**Supplementary Materials**

**Table S1.** Subpopulations of individuals described in the community compartment

|  |  |
| --- | --- |
|  | **Descriptor** |
| **Injecting behaviour** | IDU |
|  | Non-IDU |
| **HCV-related descriptor** | HCV antibody positive |
|  | HCV antibody negative |
|  | HCV RNA positive |
|  | HCV RNA negative |
| **Aboriginal identity** | ATSI |
|  | non-ATSI |

**Table S2** Risk groups implemented in the model

|  |
| --- |
| **Risk group** |
| Non-injecting |
| Injecting less than daily, using opioid, not sharing injecting equipment |
| Injecting less than daily, using opioid, sharing injecting equipment |
| Injecting less than daily, not using opioid, not sharing injecting equipment |
| Injecting less than daily, not using opioids, sharing injecting equipment |
| Injecting daily or more than daily, using opioids, not sharing injecting equipment |
| Injecting daily or more than daily, using opioids, sharing injecting equipment |
| Injecting daily or more than daily, not using opioids, not sharing injecting equipment |
| Injecting daily ore more than daily, not using opioids, sharing injecting equipment |

**Implementation of the model**

The model was written in C++ programming language (1). The model simulates on a time scale of 1 day, executing up to 23 possible events for every individual per day. The 23 in-prison events implemented in the model relate to: movement between prisons with different security settings, release to community, death, natural clearance of HCV, transition between risk groups, sharing injecting equipment, liver disease stage progression, and participation in HCV treatment and prevention programs. The implementation of each of these events is detailed below. The implemented algorithm of the model is as follows:

1. The model first reads in the number of days *Tmax* to simulate, and populates the model with a set initial population. The initial population of the community according to IDU, HCV, and indigenous status was estimated from published literature, and the Australian Bureau of Statistics (ABS) (2-4) (Table S3), while the initial prison population according to IDU, HCV, and indigenous status was estimated from data from the Corrective Services NSW, NSW Inmate Health Surveys, and from the HITS-p study – an observational cohort of incarcerated people with a history of IDU at risk of HCV infection in NSW (5-10) (Table S3). Parameters used for assigning the remaining characteristics of each incarcerated individual in the initial population can be found in Table S4.
2. The model then starts the simulation at simulation time *t*=1. For each time step, the total prison population is first updated by incarcerating *n* individuals from the community into the prison. The number of newly incarcerated individuals *n* is drawn using an exponential distribution on a range with a mean of 2.7. This number represents the average new incarcerations per day in NSW estimated from the number of new inmates per prison in NSW in 2005 as reported by Corrective Services NSW (5) (Table S4). An annual increase of 0.04% is applied on this daily range based on the average annual increase in new prison entrants in NSW from 2006 to 2016 as reported by the ABS (4, 11-19).

Newly incarcerated individuals are assigned prison location, demographic and risk behavior characteristics, and HCV infection history based on estimated probability distributions as detailed in (Table S4).

1. The model then goes through every incarcerated individual to apply in-prison events.
   1. For each individual, an event probability for each of the 23 events is assigned using the specified distributions, dependent on the current characteristics of the individual.
   2. Based on each event probability, the occurrence of each event is then set by drawing from a binomial distribution. This sets whether an event will be performed or not for this particular time step in the model.
   3. Events set to occur are then performed in a stochastic order until all occurring events are executed or a *death* or *move out of prison* event is executed, in which the individual agent is removed from the simulation.
2. The model increments simulation time *t* by 1.
3. The model repeats steps 2 through to 4 until simulated time *Tmax* is reached.

The model implements HCV infection as a by-product of the sharing injecting equipment event, with a per-event probability of 0.0057 (95 CI: 0.0032, 0.00105) [Table XX] (20), with HCV transmission considered only among injecting individuals in the same prison location. This assumption was based on the fact that there are rare HCV infection episodes identified among individuals who deny IDU (21, 22). All parameter values used in the model have been normalized into probability values per day by dividing annual parameters by 365. All distributions used in the model were as implemented in the GNU scientific library (GSL) (23).

As in the reality of NSW prisons, DAA treatment implemented in the model comes into effect only from 2014 onwards, with *n=*200 successful in-prison treatments between 2014 and 2016, *n*=700 between 2016 and 2017, and *n=*1000 between 2017 and 2018 (24). Similarly, OST was incorporated in the simulations from 2015 onwards, with *n*=1400 incarcerated individuals undergoing OST annually between 2015 and 2017 (24). From 2018 (for DAA) and 2017 (OST) onwards, the model maintains the number of participants for each prevention strategy as the status quo.

**Table S3.** Initial population values utilized for pertaining to the community-based subsets estimated from in 2005. Population values were estimated according to characteristics: IDU, HCV status and indigenous status.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **IDU HCV Ab+ RNA+**  **[indigenous]** | **IDU HCV Ab+ RNA-** | **IDU HCV Ab- RNA-** | **Non-IDU HCV Ab+ RNA+** | **Non-IDU HCV Ab+ RNA-** | **Non-IDU HCV Ab- RNA-** | **Total** |
| Communitya | 915,777 [278,241] | 216,939 [57,556] | 1,572,259 [485,550] | 746,360 [224,741] | 174,585 [44,181] | 1,572,260 [485,551] | 6,774,000 ([52](#_ENREF_52)) |
| Minimum Securityb | 444 [140] | 111 [35] | 757 [239] | 363 [115] | 91 [29] | 757 [239] | 3320 ([34](#_ENREF_34)) |
| Medium securityb | 294 [93] | 74 [23] | 501 [158] | 241 [76] | 60 [19] | 502 [158] | 2199 ([34](#_ENREF_34)) |
| Maximum securityb | 385 [121] | 96 [30] | 656 [207] | 315 [99] | 79 [25] | 656 [207] | 2876 ([34](#_ENREF_34)) |

a Estimated using reported proportions of HCV sub-populations in the community ([31-33](#_ENREF_31)); b Estimated using reported proportions of HCV sub-populations in prisons ([35](#_ENREF_35), [36](#_ENREF_36))

**Table S4.** Parameters for assigning demographic characteristics, risk behaviours, HCV status, and liver disease stage of newly incarcerated individuals.

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Distribution** | **Mean value** | **Reference** |
| Incarcerated in a minimum security prison upon entry | Exponential (μ = 0.00365) | 0.00365 | ([53](#_ENREF_53)) |
| Incarcerated in a medium security prison upon entry | Exponential (μ = 0.0657) | 0.0657 | ([53](#_ENREF_53)) |
| Incarcerated in a maximum security prison upon entry | Exponential (μ = 0.219) | 0.219 | ([53](#_ENREF_53)) |
| Indigenous status | Binomial (*n*=1, *p*=0.20) | 0.20 | ([36](#_ENREF_36)) |
| Active IDU behaviour upon entry | Binomial (*n*=1, *p*=0.20) | 0.20 | ([37](#_ENREF_37), [38](#_ENREF_38)) |
| Injecting daily or more | Binomial (*n*=1, *p*=0.1646) | 0.1646 | ([37](#_ENREF_37), [38](#_ENREF_38)) |
| Injecting opioids | Binomial (*n*=1, *p*=0.89) | 0.89 | ([37](#_ENREF_37), [38](#_ENREF_38)) |
| Sharing injecting equipment | Binomial (*n*=1, *p*=0.8957) | 0.8957 | ([37](#_ENREF_37), [38](#_ENREF_38)) |
| HCV Ab + for indigenous PWID | Binomial (*n*=1, *p*=0.60) | 0.60 | ([29](#_ENREF_29)) |
| HCV Ab + for non-indigenous, PWID | Binomial (*n*=1, *p*=0.424) | 0.424 | ([29](#_ENREF_29)) |
| HCV Ab + for indigenous, non-PWID | Binomial (*n*=1, *p*=0.29) | 0.29 | ([29](#_ENREF_29)) |
| HCV Ab + for non-indigenous, non-PWID | Binomial (*n*=1, *p*=0.25) | 0.25 | ([29](#_ENREF_29)) |
| HCV Ab + RNA+ | Binomial (*n*=1, *p*=0.80) | 0.80 | ([29](#_ENREF_29)) |
| HCV liver disease stage F0 and F1 | Multinomial (*K*=4, *n*=1, *p*=0.66) | 0.66 | ([51](#_ENREF_51)) |
| HCV liver disease stage F2 | Multinomial (*K*=4, *n*=1, *p*=0.11) | 0.11 | ([51](#_ENREF_51)) |
| HCV liver disease stage F3 | Multinomial (*K*=4, *n*=1, *p*=0.11) | 0.11 | ([51](#_ENREF_51)) |
| HCV liver disease stage F4 | Multinomial (*K*=4, *n*=1, *p*=0.12) | 0.12 | ([51](#_ENREF_51)) |

Numbers have been calibrated to match reported data.

**Transition between IDU risk groups**

There are 9 events that directly affect an individual’s IDU risk groups in the model: (i) Stop injecting, (ii) start injecting less than daily, and using opioids, without sharing injecting equipment, (iii) start injecting less than daily, using opioids, and sharing injecting equipment, (iv) start injecting less than daily, without using opioids, and without sharing injecting equipment, (v) start injecting less than daily, and sharing injecting equipment, without using opioids, (vi) start injecting daily or more than daily, and using opioids, without sharing injecting equipment, (vii) start injecting daily or more than daily, and using opioids, and without sharing injecting equipment, (viii) start injecting daily or more than daily, without using opioids, and without sharing injecting equipment, and (ix) start injecting daily or more than daily, and sharing injecting equipment, without using opioids. The model consists of 81 parameters for events related to IDU transition. Probabilities vary depending on the current risk group of an individual and were estimated from the HITS-p dataset (6, 7, 10). For every subject, responses to interview questions regarding injecting drug behavior, injecting frequency, opioid use, and sharing of injecting equipment since the last interview were considered. Subject responses were grouped to match the risk groups defined in the model. The cumulative frequency was calculated for each risk group and a per-day probability was estimated using the total person-days as the denominator.

Assuming an IDU risk group transition event was set to occur for a particular individual at a particular time point, the event is executed simply by updating the current injecting, injecting frequency, sharing, and opioid injecting status of the individual accordingly.

**Table S3.** Parameters for in-prison events relating to transition between IDU risk groups

|  |  |  |  |
| --- | --- | --- | --- |
| **Event** | **Probability** | **Distribution** | **Reference** |
| Non-injecting → Injecting less than daily/Opioid/No sharing | 4.76071E-05 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting less than daily/Opioid/Sharing | 6.12091E-05 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting less than daily/Non opioid/No sharing | 2.7204E-05 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting less than daily/Non opioid/ Sharing | 8.16121E-05 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting daily or more/Opioid/No sharing | 6.80101E-06 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting daily or more/Opioid/ Sharing | 6.80101E-06 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting daily or more/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Non-injecting → Injecting daily or more/Non opioid/ Sharing | 1.3602E-05 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Non-injecting | 0.002009895 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting less than daily/Opioid/Sharing | 0.000309215 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting less than daily/Non opioid/No sharing | 0.000463822 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting less than daily/Non opioid/ Sharing | 0.000309215 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting daily or more/Opioid/No sharing | 0.000154607 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting daily or more/Opioid/ Sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting daily or more/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → Injecting daily or more/Non opioid/ Sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Non-injecting | 0.001054254 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting less than daily/Opioid/No sharing | 0.000162193 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting less than daily/Non opioid/No sharing | 8.10964E-05 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting less than daily/Non opioid/ Sharing | 0.000486579 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting daily or more/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting daily or more/Opioid/ Sharing | 0.000243289 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting daily or more/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → Injecting daily or more/Non opioid/ Sharing | 8.10964E-05 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Non-injecting | 0.003284843 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting less than daily/Opioid/No sharing | 0.000117316 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting less than daily/Opioid/Sharing | 0.000351947 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting less than daily/Non opioid/ Sharing | 0.000234632 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting daily or more/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting daily or more/Opioid/ Sharing | 0.000117316 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting daily or more/Non opioid/No sharing | 0.000117316 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → Injecting daily or more/Non opioid/ Sharing | 0.000117316 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Non-injecting | 0.002003473 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting less than daily/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting less than daily/Opioid/Sharing | 0.000133565 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting less than daily/Non opioid/No sharing | 0.000534259 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting daily or more/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting daily or more/Opioid/ Sharing | 0.000133565 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting daily or more/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → Injecting daily or more/Non opioid/ Sharing | 0.000400695 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Non-injecting | 0.001782042 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting less than daily/Opioid/No sharing | 0.000411241 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting less than daily/Opioid/Sharing | 0.000411241 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting less than daily/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting less than daily/Non opioid/ Sharing | 0.000548321 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting daily or more/Opioid/ Sharing | 0.00013708 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting daily or more/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → Injecting daily or more/Non opioid/ Sharing | 0.00027416 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Non-injecting | 0.002455938 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting less than daily/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting less than daily/Opioid/Sharing | 0.000433401 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting less than daily/Non opioid/No sharing | 0.000433401 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting less than daily/Non opioid/ Sharing | 0.000288934 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting daily or more/Opioid/No sharing | 0.000144467 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting daily or more/Non opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → Injecting daily or more/Non opioid/ Sharing | 0.000433401 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Non-injecting | 0.004616477 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting less than daily/Opioid/No sharing | 0.000355114 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting less than daily/Opioid/Sharing | 0.000355114 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting less than daily/Non opioid/No sharing | 0.000355114 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting less than daily/Non opioid/ Sharing | 0.000355114 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting daily or more/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting daily or more/Opioid/ Sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → Injecting daily or more/Non opioid/ Sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Non-injecting | 0.000268528 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting less than daily/Opioid/No sharing | 0.000268528 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting less than daily/Opioid/Sharing | 0.000268528 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting less than daily/Non opioid/No sharing | 0.000268528 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting less than daily/Non opioid/ Sharing | 0.000805585 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting daily or more/Opioid/No sharing | 0 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting daily or more/Opioid/ Sharing | 0.000268528 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → Injecting daily or more/Non opioid/No sharing | 0.000268528 | Multinomial | (6, 7, 10) |
| Non-injecting → No change | 0.002752032 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/No sharing → No change | 0.000618429 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Opioid/Sharing → No change | 0.000648771 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/No sharing → No change | 0.000351947 | Multinomial | (6, 7, 10) |
| Injecting less than daily/Non opioid/ Sharing → No change | 0.001469213 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/No sharing → No change | 0.00013708 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Opioid/ Sharing → No change | 0.000144467 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/No sharing → No change | 0.000355114 | Multinomial | (6, 7, 10) |
| Injecting daily or more/Non opioid/ Sharing → No change | 0.001074114  (0.0000537057, 0.0020945223) | Multinomial | (6, 7, 10) |

**Movement between prison locations**

There are 4 events that directly affect an individual’s location in the model: (i) release from prison, (ii) move to minimum security prison, (iii) move to medium security prison, (iv) move to maximum security prison. The model consists of 12 parameters relating to movement between prison locations. Probabilities vary depending on the current location of an individual and were estimated by considering the movement of every prisoner between any two locations. The monthly number of prisoner movements between two locations (any prison, and any prison to community) in NSW from 2006 to 2016 were obtained from the Corrective Services NSW (25). Movements were categorized according to prison security classification, with hybrid prisons considered by assigning each with its dominant security classification (90% of the population) (Table S4). Known hospital and reception prisons were not included in the inter-prison analysis to remove potential bias of non-regular prison movements. A monthly movement probability between any two locations was calculated by dividing the number of prisoner movements by the prison population in that security classification per month. These were then averaged and converted into daily rates by dividing it by 30. Finally, movement probabilities were adjusted to calibrate the model against the reported prison population data [REF].

Assuming a movement event was set to occur for a particular individual at a particular time point, the event is executed by updating the current location of the individual accordingly.

**Table S4.** Parameters for in-prison events relating to movement between prison locations

|  |  |  |  |
| --- | --- | --- | --- |
| **Event** | **Probability** | **Distribution** | **Reference** |
| Minimum security prison → Community | 0.00035 | Exponential distribution | (25) |
| Minimum security prison → Medium security prison | 0.000382 | Exponential distribution | (25) |
| Minimum security prison → Maximum security prison | 0.000225 | Exponential distribution | (25) |
| Remain in minimum security prison | 0.0006937 | Exponential distribution | (25) |
| Medium security prison → Community | 0.000257 | Exponential distribution | (25) |
| Medium security prison → Minimum security prison | 0.001111935 | Exponential distribution | (25) |
| Medium security prison → Maximum security prison | 0.0002884 | Exponential distribution | (25) |
| Remain in medium security prison | 0.00363 | Exponential distribution | (25) |
| Maximum security prison → Community | 0.00003 | Exponential distribution | (25) |
| Maximum security prison → Minimum security prison | 0.0002915 | Exponential distribution | (25) |
| Maximum security prison → Medium security prison | 0.000404 | Exponential distribution | (25) |
| Remain in maximum security prison | 0.004653 | Exponential distribution | (25) |

**Sharing of injecting equipment**

The probability of sharing injecting equipment for individuals who are injecting less than daily was set to 0.044374 (CI:), and 0.16004902 (CI:) for individuals injecting daily or more than daily. These probabilities were obtained from the HITS-p by considering interview responses to questions regarding sharing of any injecting equipment depending on injecting frequency (e.g. less than daily, daily or more) since the last interview (6, 7, 10). HCV infection was implemented in the model as a possible consequential event following sharing of injecting equipment with a per-event probability of 0.0057 (95 CI: 0.0032, 0.00105) (20). Assuming a sharing event was set to occur for a particular individual, hereby referred to as the source, the event is executed by then drawing the probability of infecting another individual using an exponential distribution based on the per-event probability of HCV infection. Both sharing and infection probabilities have been adjusted to calibrate the model against the reported prison population data [REF].

Assuming an infection event was set to occur, an infected individual was selected from the pool of susceptible individuals in the same prison according to their risk behaviours at the time of the event. The following risk behaviours reported to be associated with HCV infection in the HITS-p cohort were then considered for each susceptible individual: ATSI, frequency of injecting, and injecting opioids (10). An infected individual is then selected based on a weighted multinomial probability distribution. Hazard risk coefficients of the risk behaviours considered as estimated from a time dependent Cox regression analysis (10) were used as weights:

where HATSI = 2.28, HInj = 2.22, HInjOp = 4.15, and is the sum of the three hazard risk coefficients. Upon selecting an individual to be infected from the susceptible pool, the infection event is executed by updating the individual’s HCV status.

**Death**

There are 2 events that initiate an individual’s death in the model: (i) in-prison natural death, and (ii) F4 HCV-related death. In-prison death rate was estimated from the number of in-prison deaths caused by traumatic injuries including hanging, fatal injury in the process of detaining, and deaths during attempts to escape from prison in NSW from 2008 to 2011 as reported by the Australian Institute of Criminology (AIC) (26). HCV-related death rate was estimated from the number of deaths caused by HCV in NSW from 2008 to 2011 as reported by the AIC (26).

Assuming a death-inducing event was set to occur for a particular individual at a particular time point, the event is executed by removing the individual, along with all characteristics stored, from the model.

**Table S5.** Parameters for in-prison events relating to death

|  |  |  |  |
| --- | --- | --- | --- |
| **Event** | **Probability** | **Distribution** | **Reference** |
| In-prison natural death | 0.00000506 (0.00000424, 0.0000056) | Normal distribution | (26) |
| F4 HCV-related death | 0.000000284 (0.000000261, 0.000000304) | Normal distribution | (26) |

**Progression of HCV**

There are 4 events that directly affect the progression of HCV of an individual in the model: (i) progression to metavir liver disease stage F1, (ii) progression to metavir liver disease stage F2, (iii) progression to metavir liver disease stage F3, and (iv) progression to metavir liver disease stage F4. The model consists of 4 parameters for events related to progression of HCV. Probabilities vary depending on the current metavir liver disease stage of an individual and were based on an estimation of stage-specific HCV fibrosis progression rates from Thein, et al. (27).

Assuming a progression of HCV event was set to occur for a particular individual at a particular time point, the event is executed by updating the individual’s recorded liver disease stage accordingly.

**Table S6.** Parameters for in-prison events relating to progression of HCV

|  |  |  |  |
| --- | --- | --- | --- |
| **Event** | **Probability** | **Distribution** | **Reference** |
| F0 → F1 | 0.00032 (0.00016, 0.000077) | Exponential distribution | (27) |
| F1 → F2 | 0.00023 (0.00018, 0.0003) | Exponential distribution | (27) |
| F2 → F3 | 0.00023 (0.00018, 0.00030) | Exponential distribution | (27) |
| F3 → F4 | 0.00036 (0.00015, 0.00087) | Exponential distribution | (27) |

**Clearance of HCV**

There are 2 events that directly affect the clearance of HCV of an individual in the model: i) natural clearance of HCV, and (ii) clearance of HCV due to DAA. The probability of clearance varies depending on the time since an individual was infected with HCV. The probability of natural clearance of HCV was estimated from the InC3 cohort (28). This probability was adjusted to calibrate the model against the reported prison population data [REF].

Assuming a clerance of HCV event was set to occur for a particular individual at a particular time point, the event is executed by updating the HCV status of the individual.

**Table S7.** Parameters for in-prison events relating to progression of HCV

|  |  |  |  |
| --- | --- | --- | --- |
| **Event** | **Probability** | **Distribution** | **Reference** |
| Natural clearance of HCV | 0.115 (0.096, 0.14) | Exponential distribution | (28) |
| Clearance of HCV due to DAA | 0.95 (0.90, 0.96) | Exponential distributuon | (24) |

**Treatment and prevention programs**

There are 6 events related to HCV treatment and prevention programs implemented in the model: (i) start DAA, (ii) drop-out of DAA, (iii) start OST, (iv) drop-out of OST, (v) start NSP, (vi) drop-out of NSP. For DAA, the probability of participating in DAA therapy was set to 90% assuming an individual is HCV Ab+ RNA+ and is not currently enrolled in DAA. The probability of dropping out of DAA therapy was set to 10% (24). For OST, the probability of participating in OST therapy was set to 95.10, while the probability of dropping out of OST therapy was set to 4.9% (29).

Treatment and prevention programs were implemented with an annual limit of enrolment slots *k*. Enrolment slots *k* were distributed through 365 days with a daily cap , allowing a maximum of *m* individuals to be enrolled in a program per simulated day. For each simulated day, the daily cap *m* and enrolment slots *k* for each program is reduced by 1 for every individual simulated to start that specific program. The daily cap *m* and enrolment slots *k* for each program is increased by 1 for every individual simulated to drop-out of that specific program.

As in the reality of NSW prisons, DAA treatment and OST implemented in the model simulations come into effect only from the year 2014 and 2015, respectively. For DAA treatment, *n=*200 successful in-prison treatments were simulated between 2014 and 2016, *n*=700 between 2016 and 2017, and *n=*1000 between 2017 and 2018 (24). For OST, *n*=1400 incarcerated individuals undergoing OST annually between 2015 and 2017 were simulated (24).

**Table S8.** Parameters for in-prison events relating to treatment and prevention programs

|  |  |  |  |
| --- | --- | --- | --- |
| **Event** | **Probability** | **Distribution** | **Reference** |
| Start DAA therapy (assuming non-participation) | 90.00 | Fixed |  |
| Drop out of DAA therapy (assuming participation) |  |  |  |
| Start OST (assuming non-participation) | 95.10 | Fixed |  |
| Drop out of OST (assuming participation) | 04.9 | Fixed |  |
| Start NSP (assuming non-participation) | 90.00 | Fixed |  |
| Drop out of NSP (assuming participation) |  |  |  |

**Table S9.** Calibration of prison population

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Year | Simulated value (CI 95%) | Observed value | Reference |
| Total NSW prison population | 2006 | 8472 (8395, 8572) | 8400 | (30) |
|  | 2007 | 8644 (8490, 8827) | 8809 | (31) |
|  | 2008 | 8854 (8685, 9057) | 9009 | (32) |
|  | 2009 | 9116 (8854, 9336) | 9532 | (33) |
|  | 2010 | 9346 (9130, 9568) | 9507 | (34) |
|  | 2011 | 9643 (9473, 9884) | 9228 | (35) |
|  | 2012 | 9994 (9797, 10202) | 8931 | (36) |
|  | 2013 | 10366 (10159, 10637) | 9187 | (37) |
|  | 2014 | 10742 (10520, 10970) | 9849 | (38) |
|  | 2015 | 11134 (10881, 11381) | 10826 | (39) |
|  | 2016 | 11543 (11313, 11766) | 11543 | (40) |
| Minimum security prisons | 2006 | 3329 (3295, 3381) | 3320 | (30) |
|  | 2007 | 3356 (3302, 3439) | 3481 | (31) |
|  | 2008 | 3360 (3301, 3441) | 3286 | (32) |
|  | 2009 | 3411 (3334, 3465) | 3347 | (33) |
|  | 2010 | 3452 (3399, 3481) | 3362 | (34) |
|  | 2011 | 3530 (3485, 3580) | 3312 | (35) |
|  | 2012 | 3640 (3562, 3678) | 3321 | (36) |
|  | 2013 | 3764 (3703, 3822) | 3443 | (37) |
|  | 2014 | 3865 (3827, 3914) | 3627 | (38) |
|  | 2015 | 4001 (3928, 4095) | 3827 | (39) |
|  | 2016 | 4126 (4046, 4222) | 4294 | (40) |
| Medium security prisons | 2006 | 2121 (2104, 2136) | 2200 | (30) |
|  | 2007 | 2058 (2024, 2089) | 2354 | (31) |
|  | 2008 | 2067 (2038, 2112) | 2410 | (32) |
|  | 2009 | 2107 (2082, 2159) | 2558 | (33) |
|  | 2010 | 2126 (2090, 2207) | 2665 | (34) |
|  | 2011 | 2179 (2149, 2264) | 2282 | (35) |
|  | 2012 | 2254 (2214, 2317) | 1983 | (36) |
|  | 2013 | 2345 (2302, 2404) | 1951 | (37) |
|  | 2014 | 2440 (2381, 2469) | 2043 | (38) |
|  | 2015 | 2518 (2479, 2549) | 1867 | (39) |
|  | 2016 | 2597 (2569, 2622) | 1927 | (40) |
| Maximum security prisons | 2006 | 3022 (2995, 3055) | 2880 | (30) |
|  | 2007 | 3229 (3163, 3297) | 2974 | (31) |
|  | 2008 | 3426 (3345, 3503) | 3313 | (32) |
|  | 2009 | 3569 (3436, 3711) | 3627 | (33) |
|  | 2010 | 3767 (3640, 3879) | 3480 | (34) |
|  | 2011 | 3922 (3837, 4039) | 3634 | (35) |
|  | 2012 | 4099 (4020, 4206) | 3627 | (36) |
|  | 2013 | 4256 (4152, 4009) | 3793 | (37) |
|  | 2014 | 4436 (4311, 4586) | 4179 | (38) |
|  | 2015 | 4615 (4473, 4735) | 5132 | (39) |
|  | 2016 | 4819 (4696, 4921) | 5322 | (40) |

**Table S10.** Calibration of prison sub-populations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Year | Value (CI 95%) | Observed value | Reference |
| Proportion of incarcerated individuals with a history of IDU | 2006 | 54.50 (54.3, 54.7) |  | (41, 42) |
|  | 2007 | 57.31 (56.79, 57.83) |  | (41, 42) |
|  | 2008 | 59.55 (58.62, 60.48) |  | (41, 42) |
|  | 2009 | 61.80 (60.60, 63.00) |  | (41, 42) |
|  | 2010 | 63.52 (62.82, 64.22) |  | (41, 42) |
|  | 2011 | 64.64 (63.95, 65.32) |  | (41, 42) |
|  | 2012 | 65.38 (64.78, 65.97) |  | (41, 42) |
|  | 2013 | 66.20 (66.11, 66.29) |  | (41, 42) |
|  | 2014 | 66.85 (66.35, 67.35) |  | (41, 42) |
|  | 2015 | 67.61 (66.91, 68.31) | 59.3 (53.6, 65) move to 2015 [from across 3 periods] [put them both] | (41, 42) |
|  | 2016 | 67.98 (67.38, 68.57) |  | (41, 42) |
| Proportion of incarcerated individuals who are active injectors | 2006 | 25.89 (25.89, 25.89) |  |  |
|  | 2007 | 19.89 (19.89, 19.89) |  |  |
|  | 2008 | 16.65 (16.65, 16.65) |  |  |
|  | 2009 | 15.03 (15.03, 15.03) |  |  |
|  | 2010 | 14.18 (14.18) |  |  |
|  | 2011 | 13.76 (13.76, 13.76) |  |  |
|  | 2012 | 13.69 (13.69, 13.69) |  |  |
|  | 2013 | 13.74 (13.74, 13.74) |  |  |
|  | 2014 | 13.96 (13.96, 13.96) |  |  |
|  | 2015 | 14.08 (14.08, 14.08) |  |  |
|  | 2016 | 13.87 (13.87, 13.87) |  |  |
| Proportion of incarcerated individuals who are injecting opioids | 2006 | 20.23 (20.21, (20.26) | 14.00 | (6, 7, 10) |
|  | 2007 | 12.70 (12.51, 12.89) |  | (6, 7, 10) |
|  | 2008 | 9.59 (9.26, 9.92) |  | (6, 7, 10) |
|  | 2009 | 8.30 (8.19, 8.40) |  | (6, 7, 10) |
|  | 2010 | 8.01 (7.71, 8.30) |  | (6, 7, 10) |
|  | 2011 | 7.88 (7.76, 8.00) |  | (6, 7, 10) |
|  | 2012 | 7.66 (7.48, 7.84) |  | (6, 7, 10) |
|  | 2013 | 7.62 (7.61, 7.63) |  | (6, 7, 10) |
|  | 2014 | 7.73 (7.58, 7.88) |  | (6, 7, 10) |
|  | 2015 | 7.91 (7.64, 8.18) |  | (6, 7, 10) |
|  | 2016 | 7.58 (7.50, 7.65) |  | (6, 7, 10) |
| Proportion of incarcerated individuals who are HCV Ab+ RNA- | 2016 | 40.80 (40.73, 40.87) | 41.85 (41, 42.7) | (41, 42) |
|  | 2007 | 41.47 (41.25, 41.69) |  | (41, 42) |
|  | 2008 | 41.68 (41.40, 41.95) |  | (41, 42) |
|  | 2009 | 41.76 (41.45, 42.06) |  | (41, 42) |
|  | 2010 | 41.78 (41.77, 41.79) |  | (41, 42) |
|  | 2011 | 41.68 (41.58, 41.78) |  | (41, 42) |
|  | 2012 | 41.55 (41.38, 41.71) |  | (41, 42) |
|  | 2013 | 41.27 (40.76, 41.79) |  | (41, 42) |
|  | 2014 | 40.67 (40.33, 41.01) |  | (41, 42) |
|  | 2015 | 40.55 (40.45, 40.65) |  | (41, 42) |
|  | 2016 | 40.23 (40.09, 40.36) |  | (41, 42) |
| Proportion of incarcerated individuals who are HCV Ab+ RNA+ | 2006 | 28.56 (28.53, 28.58) | 26.00 (25.00, 27.00) | (41, 42) |
|  | 2007 | 28.88 (28.77, 28.98) |  | (41, 42) |
|  | 2008 | 28.62 (28.53, 28.70) |  | (41, 42) |
|  | 2009 | 28.56 (28.46, 28.65) |  | (41, 42) |
|  | 2010 | 28.19 (28.12, 28.56) |  | (41, 42) |
|  | 2011 | 27.48 (27.40, 27.05) |  | (41, 42) |
|  | 2012 | 27.01 (26.97, 27.05) |  | (41, 42) |
|  | 2013 | 26.48 (26.11, 26.84) |  | (41, 42) |
|  | 2014 | 24.93 (24.57, 25.30) |  | (41, 42) |
|  | 2015 | 23.89 (23.66, 24.11) |  | (41, 42) |
|  | 2016 | 20.55 (20.43, 20.67) |  | (41, 42) |

**Table S11.** Incidence and Prevalence calibration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Year | Value (CI 95%) | Observed value | Reference |
| Incidence of HCV among incarcerated PWID | 2006 | 11.09 (11.07, 11.16) | 12.07 (8.89, 15.25) | (6) |
|  | 2007 | 9.81 (9.26, 10.36) | 12.07 (8.89, 15.25) | (6) |
|  | 2008 | 10.38 (10.08, 10.69) | 12.07 (8.89, 15.25) | (6) |
|  | 2009 | 10.43 (10.21, 10.65) | 9.74 (6.81, 12.67) | (6) |
|  | 2010 | 11.21 (10.91, 11.52) | 9.74 (6.81, 12.67) | (6) |
|  | 2011 | 10.70 (10.14, 11.26) | 13.30 (8.64, 17.96) | (6) |
|  | 2012 | 10.54 (9.74, 11.34) | 13.30 (8.64, 17.96) | (6) |
|  | 2013 | 10.54 (10.09, 10.99) | 13.30 (8.64, 17.96) | (6) |
|  | 2014 | 9.79 (9.53, 10.05) |  |  |
|  | 2015 | 11.79 (11.05, 12.55) |  |  |
|  | 2016 | 10.48 (10.45, 10.51) |  |  |
| Prevalence of HCV among the prison pooulation | 2006 | 40.80 (40.73, 40.87) |  |  |
|  | 2007 | 41.47 (41.25, 41.69) |  |  |
|  | 2008 | 41.68 (41.40, 41.95) |  |  |
|  | 2009 | 41.76 (41.45, 42.06) |  |  |
|  | 2010 | 41.78 (41.77, 41.79) | 24.00 [ignore] | (43) |
|  | 2011 | 41.68 (41.58, 41.78) |  |  |
|  | 2012 | 41.55 (41.38, 41.71) |  |  |
|  | 2013 | 41.27 (40.76, 41.79) | 27.00 [ignore] | (44) |
|  | 2014 | 40.67 (40.33, 41.01) |  |  |
|  | 2015 | 40.55 (40.45, 40.65) | 40% 2015 IHS |  |
|  | 2016 | 40.23 (40.09, 40.36) |  |  |

Incidence DAA scenario

|  |  |  |  |
| --- | --- | --- | --- |
|  | maintained number of *n=*1000 DAA treatments annually from 2018 | one-time increase of 80% in DAA treatments after 2018 | one-time reduction of 80% in DAA treatments after 2018 |
| 2014 | 9.79 (9.53, 10.05) | 11.07 (9.85, 12.28) | 10.94 (10.94, 10.94) |
| 2015 | 11.80 (11.05, 12.55) | 10.51 (10.34, 10.67) | 11.47 (10.91, 12.03) |
| 2016 | 10.48 (10.45, 10.51) | 10.04 (9.41, 10.67) | 10.47 (10.91, 12.03) |
| 2017 | 11.22 (11.02, 11.42) | 11.56 (11.0, 12.13) | 10.06 (9.51, 10.60) |
| 2018 | 11.04 (10.77 ,11.31) | 11.06 (10.80, 11.32) | 10.51 (9.48, 11.53) |
| 2019 | 10.30 (10.28, 10.33) | 10.96 (10.46, 11.47) | 10.43 (9.74, 11.13) |
| 2020 | 10.65 (10.34, 10.96) | 9.96 (8.96, 10.95) | 10.23 (10.12, 10.33) |
| 2021 | 10.73 (10.44, 11.03) | 11.88 (11.45, 12.32) | 10.74 (9.82, 11.67) |
| 2022 | 10.85 (10.78, 10.92) | 9.69 (9.57, 9.81) | 9.80 (9.23, 10.37) |
| 2023 | 10.81 (10.53, 11.08) | 10.51 (10.06, 10.95) | 9.88 (9.92, 10.06) |
| 2024 | 10.45 (10.45, 10.45) | 10.33 (10.20, 10.46) | 10.35 (9.92, 10.77) |
| 2025 | 10.95 (10.89, 11.01) | 11.96 (11.69, 12.24) | 10.77 (10.52, 11.0) |
| 2026 | 10.60 (10.16, 11.045) | 11.27 (10.40, 12.14) | 10.28 (9.98, 10.59) |

Prevalence DAA scenario

|  |  |  |  |
| --- | --- | --- | --- |
|  | maintained number of *n=*1000 DAA treatments annually from 2018 | one-time increase of 80% in DAA treatments after 2018 | one-time reduction of 80% in DAA treatments after 2018 |
| 2014 | 24.93 (24.57, 25.30) | 25.56 (24.85, 26.27) | 25.55 (25.17, 25.93) |
| 2015 | 23.89 (23.66, 24.11) | 24.18 (23.63, 24.74) | 24.51 (24.05, 24.97) |
| 2016 | 20.55 (20.43, 20.67) | 20.62 (20.15, 21.11) | 21.13 (20.52, 21.75) |
| 2017 | 13.96 (13.77, 14.15) | 13.77 (13.30, 14.24) | 14.18 (13.57, 14.78) |
| 2018 | 11.62 (11.30, 11.93) | 11.41 (10.94, 11.89) | 11.56 (11.17, 11.94) |
| 2019 | 8.97 (8.68, 9.25) | 5.93 (5.36, 6.51) | 11.86 (11.62, 12.10) |
| 2020 | 3.65 (3.46, 3.84) | 0.03, (0.01, 0.05) | 11.68 (11.54, 11.83) |
| 2021 | 0.25 (0.20, 0.30) | 0.01 (0.01, 0.01) | 11.56 (11.54, 11.58) |
| 2022 | 0.01 (0.01, 0.01) | 0.01 (0.01, 0.01) | 11.54 (11.40, 11.68) |
| 2023 | 0.01 (0.01, 0.01) | 0.01 (0.01, 0.01) | 11.45 (11.25, 11.64) |
| 2024 | 0.01 (0.01, 0.01) | 0.01 (0.01, 0.01) | 11.43 (11.25, 11.64) |
| 2025 | 0.01 (0.01, 0.01) | 0.01 (0.01, 0.01) | 11.54 (11.41, 11.68) |
| 2026 | 0.01 (0.01, 0.01) | 0.01 (0.01, 0.01) | 11.79 (11.65, 11.92) |

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