in particular, non-Western migrants should be considered. However, more (cost-effective) research is needed to gain more insight into which specific migrant groups to screen.

In order to improve screening efficiency a combination of a risk assessment tool and the use of internet should be considered. Also, control regions and the report of used methods, including type of diagnostic test, should be systematically reported in order to evaluate the screening programs. In addition, GPs should be more aware of HCV infection and could play a key role in HCV screening. In order to prevent an increase in HCV prevalence, monitoring of groups at possible risk for HCV such as the HIV-negative MSM and young drug users should be continued. Also, preventive measures should be continued in groups where new infections occur such as among the HIV-infected MSM. Finally, routine screening methods in groups at high risk for acute infection should use appropriate tests.

The outcomes of this thesis show that the Amsterdam Academic Collaborative on Public Health GGD Amsterdam/AMC (Sarphati initiative) is an efficient tool for translating public health questions into research, and scientific results into practice and policy. Whereas issues were often approached from one viewpoint in the past, the multidisciplinary character of this Collaborative has established a solid framework linking science, policy and practice.
References


(40) Nishioka SA, Gyorkos TW, Joseph L, Collet JP, Maclean JD. Tattooing and risk for transfusion-transmitted diseases: the role of the type, number and design of the tattoos, and the conditions in which they were performed. Epidemiol Infect 2002 February;128(1):63-71.


