A matched comparison study of hepatitis C treatment outcomes in the prison and community setting, and an analysis of the impact of prison release or transfer during therapy

Aspinall, E. J.; Mitchell, W.; Schofield, J.; Cairns, A.; Lamond, S.; Bramley, P.; Peters, S. E.; Valerio, H.; Tomnay, J.; Goldberg, D. J.; Mills, P. R.; Barclay, S. T.; Fraser, A.; Dillon, J. F.; Martin, N. K.; Hickman, M.; Hutchinson, S. J.

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Impact of release or transfer on Hepatitis C treatment outcomes among prisoners

Authors:

Aspinall EJ [1, 2], Mitchell W [3], Schofield J [4], Cairns A [5], Lamond S [5], Bramley P [3], Peters SE [6], Valerio H [1, 2], Tomnay J [7], Goldberg DJ [2, 1], Mills P [6], Barclay S [8], Fraser A [9], Dillon J [10], & Hutchinson SJ [1, 2]

Author affiliations:

1. School of Health and Life Sciences, Glasgow Caledonian University, UK
2. Health Protection Scotland, NHS National Services Scotland, Glasgow, UK
3. NHS Forth Valley Viral Hepatitis Service, UK
4. Public Health Protection Unit, NHS Greater Glasgow & Clyde, UK
5. Western General Hospital, Edinburgh, UK
6. Gartnavel General Hospital, Glasgow, UK
7. Crosshouse Hospital, Kilmarnock, UK
8. Glasgow Royal Infirmary, NHS Greater Glasgow & Clyde, UK
9. Aberdeen Royal Infirmary, NHS Grampian, UK
10. Ninewells Hospital and Medical School, NHS Tayside, UK

Corresponding author:
Dr Esther J Aspinall
NHS National Services Scotland
5 Cadogan Street
Glasgow
G2 6QU

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Background & Aims

Prisoners are a priority group for Hepatitis C (HCV) therapy. However, there is concern that release or transfer during therapy may have a negative impact on treatment completion and Sustained Virological Response (SVR).

Methods

A national database was used to compare treatment outcomes between prison treatment initiates and a matched community sample. Additional data was collected from three Health Boards, to investigate the impact of prison release or transfer on treatment outcomes. Treatment naïve patients aged ≥20 years, infected with genotype 1/2/3/4, and treated between 2009 -12, were eligible for inclusion.

Results

291 prison treatment initiates were matched with 1,137 community initiates: SVRs were 61% (95% CI 55% to 66%) and 63% (95% CI 60% to 66%) respectively, using intention to treat (ITT) analysis. Odds of achieving a SVR were not significantly associated with prisoner status ($p = 0.33$).

Using ITT analysis, SVRs were 74% (95% CI 65% to 81%), 59% (95% CI 42% to 75%) and 45% (95% CI 29% to 62%) among those incarcerated for the full treatment duration, transferred during treatment, or released during treatment respectively. Odds of achieving a SVR were significantly associated with release ($p<0.01$), but not transfer ($p=0.18$).

Conclusions

Prison-based HCV treatment achieves similar outcomes to community-based treatment. However, transfer or release during therapy can lead to poorer treatment outcomes, and may waste valuable healthcare resources. Treatment disruption should be avoided whenever possible, using anticipatory planning and medical holds where appropriate.

1. Introduction

Chronic hepatitis C is an important cause of liver-related morbidity and mortality worldwide [Lavanchy, 2009]. People who inject drugs (PWID) are over-represented within the judicial system, with global prevalence of HCV antibody among the prison population estimated to be 26%, and 64% among prisoners who report a history of injecting drug use [Larney 2013]. With more than 10 million people incarcerated at any one time [Walmsley 2013], this equates to over 2 million HCV antibody positive detainees worldwide [Larney 2013]. Prisoners with HCV pose a considerable risk of onward transmission, through the use of non-sterile injecting equipment (e.g. for drug injecting or tattooing) in a setting where needle exchange is limited or absent [Hunt, 2009]. For this reason, the European Association for the Study of Liver Disease (EASL) recommendations were recently updated to include incarcerated individuals as a priority group for Hepatitis C therapy, regardless of stage of liver disease [EASL 2015].

In Scotland, approximately 1,500 prisoners (19% of the total prisoner population) have evidence of current or previous infection with HCV [Taylor 2013], and it is estimated that over 70% of HCV antibody positive PWID have been incarcerated at some point [UWS 2012]. Since the publication of the Hepatitis C Action Plan, which set targets to increase both the number and proportion of treatment initiations taking place in the prison setting [Scottish Government 2008], annual HCV treatment uptake has increased from 468 initiations in 2007/08, to more than 1,000 in 2013/14, and the proportion of initiations in the prison setting has increased from 4% to 14% (translating to a seven-fold increase) over the same time period [UK HCV Report 2014].

The drive to increase treatment uptake in Scottish prisons has led to the development of dedicated prison-based HCV services, as well as a willingness to commence treatment in short-term prisoners who are likely to be released or transferred prior to their treatment completion date. While an American study has reported on treatment outcomes among prisoners incarcerated for the full treatment duration [Rice 2012], no such investigation has hitherto examined treatment among prisoners whose release might pre-date treatment completion, or assessed the impact of inter-prison transfer. In the context of the potential benefits of the all-oral directly-acting antivirals (DAAs) [Kohli 2014] and the EASL recommendations on priority access for prisoners, the aim of this study was to understand the potential facilitators and barriers to treating HCV among prisoners: by comparing treatment outcomes among prisoners and a matched population in the community using a national clinical database, and by further investigating factors (including prison release or transfer during therapy) that might be associated with adverse treatment outcomes, among a subset of prisoners at three of Scotland's largest Health Boards. Such information will inform future clinical guidance on treatment strategies for prison inmates.

2. Patients and methods

Hepatitis C treatment and care

In Scotland, healthcare is delivered by fourteen geographically-defined Health Boards as part of a national universal service. Health Boards are free to design their Hepatitis C services according to local population needs, although outcomes are monitored nationally through the Scottish Government Blood Borne Virus Framework and the HCV Outcome and Quality Indicators (Scottish Government 2011, HIS 2012). The majority of community-based treatment for HCV in Scotland is delivered by Specialist Nurse Practitioners (SNPs) overseen by Consultant Physicians, and is based in hospital clinics. Prison-based delivery of HCV treatment is similar, and is usually delivered by a dedicated prison-liaison team. The team develop close working relationships with prison staff, allowing early information sharing about potential prisoner release or transfer. In the three Health Boards where additional data was collected, prisoners who need to continue treatment after release or transfer are referred (in writing and by telephone) to the receiving community- or prison-based service. Addictions support, including opiate replacement therapy (ORT), is available to both prison and community patients, although prisoners may be prioritised within some Health Board areas for ORT treatment slots.

Data collection

In Part 1 of the study, the Scottish HCV Clinical Database was used to compare treatment outcomes between prison and community treatment initiates. This database holds information on all patients treated for HCV at NHS clinics in Scotland (accounting for >95% of total treatment initiations). Data held includes a unique database number, date of birth, sex, ethnicity, cirrhosis status, HIV and Hepatitis B status, HCV genotype, type of HCV treatment received, Health Board where treatment commenced, prisoner status at treatment initiation, and treatment outcome. Of note, prisoner status for the full duration of treatment is not available in the Clinical Database. Health Boards with comprehensive data on both prison and community treatment initiations were included in the study i.e. NHS Forth Valley, Lothian, Greater Glasgow & Clyde, Tayside, Grampian, Fife, Lanarkshire, Borders, and Highlands.

In Part 2, additional data were collected from medical records of prison treatment initiates, to investigate factors associated with treatment completion and treatment outcome among this population. The additional data were collected from three Scottish Health Boards with the largest caseload of prison-based patients during the period 2009- 12 (NHS Forth Valley, NHS Greater Glasgow and Clyde, and NHS Lothian), and included year of birth, sex, cirrhosis status, injecting drug use, HCV genotype, type of HCV treatment, length of prison sentence, date of any prison release or prison transfer, and any support provided after release.

Inclusion criteria

Patients were eligible for inclusion in Part 1 of the study if they were treatment-naive adults aged ≥ 20 years infected with genotype 1, 2, 3, or 4, treated with PEG/RBV and/or a DAA regimen, and were initiated on treatment after 1st June 2009 (when prisoner status started to be reliably reported on the clinical database) and before 1st December 2011 (genotypes 1 and 4) and 1st June 2012 (genotypes 2 and 3), to allow adequate time for ascertainment of treatment outcomes.

Patients were eligible for inclusion in Part 2 of the study if they met all of the inclusion criteria applying to Part 1 of the study, *and* had initiated treatment in prison in one of the three selected Health Board areas. Eligible patients were identified from either Health Board records or the Scottish Clinical Database.

Definitions of Treatment Outcomes

The following definitions were used:

Treatment completion: reached the end of planned course of therapy, regardless of whether attended for SVR check

SVR: undetectable HCV RNA at 24 weeks post treatment completion

Relapse: HCV RNA negative at treatment completion, but subsequently HCV RNA positive at 12-24 weeks post treatment completion.

No response: HCV RNA detectable at end of treatment

Data analysis

Part 1:

Patient characteristics (including age at treatment initiation, sex, HCV genotype, ethnicity, cirrhosis status, year of treatment) and treatment outcomes were compared between patients who initiated HCV treatment in prison, and patients who initiated treatment in the community (for both the total community sample, and the matched community sample).

Variable ratio matching was used to match each individual who initiated treatment in prison with up to five individuals who initiated treatment in the community. Matching was based on age at treatment commencement, sex, treatment type, cirrhosis status at or within 30 days of treatment commencement, and HCV genotype. Matching on categorical variables (sex, treatment type, cirrhosis status, and HCV genotype) was exact, and matching on continuous variables (age at treatment commencement) was optimal, using mahalanobis distance scores [Soledad 2003, Stuart 2010]. Variable ratio matching may lead to differences in characteristics between the prison and the matched community sample, which can be adjusted for in further analysis.

The odds of achieving a SVR among prison treatment initiates compared to community initiates were calculated for all patients and by genotype (GT 1/4 and GT 2/3), using conditional logistic regression to account for the matched study design. Two different populations were used for analysis: the intention to treat population (ITT), (i.e. all patients who received at least one dose of treatment, regardless of whether they were followed-up) and the per protocol population (i.e. all patients where the outcome of treatment was known). The latter analysis was conducted to adjust for the higher proportion of patients (among both prison and community initiates) for whom outcome data were not available in the later years of the study. An unmatched logistic regression investigating factors associated with SVR, including age at treatment commencement, sex, treatment type, cirrhosis status at or within 30 days of treatment commencement, HCV genotype, and prisoner status, was conducted as a sensitivity analysis.

Part 2:

The characteristics of patients initiated on therapy in prison (including age at treatment commencement, sex, HCV genotype, cirrhosis status, type of treatment, year of treatment commencement, released during treatment and transferred during treatment) were compared between those who did and did not complete treatment, and who did or did not achieve a SVR. Analysis was conducted using both the ITT and the per protocol population. Because some prisoners were both transferred and released from prison during treatment (and release was considered to be more important in determining treatment outcome), a hierarchical variable was created as follows: i) neither released nor transferred, ii) transferred but not released, and iii) released, whether transferred or not.

Logistic regression was used to investigate factors associated with completing treatment, and achieving a SVR, for all patients, and by genotype (GT 1/4 and GT 2/3). Factors significant at $p<0.1$ level on univariate analysis were included in the multivariate model. An additional variable 'Intention to complete treatment in prison' is presented in the univariate analysis, but was not included in the multivariate analysis, due to a high degree of correlation with the 'Released during treatment' variable.

Ethical approval

A submission was made to the South East Scotland Research Ethics Committee (application 14/WM/1045), who advised that ethical submission was not required for this study.

Results

Part 1: Matched analysis of Scottish clinical database

There were 2,657 individuals treated for HCV between 2009 and 2012 and who met the study inclusion criteria: 291 initiated treatment in prison, and 2,366 initiated treatment in

the community. After matching the 291 prison initiates, there were 1,137 community 'controls' (Table 1).

Among 291 patients who initiated treatment in prison, 261 (90%) were male, 163 (56%) were aged 20-39 years, 8 (3%) were cirrhotic at treatment commencement, and 115 (40%) were treated for GT 1/4. Among the matched sample of 1,137 patients who initiated treatment in the community, 995 (88%) were male, 583 (51%) were aged 20-39 years, 40 (4%) were cirrhotic at treatment commencement, and 461 (40%) were treated for GT 1/4. More than 95% of initiates in both treatment settings were treated with PEG/RBV alone.

Treatment outcomes

SVRs were 61% (95% confidence interval [CI] 55% to 66%) among patients initiated on treatment in prison, compared to 63% (95% CI 60% to 66%) among patients initiated on treatment in the community. The odds of achieving a SVR were not significantly associated with prisoner status at treatment initiation, whether calculated using conditional logistic regression (odds ratio [OR] 0.87, 95% confidence interval [CI] 0.67, 1.15; p = 0.33), or unmatched logistic regression (OR 0.90, 95% CI 0.70, 1.17; p = 0.45) (Appendix 1). The same findings were observed when stratified by genotype (Table 2 and Appendix 1).

Part 2: Additional data collection from selected Health Board prison clinics

Two hundred patients commenced HCV therapy in prison during 2009- 12 in the three Health Board areas selected for additional data collection (Table 3). Of 200 patients, 173 (87%) were male, 131 (66%) were aged 20-39 years, 7 (4%) were cirrhotic at the time of treatment commencement, and 77 (39%) were treated for GT 1/4. The characteristics of this subsample of 200 patients were comparable to the total population of prison treatment initiates in Part 1 of the study, except for a slightly higher proportion of younger prisoners in the subsample (56% were aged 20-39 years in the total prisoner population, compared to 66% in the subsample).

The majority of prisoners (66%) were serving prison sentences of less than four years. Forty-eight prisoners (24%) had injected drugs within the year prior to HCV treatment, and 98 (49%) were using opiate replacement therapy (ORT). Twenty-five prisoners (13%) were treated during 2009, 74 (37%) during 2010, 62 (31%) during 2011, and 36 (18%) during 2012 (lower treatment numbers during 2012 due to a partial year of data).

Treatment intentions

Of 200 prisoners initiating treatment, 128 (64%) intended to complete treatment while incarcerated, 38 (19%) intended to complete treatment in the community, and 34 (17%) had unknown treatment intentions. Of the 128 patients intending to complete treatment in prison, 43 (34%) had GT1/4 infection and 85 (66%) had GT2/3 infection. Ninety-eight (77%) remained in prison for the full treatment duration, 22 (17%) were transferred, and 8 (6%)

were released during treatment. Of the 38 patients intending to complete treatment in the community, 22 (58%) had GT1/4 infection and 16 (42%) had GT2/3.

Prison transfer and release

Among the 200 prisoners, 125 (63%) remained in the same prison for the full treatment duration, 37 (19%) were transferred but not released, and 38 (19%) were released during treatment. Among the 38 individuals released during treatment, this was a planned event for 28 (74%), and not planned or not known for 10 (26%) prisoners.

SVRs were 74% (95% CI 65% to 81%) for those not released or transferred, 59% (95% CI 42% to 75%) for those transferred, and 45% (95% CI 29% to 62%) for those released during treatment. Using per protocol analysis (excluding individuals where the SVR outcome was not known), SVRs were 84% (95% CI 75% to 90%) among those not released or transferred, 81% (95% CI 62% to 94%) among those transferred, and 74% (95% CI 52% to 90%) among those released during treatment (Appendix 2).

Factors associated with treatment completion

Of the 200 prisoners, 147 (74%, 95% CI 67% to 80%) completed a full course of treatment and 35 (18%) did not. Treatment completion status was not known for 18 (9%) individuals: for the purposes of logistic regression it was assumed that these individuals had not completed treatment. In the univariate analysis including all genotypes, treatment completion was significantly associated with genotype, cirrhosis status, intention to complete treatment while incarcerated, and transfer or release from prison during treatment. In the multivariate analysis including all genotypes, treatment completion was significantly associated with cirrhosis status (OR 0.16, 95% CI 0.03, 0.81, p=0.03), being transferred during treatment (OR 0.41, 95% CI 0.17, 1.00, p =0.05), or being released during treatment (OR 0.10, 95% CI 0.04, 0.24, p <0.01).

Factors associated with achieving a SVR

Of the 200 prisoners, 131 (66%, 95% CI 59% to 72%) achieved a SVR, and 27 (14%) did not. SVR status was unknown for 42 individuals (21%): for the purposes of logistic regression it was assumed that these individuals did not achieve a SVR. In the univariate analysis, achieving a SVR was significantly associated with genotype, intention to complete treatment in prison, prison transfer, or release from prison during treatment. In the multivariate analysis, achieving a SVR was significantly associated with GT 2/3 (OR 2.1, 95% CI 1.12, 3.90, p =0.02) and being released from prison during treatment (OR 0.33, 95% CI 0.15, 0.71, p < 0.01), but not with transfer during treatment (OR 0.58, 95% CI 0.26, 1.27, p=0.18).

Discussion

The use of prison-based treatment programmes for chronic HCV has become an increasingly popular strategy in recent years, with the publication of a number of prioritisation

statements, treatment targets, and clinical guidelines relating to prison healthcare [EASL 2015, Scottish Government 2008, Ministerial Advisory Committee 2008, AASLD 2015]. Treatment during incarceration theoretically offers an ideal setting for the monitoring of therapy, as well as the potential to achieve a population impact on HCV transmission given that the majority of HCV-infected PWID are known to the prison system [UWS 2012]. The results of this study suggest that HCV treatment in the prison setting is both feasible and effective. Of nearly 1,500 individuals treated for HCV in Scotland between 2009 and 2012, treatment outcomes were similar between individuals commenced on therapy in prison (61% [95% CI 55% to 66%]), and a matched sample in the community (63% [95% CI 60% to 66%]), although some important factors (such as ethnicity and HIV status) could not be matched for in this analysis. This finding is similar to a previous comparison study by Rice et al, despite a higher prevalence of liver disease among their prison treatment population [Rice 2012].

Although prison-based treatment can be an effective strategy, it is evident that this approach is not without its challenges. In this study, nearly 40% of prisoners were either released or transferred during HCV therapy, and outcomes were generally poorer for these individuals: SVRs were 59% (95% CI 42% to 75%) for those transferred, and 45% (95% CI 29% to 62%) for those released, compared to 74% (95% CI 65% to 81%) for those who remained incarcerated for the full treatment duration. This pattern was still evident (but less marked) using per protocol analysis, suggesting that only part of this difference is due to loss to follow-up or failure to attend for a final SVR check.

Poorer treatment outcomes among transferred prisoners raise a number of issues for both healthcare providers and custodial staff. In contrast to prisoners who are released, transferred prisoners remain under the care of the prison system, and any unplanned interruption in therapy is by definition the responsibility of the system, rather than the patient. Incomplete treatment leads to an increased risk of treatment failure and antiviral resistance [Poveda 2014], and may waste scarce healthcare resources, particularly in the era of expensive DAA therapies. It also raises a wider issue about the fairness of health care in the prison setting, which should be equivalent to community provision in that country, 'without discrimination on the grounds of [a prisoner's] legal situation' [United Nations 1990].

What can be done to improve treatment outcomes for transferred prisoners? In the first instance, transfer during treatment should be prevented wherever possible, using a policy of medical hold (whereby prisoners receiving a course of medical treatment are prohibited from moving prison, except for security reasons) if necessary. The use of medical holds may be inconsistently applied (a recent report in England suggested that only 48% of prisons were using medical holds for HCV treatment), and may in some cases disadvantage a prisoner who wishes to transfer for family reasons or training opportunities [Humphreys 2013]. However, their use may be sensible in situations where the prisoner has made an

informed decision to forgo any potential benefits of transfer while treatment is being completed. For those situations where transfer is obligatory, early information sharing between custodial and healthcare staff will be particularly important. Healthcare services may also wish to agree a set of minimum requirements for prison transfers (e.g. written referral letter, results of any investigations, provision of a minimum quantity of medication by the referring service, and maximum waiting times for an appointment with the receiving team).

Poorer treatment outcomes in this study among those released during therapy are also concerning: prison release was associated with a 90% and 67% reduced odds of completing treatment and achieving a SVR respectively ($p<0.01$). It may therefore be prudent in some cases to delay treatment until after a prisoner's release, although such decisions need to be made on a case by case basis, taking into account the duration of incarceration, willingness to commence treatment, and the existence of any support structures after release. There is currently a lack of published evidence in this area, but a number of factors are likely to contribute to treatment completion once released; including strong family support, stable housing and employment, and links to other healthcare providers in the community. Patient motivation (both to complete treatment and moderate the use of alcohol) through provision of test results that demonstrate improvements in liver function (e.g. fibroscan results or liver function tests) [Vergniol 2009] might also be helpful.

In a small number of cases, release during treatment may be an unexpected event; for example, if a prisoner is released directly from a court hearing. In this study, only 6% of patients who intended to complete treatment while incarcerated were actually released prior to completion, suggesting that healthcare practitioners have sufficient knowledge of prisoner trajectory when treatment is started. However, it may still be of value to agree contingency plans for prisoners where incarceration for the full treatment period cannot be guaranteed. This could be as simple as seeking the prisoner's permission for HCV services to contact their GP, a close family member, or Addictions Services in the event that they are released and lost to follow-up. Developing close links with Addictions Services may be particularly useful, given the need to return for repeat prescriptions for those on OST programmes.

For those prisoners who remained incarcerated for the full duration of therapy, outcomes may actually be better than for community initiates: SVRs were 61% (95% CI 47% to 74%) for GT1/4, and 75% (66% to 83%) for GT2/3, compared to 56% (95% CI 51% to 60%) for GT1/4, and 68% (64% to 71%) for GT2/3 respectively (although the two groups are not directly comparable). Any such benefit may be related to improved treatment compliance and completion within the prison regime, which is of particular relevance to the new era of DAA therapies given the increased risk of viral resistance compared to standard PEG/RBV regimes [Poveda 2014]. However, there are ongoing operational issues with prison-based treatment; for example, optimum timing of therapy, access to symptom management (e.g.

paracetamol for fever), and timely clinical review may all be compromised due to logistical and security concerns. Poor quality diet may also contribute to the experience of treatment side-effects, and impact on treatment completion and outcomes, although supplementary nutrition is sometimes made available by prison authorities [Spaulding, 2013].

The use of new DAA regimens, which achieve SVR rates in excess of 90% across all genotypes, should improve outcomes of patients treated whilst incarcerated. On-treatment response is uniform amongst compliant patients, reducing the possibility of onward transmission by those who continue to inject whilst incarcerated. Additionally, shorter treatment durations of two-three months will allow greater opportunities for completing a full treatment course during incarceration. However, given that nearly half of all prison sentences in Scotland are less than six months in duration [Scottish Government 2012], testing of and assessment for Hepatitis C treatment needs to be offered very early in the course of incarceration if the full treatment course is to be completed prior to release.

Finally, the risk of reinfection among prisoners following treatment has been shown to be considerable [Marco 2013]. For those still incarcerated, the greatest risk lies in the continuation of injecting practice in a setting where needle exchange provision may be limited or absent [Hunt 2009]. For those released, there may be a return to old behaviours and injecting partners, many of whom will not have had the benefit of priority access to HCV treatment while in prison. Treatment guidelines suggest that the risk of reinfection should be fully explained, and that patients should be counselled on ways to minimize this risk [EASL 2015, AASLD 2015], although there is currently a lack of evidence around how this counselling can be effectively delivered.

This study has demonstrated that prison-based treatment is feasible, and achieves comparable outcomes overall to community-based treatment. However, treatment in the prison setting is not without its challenges, particularly with respect to transfer and release from prison while therapy is ongoing. Poor treatment completion rates and treatment outcomes may lead to a considerable waste of healthcare resources, particularly in the era of expensive DAA therapies. Treatment disruption due to release or transfer needs to be prevented wherever possible, while ensuring that contingency measures to maximise treatment success are in place where transfer or release is unavoidable.

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Table 1: Characteristics of 2,657 patients (291 prison-based and 2,366 community-based) commencing Hepatitis C treatment 2009-2012, by incarceration status

	Commenced treatment in prison (n= 291)	Commenced treatment in community	
		All (n= 2,366)	Matched sample (n=1,137)*
Age**			
20-29 years	27 (9.3%)	133 (5.6%)	70 (6.2%)
30-39 years	136 (46.7%)	773 (32.7%)	513 (45.1%)
40-49 years	108 (37.1%)	897 (37.9%)	461 (40.6%)
> 50 years	20 (6.9%)	563 (23.8%)	93 (8.2%)
Sex			
Male	261 (89.7%)	1,714 (72.4%)	995 (87.5%)
Female	30 (10.3%)	652 (27.6%)	142 (12.5%)
Ethnicity			
White	286 (98.3%)	2,130 (90.1%)	1,017 (89.5%)
Black/Asian/Unknown	5 (1.7%)	334 (9.9%)	115 (10.1%)
Risk factor for HCV			
Injecting drug use	255 (87.6%)	1,640 (69.3%)	841 (74.0%)
Other/Unknown	36 (12.4%)	733 (30.7%)	296 (26.0%)
Major HCV genotype			
1 or 4	115 (39.5%)	872 (36.9%)	461 (40.4%)
2	16 (5.5%)	134 (5.7%)	55 (4.8%)
3	160 (55.0%)	1,360 (57.5%)	621 (54.6%)
Cirrhosis**			
Diagnosed with cirrhosis	8 (2.8%)	277 (11.7%)	40 (3.5%)
Not diagnosed with cirrhosis	283 (97.3%)	2,089 (88.3%)	1097 (96.5%)
Year treated			
2009	43 (14.8%)	325 (13.7%)	160 (14.1%)
2010	108 (37.1%)	767 (32.4%)	385 (33.9%)
2011	93 (32.0%)	781 (33.0%)	369 (32.5%)
2012	47 (16.2%)	493 (20.8%)	223 (19.6%)
Treatment outcome (all genotypes)			
SVR	176 (60.5%)	1,425 (60.2%)	715 (62.9%)
No response/Relapse	35 (12.0%)	478 (20.2%)	196 (17.2%)
Unknown	80 (27.5%)	463 (19.6%)	226 (19.9%)
Treatment outcome by genotype			
Genotypes 1 and 4	**115 (100%)**	**872 (100%)**	**461 (100%)**
SVR	56 (48.7%)	439 (50.3%)	256 (55.5%)
No response/Relapse	22 (19.1%)	275 (31.5%)	122 (26.5%)
Unknown	37 (32.2%)	158 (18.1%)	83 (18.0%)
Genotypes 2 and 3	**176 (100%)**	**1,494 (100%)**	**676 (100%)**
SVR	120 (68.2%)	986 (66.0%)	459 (67.9%)
No response/Relapse	13 (7.4%)	213 (13.6%)	74 (10.9%)
Unknown	43 (24.4%)	305 (20.4%)	143 (21.2%)

* Community-based sample were matched on age at treatment commencement, sex, treatment type, cirrhosis status at or within 30 days of treatment commencement, and HCV genotype **At treatment commencement

Table 2: Conditional logistic regression of the odds of SVR by prisoner status, among i) the intention to treat population, and ii) the population where the outcome of treatment is known

	Intention to treat population		Population where outcome of treatment is known	
	Odds ratio* (95% CI)	p value	Odds ratio * (95% CI)	p value
ALL GENOTYPES				
Community	1	-	1	-
Prison	0.87 (0.67, 1.15)	0.33	1.18 (0.76, 1.83)	0.46
GENOTYPE 1/4				
Community	1	-	1	-
Prison	0.72 (0.47, 1.09)	0.12	1.11 (0.62, 1.99)	0.73
GENOTYPE 2/3				
Community	1	-	1	-
Prison	1.02 (0.71, 1.46)	0.93	1.28 (0.66, 2.49)	0.47

*After matching on age at treatment commencement, sex, treatment type, cirrhosis status at or within 30 days of treatment commencement, and HCV genotype

Table 3: Characteristics of 200 patients commencing Hepatitis C treatment in prison in three large health board areas, 2009-2012

Patient characteristics	All patients N (%)	Completed treatment, n (row %)			Achieved SVR, n (row %)		
		Yes	No/ not known [a]	p value [c]	Yes (n= 131)	No/not known [b] (n= 69)	p value [c]
All patients	200 (100%)	147 (74%)	53 (27%)	-	131 (66%)	69 (35%)	-
Age [c]							
20-29 years	28 (14%)	21 (75%)	7 (25%)	-	21 (75%)	7 (25%)	-
30-39 years	103 (52%)	79 (77%)	24 (23%)	0.85	64 (62%)	39 (38%)	0.21
> 40 years	66 (33%)	47 (71%)	19 (29%)	0.71	45 (68%)	21 (32%)	0.51
Not known	3 (2%)	0 (0%)	3 (100%)	-	1 (33%)	2 (67%)	-
Sex							
Male	173 (87%)	126 (73%)	47 (27%)	-	113 (65%)	60 (35%)	-
Female	27 (14%)	21 (78%)	6 (22%)	0.54	18 (67%)	9 (33%)	0.89
Major HCV genotype							
1 or 4	77 (39%)	49 (64%)	28 (36%)	-	41 (53%)	36 (47%)	**-**
2 or 3	123 (62%)	98 (80%)	25 (20%)	**0.01**	90 (73%)	33 (27%)	**<0.01**
Cirrhosis [d]							
Yes	7 (4%)	3 (43%)	4 (57%)	**-**	3 (43%)	4 (57%)	-
No	193 (97%)	144 (75%)	49 (25%)	**0.08**	128 (66%)	65 (34%)	0.22
Baseline viral load							
Low	133 (67%)	101 (76%)	32 (24%)	-	91 (68%)	42 (32%)	-
High	61 (31%)	43 (70%)	18 (30%)	0.42	36 (59%)	25 (41%)	0.20
Not known	6 (3%)	3 (50%)	3 (50%)	-	4 (67%)	2 (33%)	-
Drug injecting history							
Within last one year	48 (24%)	34 (71%)	14 (29%)	-	32 (67%)	16 (33%)	-
More than one year ago	132 (66%)	103 (78%)	29 (22%)	0.32	88 (67%)	44 (33%)	1.00
Never/unknown	20 (10%)	10 (50%)	10 (50%)	-	11 (55%)	9 (45%)	-
Opiate replacement [d]							
Yes	98 (49%)	72 (74%)	26 (27%)	-	69 (70%)	29 (30%)	-
No	30 (15%)	24 (80%)	6 (20%)	0.47	22 (73%)	8 (27%)	0.76
Not known	72 (36%)	51 (71%)	21 (29%)	-	40 (56%)	32 (44%)	-
Intention to complete treatment in prison [e]							
Yes	128 (64%)	109 (85%)	19 (15%)	**-**	94 (73%)	34 (27%)	**-**
No	38 (19%)	12 (32%)	26 (68%)	**<0.01**	16 (42%)	22 (58%)	**<0.01**
Not known	34 (17%)	26 (76%)	8 (24%)	**-**	21 (62%)	13 (38%)	**-**
Prison sentence							
< 4 years	131 (66%)	96 (73%)	35 (27%)	-	84 (64%)	47 (36%)	-
≥ 4 years	42 (21%)	33 (79%)	9 (21%)	0.49	30 (71%)	12 (29%)	0.39
Not known	27 (14%)	18 (67%)	9 (33%)	-	17 (63%)	10 (37%)	-
Transferred or released during HCV treatment							
No	125 (63%)	107 (86%)	18 (14%)	-	92 (74%)	33 (26%)	-
Transferred but not released	37 (19%)	26 (70%)	11 (30%)	**0.04**	22 (59%)	15 (41%)	**0.10**
Released (+/- transfer)	38 (19%)	14 (37%)	24 (63%)	**<0.01**	17 (45%)	21 (55%)	**<0.01**
Patients with GT 1/4	77 (100%)	49 (64%)	28 (36%)	-	41 (53%)	36 (47%)	-
Released during HCV treatment							
No*	56 (72%)	42 (75%)	14 (25%)	-	34 (61%)	22 (39%)	-
Yes*	21 (27%)	7 (33%)	14 (67%)	**<0.01**	7 (33%)	14 (67%)	**0.03**
Patients with GT 2/3	123 (100%)	98 (80%)	25 (20%)	-	90 (73%)	33 (27%)	-
Released during HCV treatment							
No*	106 (86%)	91 (86%)	15 (14%)	-	80 (75%)	26 (25%)	-
Yes*	17 (14%)	7 (41%)	10 (59%)	**<0.01**	10 (59%)	7 (41%)	0.15

[a] Treatment completion status not known for 18 (9%) cases; [b] Treatment outcome not known for 40 (20%) cases; [c] p value refers to comparison between proportion 'Yes' and proportion 'No/not known'; [d] At treatment commencement; [e] 'Intention to complete treatment in prison' was not included in the multivariate model, due to correlation with 'Released during treatment'

* Variable collapsed due to cell sizes < 5

Table 4: Logistic regression of odds of treatment completion and SVR among 200 patients who commenced Hepatitis C treatment in prison, and stratified by genotype

Patient characteristics	Odds of completing treatment		Odds of achieving a SVR	
	Adjusted odds ratio	p value	Adjusted odds ratio	p value
ALL GENOTYPES				
Major HCV genotype				
1 or 4	1	-	**1**	**-**
2 or 3	1.75 (0.85, 3.58)	0.13	**2.09 (1.12. 3.90)**	**0.02**
*Cirrhosis **				
No	**1**	**-**	1	-
Yes	**0.16 (0.03, 0.81)**	**0.03**	0.31 (0.06, 1.46)	0.14
Released or transferred during treatment				
No	**1**	-	1	-
Transferred but not released	**0.41 (0.17, 1.00)**	**0.05**	0.58 (0.26, 1.27)	0.18
Released (whether or not transferred)	**0.10 (0.04, 0.24)**	**<0.01**	**0.33 (0.15, 0.71)**	**<0.01**
GENOTYPE 1/4				
*Cirrhosis **				
No	1	-	1	-
Yes	0.33 (0.19, 5.89)	0.45	0.50 (0.29, 8.71)	0.63
Released or transferred during treatment				
No	1	-	1	-
Transferred but not released	1.17 (0.30, 4.47)	0.82	0.50 (0.16, 1.59)	0.24
Released (whether or not transferred)	**0.17 (0.05, 0.54)**	**<0.01**	**0.25 (0.08, 0.78)**	**0.02**
GENOTYPE 2/3				
*Cirrhosis **				
No	1	-	1	-
Yes	0.12 (0.01, 0.97)	**0.05**	0.24 (0.04, 1.52)	0.13
Released or transferred during treatment				
No	1	-	1	-
Transferred but not released	**0.17 (0.05, 0.56)**	**<0.01**	0.66 (0.22, 1.99)	0.46
Released (whether or not transferred)	**0.06 (0.02, 0.23)**	**<0.01**	0.43 (0.14, 1.31)	0.14

*At the time of treatment commencement

Appendix 1: Unmatched adjusted logistic regression of HCV treatment outcome (Sustained Virological Response) among 2,657 patients (291 prison and 2,366 community initiates), 2009-2012

	Intention to treat population		Population where treatment outcome is known	
	Adjusted odds ratio* (95% CI)	p value	Adjusted odds ratio * (95% CI)	p value
ALL GENOTYPES				
*Age**				
20-29 years	1	-	1	-
30-39 years	1.05 (0.73, 1.51)	0.79	0.63 (0.32, 1.23)	0.18
40-49 years	0.82 (0.57, 1.18)	0.29	**0.34 (0.18, 0.66)**	**<0.01**
>50 years	**0.58 (0.40, 0.85)**	**<0.001**	**0.21 (0.11, 0.40)**	**<0.001**
Sex				
Male	1	-	1	-
Female	1.14 (0.95, 1.38)	0.16	0.88 (0.68, 1.12)	0.29
Major HCV genotype				
1 or 4	1	-	1	1
2 or 3	**1.08 (1.07, 1.11)**	**<0.001**	**1.15 (1.12, 1.18)**	**<0.001**
*Cirrhosis**				
No	1	-	1	1
Yes	**0.56 (0.43, 0.72)**	**<0.001**	**0.42 (0.31, 0.57)**	**<0.001**
Treatment type ^				
PEG/RBV	1	-	1	1
DAA +/- PEG/RBV	**3.07 (1.61, 5.86)**	**<0.01**	**3.46 (1.60, 7.51)**	**<0.01**
Treatment setting				
Community	1	-	1	-
Prison	0.90 (0.70, 1.17)	0.45	1.33 (0.89, 1.99)	0.16
GENOTYPE 1/4				
*Age**				
20-29 years	1	-	1	-
30-39 years	0.84 (0.45, 1.56)	0.58	0.41 (0.15, 1.10)	0.08
40-49 years	0.64 (0.35, 1.19)	0.16	**0.25 (0.09, 0.68)**	**<0.01**
> 50 years	**0.45 (0.24, 0.86)**	**0.02**	**0.17 (0.06, 0.47)**	**<0.01**
Sex				
Male	1	-	1	-
Female	0.94 (0.69, 1.26)	0.67	1.12 (0.79, 1.57)	0.52
*Cirrhosis**				
No	1	-	1	-
Yes	**0.37 (0.27, 0.62)**	**<0.001**	**0.36 (0.21, 0.61)**	**<0.001**
Treatment type ^				
PEG/RBV	1	-	1	-
DAA +/- PEG/RBV	**3,27 (1.69, 6.35)**	**<0.001**	**3.39 (1.54, 7.42)**	**<0.01**
Treatment setting				
Community	1	-	1	-
Prison	0.78 (0.52, 1.18)	0.24	1.48 (0.39, 5.59)	0.56
GENOTYPE 2/3				
*Age**				
20-29 years	1	-	1	-
30-39 years	1.17 (0.75, 1.83)	0.48	0.95 (0.39, 2.33)	0.91
40-49 years	0.93 (0.60, 1.45)	0.76	0.43 (0.18, 1.03)	0.06
> 50 years	0.66 (0.41, 1.05)	0.08	**0.23 (0.10, 0.56)**	**<0.01**
Sex				
Male	1	-	1	-
Female	0.84 (0.66, 1.07)	0.17	**0.68 (0.47, 0.98)**	**0.04**
*Cirrhosis**				
No	1	-	-	-
Yes	**0.65 (0.48, 0.89)**	**<0.01**	**0.47 (0.32, 0.69)**	**<0.001**
Treatment setting				
Community	1	-	1	-
Prison	1.00 (0.71, 1.40)	0.99	1.42 (0.77, 2.61)	0.26

*At treatment commencement ^ All patients with genotype 2/3 were treated with PEG/RBV, therefore treatment type was not included in the genotype 2/3-specific model

Appendix 2: Treatment completion and SVR by prison transfer or release status among the population where the outcome of treatment is known.

Prisoner status during therapy	Completed treatment (N= 182)		Achieved a SVR (N=160)		At least one good outcome (completed treatment OR achieved a SVR) (N =188)	
	Yes, n [%]	No, n [%]	Yes, n [%]	No, n [%]	Yes, n [%]	No, n [%]
Not released or transferred during therapy	107 (87%)	16 (13%)	92 (84%)	18 (16%)	110 (89%)	13 (11%)
Transferred but not released	26 (81%)	6 (19%)	22(81%)	5 (19%)	28 (82%)	6 (18%)
Released (whether or not transferred)	14 (52%)	13 (48%)	17 (74%)	6 (26%)	24 (77%)	7 (23%)