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Routine testing for blood-borne viruses in prisons: a systematic review

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Background: People in prison have a higher burden of blood-borne virus (BBV) infection than the general population, and prisons present an opportunity to test for BBVs in high-risk, underserved groups. Changes to the BBV testing policies in English prisons have recently been piloted. This review will enable existing evidence to inform policy revisions. We describe components of routine HIV, hepatitis B and C virus testing policies in prisons and quantify testing acceptance, coverage, result notification and diagnosis. **Methods:** We searched five databases for studies of both opt-in (testing offered to all and the individual chooses to have the test or not) and opt-out (the individual is informed the test will be performed unless they actively refuse) prison BBV testing policies. **Results:** Forty-four studies published between 1989 and 2013 met the inclusion criteria. Of these, 82% were conducted in the USA, 91% included HIV testing and most tested at the time of incarceration. HIV testing acceptance rates ranged from 22 to 98% and testing coverage from 3 to 90%. Mixed results were found for equity in uptake. Six studies reported reasons for declining a test including recent testing and fear. **Conclusions:** While the quality of evidence is mixed, this review suggests that reasonable rates of uptake can be achieved with opt-in and, even better, with opt-out HIV testing policies. Little evidence was found relating to hepatitis testing. Policies need to specify exclusion criteria and consider consent processes, type of test and timing of the testing offer to balance acceptability, competence and availability of individuals.

Introduction

The prison estate in England and Wales holds approximately 84 000 people with almost 200 000 passing through the system each year.[1,2] People in prison tend to have both a higher burden of disease and poorer access to healthcare.[3] Infection with blood-borne viruses (BBVs) is higher than the general population largely due to higher levels of injecting drug use.[4] At any given time in the UK detention estate, there are approximately 40 000 problematic drug users with 55% of new prisoners testing positive for Class A drugs.[5] People who inject drugs (PWIDs) are also repeatedly incarcerated with more than 40% having been in prison at least five times.[5] Further, there is a risk of amplification of infectious disease in prisons because of overcrowding, the high prevalence of BBVs, a lack of knowledge among prison staff, limited facilities for diagnosis and treatment, large turnover and high-risk activity such as unprotected sex.[6]

In 2010, out of 6750 new HIV diagnoses in the UK, only 2.4% (160) were infected through injecting drugs.[2] Prevalence data are limited but suggest a higher rate of HIV infection in the prison population: 0.22% versus 0.14% in the UK as a whole.[2] An anonymous testing study in eight prisons across England and Wales in 1997–98 reported a prevalence of 0.4%, based on 82% uptake.[7] The 2001 National Sexual Health and HIV Strategy highlighted that people in prisons have particular HIV prevention requirements.[8] More recently, Public Health England (PHE) has focused on expanding HIV testing to reduce late diagnoses and recommends routine HIV testing for all general medical admissions in areas of high prevalence (estimated prevalence of undiagnosed HIV >= one per 1000 population aged 16-59 years).[9]

Sentinel surveillance in England for 2010 showed that a higher proportion of people in prison tested positive for hepatitis C than in all community health settings except for drug dependency services.[3] In England in 1997/98, 7% of people in prison were positive for

anti-hepatitis C virus (HCV, 31% of PWIDs) and 8% were positive for hepatitis B virus (HBV) core (20% of PWIDs).[7] However, there have been significant changes in the epidemiology of HBV infection amongst PWIDs alongside changes in the UK HBV vaccination policy. In 1989, the Prison Service introduced a policy to vaccinate 'at risk' inmates who were in prison for more than 6 months and was soon extended to include all sentenced prisoners.[10] In 1996, a super-accelerated HBV immunization schedule started for all UK prisoners,[10,11] followed in 2003 by a hyper-accelerated HBV vaccination programme in England and Wales.[12] In 2003, 37% of HBV diagnoses were due to injection drug use compared to only 4% by 2011.[12]

The Chief Medical Officer's 2012 Report and the Liver Disease Atlas of Variation 2013 emphasized the burden of liver disease and the role of infectious hepatitis, especially undiagnosed infection.[12,13] There is variation in hepatitis C testing across prisons in England. An audit of 20 prisons found that only 62% of prisons had a written HCV policy of which 92% included criteria for testing but with variation in how testing was offered.[14] There was a 47% increase in HCV testing in prisons in England between 2005 and 2008 and a 35% increase in HBV testing, but the proportion of prisoners tested has remained low.[11] The Prison Health Performance Quality Indicators include criteria for HCV testing and the need for testing data to be recorded and submitted.[5] However, these data show that in 2013, only 7.8% of new receptions to prison were tested for HCV infection.[15]

Prisons are places that provide an opportunity to test for BBVs in high-risk and underserved groups. Different models of testing policy exist. Routine testing models include both opt-in (where testing is offered to all and the individual chooses whether to have the test) and opt-out (where the individual is informed the test will be performed unless they actively refuse) although this distinction is not used consistently in the literature. Other models include testing on referral or request; risk assessment based testing and ad hoc processes. Considerations around routine testing models need to include confidentiality, the potential for reinforcing stigma in the wider community with systematic testing of this population and ensuring that the rationale for testing is patient centred. Further, opt-out models have been criticized for the potential for the test to appear mandatory to the person in prison.[16,17] However, the potential advantages of routine testing are to diagnose infection and so commence earlier treatment with better outcomes; to inform those with infection and enable subsequent behaviour change to reduce transmission; to encourage risk reduction amongst those who have negative test results; to reduce testing-related stigma and discrimination by normalizing the testing process and to reduce inequity in testing and diagnosis. Although there is undiagnosed infection in both community and prison settings, there is evidence to suggest that in prisons a large proportion of BBV infections are in people who do not report recognized risk factors and therefore only testing those identified as high risk will leave infections undiagnosed.[18]

In April 2013, NHS England assumed commissioning responsibility for the prison estate.[19] A single national commissioner offers the opportunity for quality, evidence-based, consistent services to be implemented with continuity of care as individuals move around the detention estate. PHE, The Hepatitis C Trust, British Liver Trust and National AIDS Trust all now advocate opt-out BBV testing in prisons.[20] A recent National Partnership Agreement between the National Offender Management Service and NHS England, supported by PHE, has committed to implementing an opt-out BBV testing policy in adult prisons and developing care pathways for those found to be infected by April 2014.[21]

Rationale and objectives

Changes to the BBV testing policies in prisons in England have recently been proposed and we were unable to identify a systematic review of the literature to date to inform this policy change. The objectives of this article are to review existing literature concerning the impact of routine BBV testing in prisons, to describe the components of routine BBV testing policies and to quantify BBV testing acceptance, coverage, result notification and diagnoses under such policies.

Methods

Search strategy and selection criteria

Our searches, based on PRISMA guidelines, were conducted in autumn 2013.[22] Five electronic databases were searched: Scopus, Medline, Cochrane, Web of Science and Global Health plus hand searching reference lists of key articles. Combination search terms were guided by an initial scoping review and previous research and included 'offender*', 'prison*', 'jail*', 'correctional', 'detention', 'inmate*', 'blood borne virus', 'hiv', 'hbv', 'hcv', 'hepatitis', 'test*', 'screen*'.[23] An example search term for Scopus database is (TITLE-ABS-KEY(offender* OR prison* OR jail* OR correctional OR detention OR inmate*) AND TITLE-ABS-KEY((blood borne virus) OR hiv OR hbv OR hcv OR hepatitis) AND TITLE-ABS-KEY(test* OR screen*)).

We included studies relevant to the question of the impact of routine BBV testing in the prison setting, available in English with no limits on date of publication or geographical location. We included studies of general correctional facility populations but excluded studies of subgroups (excluding gender). We included studies that considered routine (opt-in and opt-out) testing of all inmates but excluded mandatory policy studies. Owing to the ethical and legal complexity of mandatory testing, viewed by many as a breach of human rights, we decided that mandatory testing policies were outside the scope of this review. We included review articles with documented methodology; experimental studies; observational studies; studies reporting perspectives of BBV testing (including qualitative methodologies); cost-effectiveness studies and intervention description and evaluation.

Data extraction

Data extraction was informed by The Cochrane Handbook guidelines.[24] Extracted data included year of publication, population and country of study, specific location, methodology, BBV, testing policy and main results. Data extraction was also specific to the type of study and based on other guidelines, e.g. review articles were based on the PRISMA checklist[22]; qualitative studies were based on the Supplementary Guidance for Inclusion of Qualitative Research in Cochrane Systematic Reviews of Interventions.[25] Two reviewers (D.J.P. and C.R.) appraised the studies and extracted the data of interest.

Risk of bias assessment

For experimental study designs, we considered potential for bias in four main areas: random sequence generation; allocation concealment; blinding of outcome assessment and completeness of outcome data, using the Cochrane risk of bias tool.[26] For observational studies, three areas of potential bias were graded as low, unclear or high: selection bias, information bias and confounding. Qualitative studies were evaluated using the four domains suggested in the Cochrane guidance: credibility, transferability, dependability and confirmability.[27] Non-comparative evaluation descriptions were not assessed in terms of bias because there is no participant selection process or measurement of two groups for comparison. However, they offer valuable information for this review and so have been included. We used the extracted data and assessment of potential bias to inform our assessment of overall study quality.

Results

For article screening and selection process, see the PRISMA flowchart (figure 1). In total, 1961 articles were screened by title for inclusion. Three hundred and thirty-five full text articles were assessed and 44 met the eligibility criteria (table 1).

Six reviews fulfilled the inclusion criteria of having a documented methodology including high-quality systematic reviews, reviews and selected bibliographies (table 2).[44,47,50,51,58,60] Thirty-three papers were mainly quantitative, two were qualitative and three were cost-effectiveness studies. Of the non-review articles, 31/38 (82%) were conducted in the USA [nine at the Rhode Island Department of Corrections (RIDOC)], four in the UK,[48,61,65,66] one in Australia[70] and two in Jamaica.[16,29] Of the 33 quantitative studies, three were experimental[34,53,54] and 15 observational: 13 cross-sectional[29,30,36–42,49,56,59,67]; one longitudinal[57] and one before–after study.[55] We classified 15 papers as 'descriptive' that present description of routinely collected data such as evaluation, audit, process data and/or description of either single or multiple routine BBV testing interventions.[16,28,31–33,35,43,45,48,61–64,68,70] Two qualitative studies are included from the same project[46,52]; two other papers included a qualitative component.[33,59]

The majority of the studies focused on HIV infection with 40/44 (91%) including routine testing for HIV infection, 8/44 (18%) including routine testing for HCV and 5/44 (11%) including routine testing for HBV. One of these only included HBcAb as a surrogate marker for a history of risk behaviour for HIV infection.[30] Three papers included HBV, HCV and HIV routine testing.[58,61,70]

Twenty-seven studies reported on the gender of the inmates: 3 were female only[41,45,53]; 14 included both men and women[30,31,35,37–39,42,43,55,57,63,67,68,70] and 11 were male only.[16,29,33,34,36,48,49,52,54,56,64] One study disaggregated by gender to include transgender.[68]

Intervention components

Tables 3 and 4 present the testing policy components and outcomes from 17 papers with sufficient detail reported, some with multiple interventions. Two other US multisite interventions (reported in three papers) had different interventions at each site and are excluded from these tables as sufficient data could not be disaggregated for each intervention.[31,42,62] We classified 11 interventions as having an opt-in model,[16,30,36,39,41,48,49,55,61,64,70] and 8 with an opt-out[16,32,33,35,53,54,63,64] (two have both).

Exclusions from testing offer

Three studies explicitly reported excluding those without capacity to consent.[53,54,63] One study included those without capacity to consent for opt-out testing 'as they are at increased risk of sexual abuse while incarcerated and therefore will benefit from such
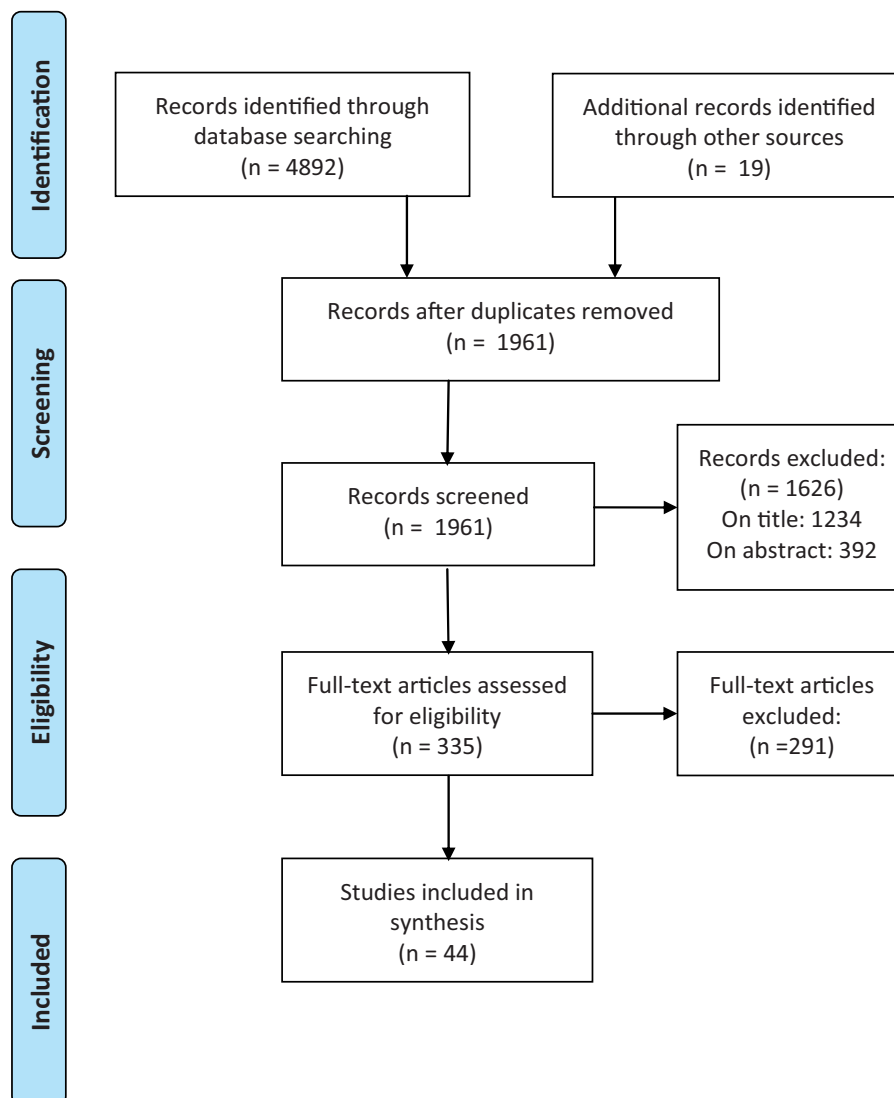

Figure 1 PRISMA flowchart

Table 1 Table of included studies

Author	Study design	HIV	HBV	HCV	Setting	Sample	Quality assessment
Amankwaa et al.[28]	Descriptive	Y			USA	51 jurisdictions	Low
Andrinopoulos et al.[16]	X-sectional	Y			Jamaica	1560 male inmates	High
Andrinopoulos et al.[29]	X-sectional	Y			Jamaica	298 male inmates	Low
Andrus et al.[30]	X-sectional	Y	Y		USA	995 male and female inmates	High
Arriola et al.[31]	Descriptive	Y			USA	1020 male and female inmates	Low
Beckwith et al.[32]	Descriptive	Y			USA	129 084 inmates	High
Beckwith et al.[33]	Descriptive	Y			USA	1364 inmates 6 staff (interviews) 6 staff (focus group)	High
Beckwith et al.[34]	Prospective controlled trial	Y			USA	264 male inmates	Low
Beckwith et al.[35]	Descriptive	Y			USA	140 739 inmates	High
Beckwith et al.[36]	X-sectional	Y			USA	100 male inmates	High
Beckwith et al.[37]	X-sectional	Y			USA	154 male and female inmates	High
Begier et al.[38]	X-sectional	Y			USA	6411 male and female inmates	High
Behrendt et al.[39]	X-sectional	Y			USA	2842 inmates (serological data) 100 inmates (survey)	High
Belenko et al.[40]	X-sectional	Y			USA	11 agencies 37 facilities	High
Cotten-Oldenberg et al.[41]	X-sectional	Y			USA	680 female inmates	High
de Voux et al.[42]	X-sectional	Y			USA	766 male and female inmates	Low
Desai et al.[43]	Descriptive	Y			USA	3493 male and female inmates	High
Enel et al.[44]	Review	Y			NA	Not applicable (NA)	Low
Farley et al.[45]	Descriptive	Y			USA	110 female inmates	Low
Grinstead et al.[46]	Qualitative	Y			USA	72 in-prison service providers	High
Hahne et al.[47]	Review		Y	Y	European	NA	High
Horne et al.[48]	Descriptive			Y	UK	3034 male inmates	High
Hoxie et al.[49]	X-sectional (repeated)	Y			USA	4307 male inmates	High
Irwin et al.[50]	Review	Y			NA	NA	Unclear
Jurgens[51]	Review	Y		Y	NA	NA	Low
Kacanek et al.[52]	Qualitative	Y			USA	105 male inmates	High
Kavasery et al.[53]	Prospective controlled trial	Y			USA	323 female inmates	High
Kavasery et al.[54]	Prospective controlled trial	Y			USA	298 male inmates	High
Liddicoat et al.[55]	Before-after	Y			USA	1004 male and female inmates	Low
MacGowan et al.[56]	X-sectional	Y			USA	547 male inmates	Low
McCusker et al.[57]	Longitudinal	Y			USA	1408 male inmates	Low
Niveau[58]	Review	Y	Y	Y	NA	NA	Low
Sabharwal et al.[59]	X-sectional	Y			USA	215 health care workers	High
Seal[60]	Review	Y			NA	NA	Low
Skipper et al.[61]	Descriptive	Y	Y	Y	UK	1618 inmates	High
Spaulding et al.[62]	Descriptive	Y			USA	877 119 male and female inmates	High
Spaulding et al.[63]	Descriptive	Y			USA	39 073 male and female inmates	Unclear
Strick et al.[64]	Descriptive	Y			USA	34 278 male inmates	High
Sutton et al.[65]	Cost effectiveness			Y	UK	NA	High
Sutton et al.[66]	Cost effectiveness			Y	UK	NA	High
Sykes and Piquero[67]	X-sectional	Y			USA	25 167 male and female inmates	Low
Tartaro and Levy[68]	Descriptive	Y			USA	698 male and female inmates	Low
Varghese and Peterman[69]	Cost effectiveness	Y			USA	NA	Low
Watkins et al.[70]	Descriptive	Y	Y	Y	Australia	946 male and female inmates	High

testing'.[16] Three studies excluded prisoners with a previous HIV diagnosis.[55,63,64] Other studies had varying exclusion criteria for study participation including non-English speaking.

Two prospective studies of opt-out oral swab HIV testing in Connecticut jails (one female, one male) compared testing rates at three time points: immediate (Day 0), early (Day 1) and delayed (Day 7) and present data on those without capacity to consent.[53,54] In the immediate testing group, 10% (male jail) and 11% (female jail) were deemed medically incompetent/lacking capacity to consent compared to statistically significant lower proportions in the other groups: early and delayed testing (males 0% and 0%, females 4% and 4%, respectively).[54]

Consent processes

Seven papers did not clearly describe consent processes,[16,30,41,48,61,63,70] whilst a further four studies only stated that 'informed consent' was required.[35,36,39,55] One required verbal consent,[64] two required written consent[33,49] and two required verbal consent for the test (to replicate the situation outside of study conditions) but written consent to

participate in the study.[53,54] One study included three sites with different processes (one written, one verbal and one that required no separate consent for the HIV test).[32]

Timing

All interventions reported the timing of the testing offer. Sixteen tested on arrival (within 28 days), whilst one described a routine testing offer to all, including both new (incarcerated <6 months) and existing inmates.[16] In the two Connecticut prospective, controlled trials of opt-out testing, both male and female immediate testing groups had more refusals (female: 32%; male: 50%) compared with early testing (female: 7%; male: 20%) and delayed testing groups (female: 12%; male: 16%).[53,54] See above for the higher proportions of those deemed medically incompetent in the immediate groups. However, the early and delayed groups had higher proportions of those not available for testing because they were bonded, been released or at court. In the female jail, the early testing group was significantly more likely to be tested than the immediate or delayed groups. In the male jail, both the early and immediate testing groups

Table 2 Summary of review articles

First author	Relevant inclusion criteria	No. papers relevant	Authors conclusions (relevant to prisons)
Enel et al.[44]	Articles published 1983–89 French, English, Italian articles Publications relating to AIDS and ethics, human rights, confidentiality, legislation or jurisprudence	2	Opinion is widely varied about the ethics of HIV screening Ethical considerations of screening in prisons include: additional isolation of HIV-infected prisoners, increased discrimination, informed consent for screening
Hahne et al.[47]	Articles published 2000-12 34 European countries English language Peer-reviewed literature Studies reporting estimated costs per additional chronic infection (HBV and HCV) identified and/or costs per life year gained	HBV = 0 HCV = 2	Insufficient evidence identified relating to cost-effectiveness of screening of prisoners for HBV and HCV to draw conclusions
Irwin et al.[50]	Articles published 1985-95 Studies addressing rates or determinants of HIV counselling and testing	4	HIV test acceptance rate in prisons: 47-89% Characteristics of programmes and inmates' HIV risk profiles differed greatly between studies
Jurgens[51]	Grey and peer-reviewed literature Articles selected as most relevant and recent	Not available	Evidence that routine HIV testing can result in large numbers of prisoners accepting HIV testing. Benefits of testing are enhanced by pre and post test counselling
Niveau[58]	Articles published 1993-2003 Articles in English, French and Spanish Grey and peer reviewed literature Articles relating to infectious disease (including HIV, HBV and HCV) in the prison setting	Not available	Effective screening policies involve voluntary screening of the greatest number of people in prison Testing should be proposed as soon as possible after arrival Screening should be systematic for HIV, HBV, HCV
Seal[60]	Articles published 2004-05 relating to HIV and correctional populations Articles with English abstracts	43	No studies were identified that examined HIV testing acceptability

were significantly more likely to be swabbed with no significant difference between the early and immediate groups.

Three of the lowest HIV opt-out testing rates were with testing on arrival but delayed beyond the first 48 h.[32,53,54] An evaluation of an opt-out programme found that with testing delayed until Days 3–4 (compared to at medical intake at two other sites), there was a greatly reduced HIV test offer rate of 3% compared with 100% and 89%.[32] The low uptake is attributed in part to the delay in testing but there are likely many confounding factors limiting conclusions.

Testing procedure

Venous blood sampling was used in 12 studies in at least one testing site,[16,30,32,35,39,41,48,49,55,61,64,70] two studies used dried blood spot testing[16,36] and five used oral testing.[33,32,53,54,63] Three studies reported false positives on initial HIV testing,[36,53,54] whilst one study reported a false-negative rapid HIV test[33] and other studies reported indeterminate test results.[38] Seven studies used rapid testing regimes compared with standard tests.[16,32,33,36,53,54,63] Two studies reported qualitative preferences for rapid testing over standard testing: one considering the staff perspective[33] and another the views of RIDOC inmates in which 88% of respondents preferred rapid testing.[37]

Testing acceptance

A review on the acceptability of voluntary HIV testing in the USA found test acceptance rates of 47-89% in prisons.[50] This was based on four studies and highlighted that the characteristics of programmes and inmates' HIV risk profiles differed greatly between studies. Table 4 reports the percentage of inmates who accepted the test as a proportion of those who were offered the test. Overall, 14 studies had sufficient data to calculate acceptance rates.[16,30,32,33,36,39,41,48,49,53–55,61,63] Figure 2 presents HIV test acceptance by testing policy and demonstrates that higher acceptance rates were achieved with opt-out testing. In the studies that report opt-out testing, acceptance rates ranged from 22 to 98%[16,32,33,53,54,63] and for opt-in, the range was 40-73%.[16,30,39,41,49,55] One opt-in study (excluded from figure 2) had an acceptance rate of 95%, but this included only 100 participants,

and the rate was calculated with the number of consenting participants as the baseline and therefore will overestimate the true acceptance rate.[36] For HCV, one opt-in study presented their acceptance rate as 12.4%.[48] Some studies present an acceptance rate deduced from a selected prison population denominator, e.g. Andrinopoulos et al.[16] that only includes inmates who accept prior counselling. These values will then give the *maximum* possible acceptance rate, and the true rate for the total prison population would be lower. Conversely, in two similar studies in Connecticut, more inmates were swabbed than gave written consent to participate in the study (144 men swabbed, 130 participated in study; 192 females swabbed, 151 consented to participate) and therefore results will likely underestimate testing uptake.[53,54]

Six studies comment on common reasons for declining a test which are having had a recent test[36,39,53–55,68]; not perceiving themselves to be at risk[36,39,53–55]; fear of a positive result[39]; dislike of venepuncture/fear of testing[30,39,53,68]; concern over confidentiality[39]; not being comfortable with the tester or the test environment[36]; already knowing themselves to be HIV infected[36,53,54]; being too tired/sleeping/watching TV[53,68]; experiencing withdrawal[53] and not being interested.[54] In addition, there were perceived negative consequences of testing positive such as being isolated. More positive reasons for having an HIV test included curiosity and it being free of charge.[52]

Testing coverage

Under opt-out HIV testing the proportion of total inmates tested ranged from 3 to 90%[32,35,53,54,63,64] and for opt-in 25–72%.[30,39,41,49,55,64,70] For HCV, three studies (all opt-in) report rates of 9%,[61] 12%[48] and 35%.[70] For HBV, there was only one opt-in study where 30% of entrants were tested (table 4).[70]

There were challenges to calculating coverage rates. Different exclusion criteria were used, and the population total was not always reported. A key reason for not receiving a test is not being offered one. A number of studies describe a policy in which all new entrants are offered testing and make an assumption that 100% actually receive the offer. Seven studies reported a 100% testing offer in at least one testing site.[30,32,39,41,48,49,61] However, other studies highlighted that less than 100% actually received the offer despite a policy to offer testing to all[32,53–55,63] and the proportion of

Table 3 Details of routine testing interventions

First author	Location	Sample[a]	Test process	Policy	Exclusions from testing offer	Consent	Timing
Andrinopoulos et al.[16]	Largest institution in Jamaica	VBS or DBST	Rapid	Mixed[b]	None documented	Mixed	New (<6 months) and current (>6 months) inmates
Andrus et al.[30]	Oregon corrections system	VBS	Standard	Opt-in	None documented	Not described	On incarceration
Beckwith et al.[36]	RIDOC[c]	DBST	Rapid	Opt-in	None documented	Informed	On incarceration
Beckwith et al.[35]	RIDOC	VBS	Standard	Opt-out	None documented	Informed	Within 24h of incarceration
Beckwith et al.[33]	RIDOC	Oral	Rapid (1 day/week)	Opt-out	Inmates not completing medical evaluation on a day when the programme was offered	Written	Within 24h of incarceration
Beckwith et al.[32]	Baltimore, Philadelphia and District of Colombia	Ba:VBS Ph: oral DC: oral	Rapid	Opt-out	None documented	Ba: Verbal Ph: Written DC: No separate consent	On incarceration (details varied between sites)
Behrendt[39]	Maryland Prison	VBS	Standard	Opt-in	None documented	Informed	On incarceration
Cotten-Oldenberg et al.[41]	North Carolina Correctional Institution for Women	VBS	Standard	Opt-in	Those returning to prison for parole violations	Voluntary, but unclear process	On incarceration
Horne et al.[48]	Dartmoor Prison, UK	HCV antibody testing and confirmatory PCR testing	Standard	Opt-in	None documented	Not described	On incarceration
Hoxie et al.[49]	Wisconsin	VBS	Standard	Opt-in	None documented	Written	On incarceration
Kavasery et al.[53]	York Correctional Institution, Connecticut	Oral	Rapid	Opt-out	Physically unavailable; deemed medically incompetent to consent; those who opted out	Written consent for study and HIV test (but verbal consent for referral to study to replicate real life opt-out situation)	3 arms: immediate (during initial medical screen on night of admission); early (during a physical examination the following evening); delayed (7 days after arrival)
Kavasery et al.[54]	New Haven Correctional Centre, Connecticut	Oral	Rapid	Opt-out	As above	As above	3 arms as above: immediate; early; delayed
Liddicoat et al.[55]	County Jail in Boston, MA	VBS	Standard	Opt-in	Self-reported to be HIV+ve; not fluent in English or Spanish; sentence of <30 days; illegal immigrants	Informed	On incarceration
Skipper et al.[61]	Isle of Wight, UK	HCV antibody testing and confirmatory PCR testing	Standard	Opt-in	None documented	Not described	On incarceration
Spaulding et al.[63]	Fulton County Jail, Georgia	Oral	Rapid	Opt-out	Self-reported to be HIV+ve; not able to provide consent	Not described	On incarceration
Strick et al.[64]	Washington State Department of Corrections	VBS	Standard	Voluntary, Opt-in and Opt-out	Those known to be HIV+ve	Verbal informed	On incarceration (within 14 days)
Watkins et al.[70]	Western Australia	VBS (HIV, HBV, HCV)	Standard (assumed)	Opt-in	None documented	Not described	Within 28 days of incarceration

a: VBS, venous blood sample; DBST, dried blood spot test.
b: Opt-in for existing inmates; 'mandatory opt-out' for new admissions and 'psychiatric patients'.
c: Rhode Island Department of Corrections.

Table 4 Outcome measures of routine testing interventions

First author	Total (new) inmates in period of analysis or sample total	Number of test offers	Number of tests performed[a]	Coverage[b]	Acceptance[c]	Received result	Positive results: new (NI) or total (TI)	Positive results[d]
Andrinopoulos et al.[16]	2057 (NB 'available for participation')	Opt-in: 1200 Opt-out: 360	Opt-in: 753 Opt-out: 303	Opt-in and out combined: 51%	Opt-in: 63% Opt-out: 84%	N/Av	Opt-in: 24 Opt-out: 10	Opt-in: 3.3% Opt-out: 3.5%
Andrus et al.[30]	977	977	637	65%	65%	N/Av	6	0.9%
Beckwith et al.[36]	100	100	95	NA	95%	Preliminary positive: 1/1 Negative: 94/94	0 (1 false positive)	0.0%
Beckwith et al.[35]	140739	N/Av	102229	73%	N/Av	N/Av	NI: 169 TI: 1259	NI: 0.2%
Beckwith et al.[33]	NA	1364	1343	NA	98%	Positive: 1/1 Negative: 0/1331	NI: 1 TI: 12	NI: 0.1%
Beckwith et al.[32]	Ba: 72000 Ph: 39181 DC: 17903	Ba: 9268 Ph: 39181 DC: 15982	Ba: 2066 Ph: 27000 DC: 12546	Ba: 3% Ph: 69% DC: 70%	Ba: 22% Ph: 69% DC: 79%	N/Av	Ba: 42 Ph: 156 DC: 106	Ba: 2% Ph: 0.6% DC: 0.8%
Behrendt et al.[39]	2791	2791	Opt-in: 1303 (Serosurvey: 2842)	Opt-in: 47%	Opt-in: 47%	N/Av	Opt-in NI: 70 (Serosurvey NI: 204)	Opt-in NI: 5.4% (Serosurvey: 7.2%)
Cotten-Oldenberg et al.[41]	680	680	483	71%	71%	N/Av	12	2.5%
Horne et al.[48]	3034	3034	HCV: 376	HCV: 12%	HCV: 12%	N/Av	HCV: 45 PCR +ve (5 confirmatory tests N/Av)	HCV: 12.0%
Hoxie et al.[49]	1987: 1783 1988: 1675	1987: 1783 1988: 1675	1987: 708 1988: 1190	1987: 40% 1988: 71%	1987: 40% 1988: 71%	N/Av	1987: 6 1988: 7	1987: 0.8% (CI:0.17-1.53) 1988: 0.6% (CI 0.15-1.03)
Kavasery et al.[53]	Imm: 108 Early: 108 Del: 107	Imm: 93 Early: 87 Del: 67	Imm: 59 Early: 79 Del: 54	Imm: 55% Early:73% Del: 50%	Imm: 63% Early: 91% Del: 81%	Preliminary positive: 2/2 Negative result: 145/147 (denominator different due to verbal consent process for swab and written consent for study participation)	0 (2 false positives)	0.0%
Kavasery et al.[54]	Imm: 103 Early: 98 Del: 97	Imm: 98 Early: 74 Del: 49	Imm: 46 Early: 52 Del: 32	Imm: 45% Early: 53% Del: 33%	Imm: 47% Early: 70% Del: 65%	Preliminary positive result: 2/2 Negative result: N/Av	NI: 1 (1 false positive) TI: 12	NI: 0.8%
Liddicoat et al.[55]	2886	1004	734	25%	73%	N/Av	NI: 2	0.3%
Skipper et al.[61]	1618	1618	HCV: 137	HCV: 9%	HCV: 9%	N/Av	HCV: 41 PCR +ve	HCV: 29.9%
Spaulding et al.[63]	39073	18869	12141	31%	64%	N/Av	NI: 52 TI: 120	NI: 0.4%
Strick et al.[64]	Voluntary: 12202 Opt-in: 16908 Opt-out: 5168	N/Av	Voluntary: 610 Opt-in: 12174 Opt-out: 4651	Voluntary: 5% Opt-in: 72% Opt-out: 90%	N/Av	Positive: 19/19 (opt-in and out combined) Negative: N/Av	Vol NI: 3 Opt-in NI: 13 Opt-out NI: 6	Vol NI: 0.5% Opt-in NI:0.1% Opt-out NI: 0.1%
Watkins et al.[70]	946	N/Av	HIV: 314 HBV: 286 HCV: 314	HIV: 33% HBV: 30% HCV: 35%	N/Av	N/Av	HIV: 2 HBV: 13 HCV: 82	HIV: 0.6% (CI: 0.2-1.5) HBV: 4.5% (CI:1.2-2.1) HCV: 24.8% (CI:20.2-29.5)

a: HIV tests unless otherwise stated as HBV or HCV.

b: Number of tests performed/total number of inmates or participants (%).

c: Number of tests performed/number of test offers (%).

d: New infections or positive test results/total tests performed (95% CIs given where available).

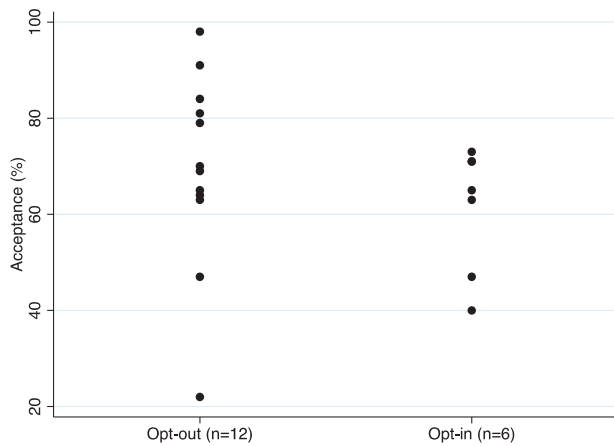NA: not applicable

N/Av: not available

Figure 2 HIV testing acceptance percentage by type of test offer

those offered screening decreased as the time from admission to testing increased.[53,54]

Equity in uptake

One concern is that those at highest risk may opt-out of testing, but the studies in this review generally do not support this. Only one study found that a high-risk group, those incarcerated for a drug offense, were 25% more likely to refuse testing.[39] In other studies, those with known risk factors or those who perceived themselves to be at higher risk were either significantly more likely to accept testing or there was no significant difference between high- and low-risk groups.[30,41,49,50,53,54,56]

Mixed results were found amongst other subgroups. Five studies found no significant association between ethnicity and acceptance of routine testing,[30,41,49,54,56] whilst two studies did.[39,67] Behrendt et al.[39] found that African-Americans were 20% more likely to refuse testing. A prospective controlled study of opt-out HIV testing found that being Hispanic was significantly associated with being tested in a bivariate model but not in the multivariable model.[53] An analysis of two large national prisoner surveys found significant racial differences in HIV testing with blacks more likely to be tested for HIV at admission than whites by about 29%.[67] Four studies report no significant association between age and testing acceptance.[16,30,54,57] However, four other studies found that younger age groups were more likely to accept an HIV test.[39,49,53,56] Two studies reported no significant association between HIV testing rates and gender,[30,39] whilst two other studies found a significant association (in one males were more likely to be tested and in the other females).[67,70]

Notification of results

Five studies included the proportion of inmates receiving HIV test results,[33,36,53,54,64] three of which used conventional (non-rapid) testing and describe giving results to the majority of those tested.[53,54,64] In one of these, only data for those with positive results were presented and one HIV positive result was notified post release.[64] A rapid HIV testing study reported that 100% of participants received initial results during the testing session.[36] However, the protocol for another rapid HIV testing study specified that those testing negative were not routinely informed of results but are given contact information if they wish to check their result.[33] Three studies present qualitative findings relating to notification of results from both provider and inmate perspectives.[33,46,52] Common themes include that those with negative results are often not informed and a general assumption of 'no news is good news'. Inmates may learn about a positive test by being moved accommodation or called to an appointment with the HIV specialist, whereas others described being called to the

medical facility with the assumption that this meant the result was positive when in fact another issue was to be addressed.[46,52]

New infections diagnosed

All 17 interventions report the number of infections identified. Table 4 presents the percentage of new cases identified through routine testing as the proportion of new cases over the total number of tests performed. A key limitation is that data about previous diagnoses are not always available or accurate and therefore may overestimate the number of new cases identified by the programme. New case identification rates for HIV opt-out programmes range from 0[53] to 3.5%,[16] but all bar one are below 1%. For HIV opt-in schemes, rates range from 0[36] to 5.4%.[39] These rates should not be directly compared, as the time when the studies were conducted will affect the HIV prevalence rate. In addition, the numbers of HIV diagnoses were very small making meaningful statistical analysis difficult. The numbers and percentages were much higher for hepatitis: for HCV new cases identified as a proportion of total tests were 12%,[48] 24.8%[70] and 29.9%.[61]

Undiagnosed infection

Four studies offer information on the proportion of HIV infections identified by opt-in testing programmes.[30,38,39,49] All estimated the total number of HIV infections through anonymous serosurvey and compared them to those obtained through routine testing (with or without self-reporting included). In one study, 47% of inmates underwent routine testing but this failed to detect 56% of the HIV cases identified through serosurvey.[39] For the other three studies, the results were 50% of cases undetected (65% tested)[30]; 28% undetected (55% tested)[49] and 24% undetected (unknown % tested).[38] All support the finding that a significant percentage of HIV infection remains undiagnosed with opt-in HIV testing. We found no studies that explored this quantitatively with opt-out testing.

The studies considering undiagnosed infection have important limitations. Those with previously diagnosed infection may not disclose their status and may also decline testing and thus will appear in the 'undiagnosed' group. Second, those with a history of injection drug use are less likely to have remnant serum for serosurvey testing which may bias the results relying on the use of remnant serum. For example, 31% of those who had a medical intake examination did not have an adequate remnant sample for HIV serosurvey testing and were more likely to be black; older and a PWID.[38] Third, the numbers of HIV diagnoses are often small thus limiting meaningful analysis, such as one study that identifies 12 HIV positive inmates of which six were identified by routine testing.[30]

Discussion

This review demonstrates that a number of studies have investigated the effectiveness and impact of routine BBV testing policies in prisons. Overall, the evidence suggests that reasonable rates of test uptake and coverage can be achieved with opt-in and, even better, with opt-out policies. There was, however, some evidence of inequitable uptake with significantly lower rates of testing amongst older individuals in half the studies that report this and mixed evidence in relation to ethnicity and gender.

The quality of the evidence is mixed with only two prospective controlled studies identified. Many studies were carried out in a single institution and so generalizability is limited. Other limitations include a reliance on self-reported data; varying denominators and exclusions from testing; insufficient details to fully understand interventions and those with known infection introducing a bias by either not disclosing status then being tested or refusing testing. Studies that use serosurvey data usually rely on remnant sera and this

introduces bias as those with sufficient available sera significantly differ from those without.

General limitations to this review are that only English language articles were included and only one reviewer carried out the study selection. Where doubt existed about inclusion, articles were discussed with the second reviewer and consensus reached. The second reviewer verified data extraction and bias assessment.

Despite these limitations, the available evidence does support the feasibility and potential benefits of routine testing (both opt-in and opt-out) over either risk stratification or on request testing. Non-routine testing policies only achieve low testing coverage rates and therefore will miss some individuals with infection.[71] However, with routine HIV opt-in policies, a number of studies also found that a significant percentage of HIV infection will remain undiagnosed.[30,38,39,49] Risk-based testing policies rely on knowledge and acknowledgement of risk; however, studies have shown that those with newly diagnosed HIV infection frequently do not self-report traditional risk factors.[35,38,72] Further, a risk assessment may be a barrier to staff offering testing, whilst with routine testing, the test can be a usual part of the intake routine therefore reducing staff burden.[73,74]

Four studies illustrate change in coverage and acceptance with different testing models. However, all have limitations reducing the strength of evidence they provide. One study only presents the crude numbers of tests before and after a change in policy and thus provides little information about the impact of the change.[31] Another compares the implementation of opt-in testing with a historical period when testing was on request.[55] Test acceptance increased from 18 to 73%, but there were so many exclusions from the opt-in testing offer as to limit the generalizability of these findings. Two other descriptive studies provide stronger evidence but are limited by the potential for cohort effects. In Fulton County Jail, there was an increase from 43% acceptance during opt-in testing to 64% under opt-out,[63] whilst in the Washington State Department of Corrections, an increase from 5% (testing on request) to 72% (opt-in) to 90% acceptance (opt-out) was reported.[64]

The studies range in place and time from 1989 to 2013 and, as the epidemiology of HIV infection has changed rapidly in that time, comparisons are difficult. Interestingly, in the USA, despite the fall in overall HIV prevalence, increased incarceration has resulted in a relatively stable number of infections in this population.[71]

Timing of the testing offer is intrinsically linked with both meeting eligibility criteria, particularly competence, and being available for testing. In the USA, the median length of stay in jail is 2–5 days, 32% of prisoners are under the influence of an illicit substance upon arrest[71] and 29% of detainees are released within 48 h.[35] A review of RIDOC HIV testing for 2000-07 showed that 43% of new HIV infections would have been missed if testing had been conducted at Day 7.[35] Immediate testing has the potential for lower rates of testing as more individuals are likely to lack capacity to consent; however, delaying the test allows greater opportunity for the inmate to have been discharged or moved elsewhere.

HCV prevalence in the prison population is higher than HIV and therefore new infection identification rates are also higher (ranging from 12 to 30%). However, evidence relating to routine HBV and HCV testing is more limited than for HIV. This may be because the studies identified are predominately from the USA. HBV may be considered less of an issue in the USA because of routine immunization of infants. However, HBV prevalence among the incarcerated is still fivefold that of the general population.[75] Few studies incorporate testing of multiple BBVs and only one study attempts to link multiple BBV testing with testing acceptance.[56]

Giving results (both positive and negative) as a part of a routine testing protocol is feasible. However, considerations need to include who is going to give the result, confidentiality issues and concerns about the distress of a diagnosis upon arrival in prison.[33] Rapid testing enables results to be given at the time of testing and

therefore reduces the likelihood of an individual being released prior to results becoming available; however, confirmatory test results may still be pending and so for both conventional and rapid testing regimes, a plan needs to be in place for informing them of their results post-release. In the USA, those released within 7-10 days typically do not receive results until after release which relies on good collaboration with community colleagues.[35]

Repeat testing is complex with studies describing individuals having multiple HIV tests.[52] At RIDOC in 2000-07, 102 229 tests were performed on an estimated 40 000–60 000 persons.[35] This demonstrates that with opt-out testing, recidivists will likely be tested multiple times. There is therefore a need for clear policy on repeat testing: if risk is ongoing, repeat testing at appropriate intervals is desirable; however, the resource implications need to be considered for unnecessary repetitive testing.

In the UK, routine opt-out BBV testing has been successful in other environments. Antenatal HIV opt-out testing has been implemented with a large increase in testing rates, significantly fewer undiagnosed cases at delivery and earlier diagnosis.[76] In the prison context, the new BBV policy includes an opt-out test offer for HIV, HBV and HCV for all prisoners within 72 h of arrival and to existing prisoners, excluding those tested within the last 12 months and not subsequently put themselves at risk; known to be positive for a BBV and for HBV if they have evidence of a negative result and have been fully vaccinated.[20] Further, it includes the concept of a 'continuous offer' so that if an individual declines testing, they will be re-offered at subsequent opportunities.[77] This programme has been implemented in a small number of 'Pathfinder' prisons which will be evaluated prior to national roll-out.[78]

Conclusion

Although there is little evidence relating to HCV and HBV testing, routine opt-in and opt-out HIV testing have been shown to be feasible and acceptable in prisons. Routine opt-out BBV testing policies should consider a number of issues: (i) The timing of the testing offer needs to balance three factors: acceptability, competence and availability. An early testing offer is preferable but with subsequent testing opportunities for those without capacity on arrival. (ii) There should be clear exclusion criteria with guidelines for when an individual reports a recent test (the most common reason for declining). (iii) Testing methods that do not include venepuncture should be considered and the population dynamics support the use of rapid testing when possible. (iv) Clear protocols are needed for informing individuals of results regardless of whether they are still in prison or not. (v) Opt-out testing in prison offers the opportunity to reduce existing disparities in community BBV testing; however, care needs to be taken to ensure equitable access to all inmates. (vi) Further research is needed to explore the ideal time to offer testing in UK prisons and the perceptions of opt-out BBV testing.

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Key points

- People in prison tend to have both a higher burden of disease and poorer access to healthcare. Infection with blood-borne viruses (BBVs) is higher than in the general population largely due to higher levels of injecting drug use.

- This systematic review found little evidence relating to hepatitis C virus (HCV) and HBV testing; however, routine opt-in and opt-out HIV testing have been shown to be feasible and acceptable in the prison setting.
- A new programme of opt-out BBV testing in England has recently been implemented in a small number of 'Pathfinder' prisons from which lessons will be learned and shared prior to national roll-out. This literature review will enable existing evidence on routine BBV testing policies to inform revisions to the programme.
- Routine opt-out BBV testing policies need to consider a number of issues: the timing of the testing offer needs to balance three key factors: acceptability, competence and availability. Clear exclusion criteria need to be set. Tests need to be sensitive and specific and the population dynamic supports the use of rapid testing when possible.
- Good quality control studies of routine testing policies and further qualitative work around the impact of opt-out testing in the prison setting are required.

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