



# Tuberculosis, HIV seroprevalence and intravenous drug abuse in prisoners

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**ABSTRACT:** High rates of tuberculosis (TB) and HIV are believed to exist in Russian prisons. Prisoners with TB were studied in order to identify the following: 1) prevalence of HIV, and risk factors for HIV and other blood-borne virus infections; and 2) clinical and social factors that might compromise TB treatment effectiveness and/or patient adherence and, hence, encourage treatment failure.

A 1-yr cross-sectional prevalence study of 1,345 prisoners with TB was conducted at an in-patient TB facility in Samara, Russian Federation.

HIV and hepatitis B and/or C co-infection occurred in 12.2% and 24.1% of prisoners, respectively, and rates were significantly higher than in civilians. Overall, 48.6% of prisoners used drugs, of which 88.3% were intravenous users. Prisoners were more likely to be intravenous drug users and HIV positive compared with civilians with TB, and 40.2% of prisoners shared needles. Two-thirds of prisoners (68.6%) had received previous TB drug therapy (frequently multiple, interrupted courses) and were significantly more likely than civilians to have had previous therapy consistent with the high drug-resistance rates seen.

Prisons are major drivers of the tuberculosis and HIV epidemics. Novel strategies are needed to reduce the spread of blood borne diseases, particularly in intravenous drug users.

**KEYWORDS:** HIV, intravenous drug users, prisons, Russia, tuberculosis

One of the world's fastest-growing HIV epidemics is occurring in Russia. By mid 2004, 283,000 individuals were reported as HIV positive [1], equivalent to a prevalence of 136 per 100,000 people [2]. In 2003, there was also a significant rise in tuberculosis (TB) incidence and mortality [3] to 83.0 per 100,000 and 22.0 per 100,000, respectively [4, 5]. High rates of drug-resistant TB and multiple drug-resistant TB (MDRTB) have been reported from former countries of the USSR [6–11]. Unfortunately, the HIV and TB epidemics are now converging in Russia [12].

Globally, prisons have shown some of the highest concentrations of TB, viral hepatitis and HIV; for example, worldwide, it is estimated that HIV infection is 75-times higher in prisoners than among civilian population [13]. The Russian Federation has one of the highest incarceration rates in the world, with nearly 1% of the population kept in prisons [14], and ~350,000 people leaving prisons annually. Many of the released prisoners have TB that has only been partially treated, but, frequently, ex-prisoners do not register with the civilian medical service and, therefore, fail to continue their treatment. The

high rates of treatment interruption are a major factor associated with drug resistance. Russian prisons are sites of poor health. In 2002, of 905,000 prisoners in Russia, 405,000 were ill and 90,000 of these had TB, 102,000 were drug addicts and 72,000 were alcoholics [15].

Samara is one of 89 regions in Russia, with a population of 3.3 million. Although an economically advanced region, it is a site of a rapidly expanding HIV epidemic, with 22,424 registered cases in mid 2004 [16, 17]. In 2003, the corresponding new TB cases and mortality rates were 74.9 per 100,000 and 12.3 per 100,000, respectively [18, 19]. TB is also a major problem in Samaran prisons, with a TB incidence rate of 2,200 per 100,000 [18, 19]. Over 400 cases of co-infection with TB and HIV had been reported by mid 2004 in Samara.

The current authors performed the largest systematic cross-sectional study of Russian prisoners with TB to date, with the aim of: 1) establishing the prevalence of HIV co-infection; 2) identifying risk factors for concurrent HIV infection, for non-completion or poor adherence of treatment; and 3) producing a detailed demographic, clinical

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and social profile of TB patients. It was hoped that this analysis would help to define the appropriate public health action, aiming to reduce HIV and blood-borne virus transmission, and improve TB treatment for prisoners in the Russian penitentiary services and elsewhere in the industrialised world.

## METHODS

Patients with pulmonary TB were recruited from the prison TB hospital colony over 1 yr from November 2001 to October 2002. The TB hospital colony is an in-patient facility that diagnoses and admits all TB cases from the prison sector for treatment. TB in prisoners is diagnosed using a combination of radiological screening (on admission and then every 6 months), microscopy and bacteriological culture. Consecutive patients aged >18 yrs were invited to take part on arrival at the TB hospital colony, gave informed written consent, and were interviewed by a team of trained Russian nurses using a structured questionnaire. All TB patients were routinely tested for HIV and hepatitis B and C. Over the same time period, 1,522 civilian males with pulmonary TB were interviewed using the same questionnaire to further identify particular features related to prisoner-associated TB compared with males in civil society. Civilian males were drawn from all 18 civilian TB dispensaries across the region, in proportion to the number of new TB cases contributed annually by each dispensary. The questionnaire and study was developed and approved by the Federal Tuberculosis Institutions (Moscow), Samara TB service, Samara Ethics Committee, and the Samara Regional Health Dept, under whose auspices the study was conducted. Questionnaire-derived demographic (*e.g.* age, sex, ethnicity, housing), clinical and social data (*e.g.* sexually transmitted diseases, HIV and hepatitis status, bacille Calmette-Guérin (BCG) vaccination, TB contact and treatment history) were verified using the medical notes. The sexual health section of the questionnaire was completed using previously established methodology [20, 21]. Radiological reports were analysed descriptively (area of lungs affected and presence of cavities).

Comparative analyses against all variables were conducted between HIV-positive and -negative groups using Chi-squared and Mann-Whitney U-tests. From the univariate analysis, all variables that had a *p*-value of  $\leq 0.1$  were included in a multivariate logistic regression analysis. The initial model contained all variables meeting this criterion, with nonsignificant variables removed sequentially until only statistically significant variables were included.

## RESULTS

Questionnaires were completed and medical notes reviewed on 1,345 prisoners with TB across the region (<2% refused to participate). Prisoners were nearly all male, principally of Russian ethnicity (83.3%), had been BCG vaccinated (98.8%) and had a median age of 31 yrs (range 21–39; table 1). Few had been homeless (1.5%), but a large minority (27.1%) had lived in poor communal housing before imprisonment. Some prisoners had previously been incarcerated on a number of occasions, as follows: once (1.5%), twice (19.2%), three times (37.5%) and four times (25.1%).

### **Clinical and social profile of prisoners compared with civilians**

The principal clinical features of the prisoners interviewed are given in table 1 and were typical of those with pulmonary TB. With the exception of a productive cough (83.6%), fatigue (79.7%) and shortness of breath (52.7%), most features were exhibited by only a minority of patients, emphasising the importance of laboratory confirmation of TB. Prisoners, despite a widespread system of repeated fluorographic examination, were more likely to be symptomatic and have advanced disease (83.6% had a productive cough and 48.2% had two damaged zones with/without cavities on their chest radiographs). Over two-thirds (68.6%) had received previous TB drug therapy, which is a major risk factor for drug resistance. High rates of civilians and prisoners had received BCG vaccination.

Table 1 indicates the rates of HIV and principal blood-borne virus (hepatitis B or C) co-infection, previous history of sexually transmitted infections (STIs) and sexual practices for prisoners. The rate of co-infection with HIV was 6.0% overall (197 out of 3,279), but was significantly higher (12.2%; 164 out of 1,344) in prisoners compared with civilian TB patients (1.7%; 33 out of 1,935). The rate difference was 8.6–12.4%, relative risk (RR) was 4.9–10.3 and the odds ratio was 5.47–11.7 between civilian and prisoner patients at a significance of  $p < 0.001$ .

Viral hepatitis was seen in 24.1% of prisoners, reflecting the high rates of jaundice observed (16.5%). The rates of HIV and viral hepatitis were higher in intravenous drug users (IDUs) compared with prisoners who did not inject drugs, based on those answering the question on IDU (10.7% (61 out of 568) versus 11.1% (six out of 54),  $p < 0.05$ ; and 34.1% (192 out of 563) versus 28.9% (22 out of 76),  $p > 0.05$ ). Approximately 26.7% of prison patients had been infected with a STI.

Most patients started smoking early in life and alcohol consumption was high generally, which was reflected in the high rates of liver disease and jaundice, although 7.5% did not drink at all. Smoking and alcohol consumption were higher amongst prisoners compared with civilians with TB (table 2). Overall, 48.6% (648 out of 1,334) of prisoners used drugs, which was significantly higher than amongst civilian patients. Drug abuse amongst prisoners was primarily intravenous (88.3%), with opiates as the preferred type of drug (85.6%). Sharing needles was practiced by 40.2% of IDUs, with 3.1% using blood as a stabiliser material.

Overall, prisoners did not appear to be more economically disadvantaged than civilians, as although civilians were less likely to have owned their own flat previously, they were less likely to have lived in a "wooden house" (a traditional basic dwelling made of wood with no internal sanitation).

### **Differences between HIV-positive and -negative TB patients**

Prisoners with HIV and TB (table 3) co-infection were more likely to have fever (RR=1.55; 95% confidence interval (CI) 1.04–2.29), but were less likely to report weight loss (RR=0.63; 95% CI 0.43–0.92) or shortness of breath (RR=0.62; 95% CI 0.44–0.88). They also reported a history of previous lung disease more frequently (RR=2.42; 95% CI 1.54–3.83).

HIV-positive individuals were more likely to have previous liver disease (RR 4.90; 95% CI 2.99–8.02), jaundice (RR 6.38;

**TABLE 1** Demographic, clinical and social parameters of prisoners with tuberculosis (TB)

Variable	Responding prisoners n	n (%)
<b>Sex</b>	1342	
Male		1327 (98.9)
Female		15 (1.1)
<b>Age<sup>#</sup></b>	1336	
<b>Ethnicity</b>	1333	
Russian		1111 (83.3)
<b>Residence</b>		
Homeless	1319	20 (1.5)
Own flat	1334	910 (68.2)
Common flat	1334	33 (2.5)
Hostel	1334	10 (0.8)
Wooden house <sup>†</sup>	1333	360 (27.1)
Share accommodation with other adults	1345	1173 (87.2)
Sharing with children	1345	260 (19.3)
<b>Clinical</b>		
Active pulmonary TB	1336	1114 (83.4)
Productive cough	1339	1119 (83.6)
Weight loss	1335	420 (31.5)
Night sweats	1336	370 (27.7)
Fever	1332	277 (20.8)
Shortness of breath	1338	705 (52.7)
Chest pain	1335	652 (48.8)
Fatigue/weakness	1338	1066 (79.7)
<b>Contact with TB cases</b>	1338	551 (41.2)
Home <sup>+</sup>	1338	204 (15.2)
Workplace	478	6 (1.3)
<b>BCG vaccination</b>	1209	1195 (98.8)
<b>Radiology zones affected</b>		
≥2 damaged zones	1252	552 (44.1)
≥2 damaged zones and/or cavities	1253	604 (48.2)
<b>Treatment<sup>‡</sup></b>		
Previous drug therapy or currently on therapy for >4 weeks	1339	1214 (90.7)
Surgical treatment	1340	21 (1.6)
<b>Sexually transmitted and blood-borne infections</b>		
HIV positive	1344	164 (12.2)
Hepatitis B or C infection	1327	320 (24.1)
Jaundice	1337	221 (16.5)
Any STI	1327	354 (26.7)
Gonorrhoea	1323	85 (6.4)
Syphilis	1327	116 (8.7)
Chlamydia	872	4 (0.5)
<b>Recreational drugs<sup>§</sup></b>	1334	648 (48.6)
Cocaine	589	17 (2.9)
Marijuana	600	116 (19.3)
Amphetamine	589	7 (1.2)
Opiate	645	552 (85.6)
By injection	642	567 (88.3)
Injecting and sharing needles	532	214 (40.2)
<b>Smoking</b>		
Current smoker	1339	1293 (96.6)
Cigarettes	1292	632 (81.8)
Ex-smoker	1304	21 (1.6)

**TABLE 1** (Continued)

Variable	Responding prisoners n	n (%)
<b>Alcohol consumption<sup>f</sup></b>	1339	1238 (92.5)
Every day	1235	144 (11.7)
<b>Social activities</b>		
Visiting saunas	1325	775 (58.5)
Visit pubs/clubs	1327	670 (50.5)
Visit church	1156	41 (3.5)

BCG: bacille Calmette–Guérin; STI: sexually transmitted infection. <sup>#</sup>: median (interquartile range) 31 yrs (25–39); <sup>†</sup>: no modern conveniences; <sup>+</sup>: parents, grandparents, uncles, aunts, siblings, partners; <sup>‡</sup>: this includes conventional TB drug chemotherapy, surgical management, and "pathogenetic/physiotherapeutic" treatments (e.g. laser, UV light, electrical) unique to the Russian TB system; <sup>§</sup>: self-reported only.

95% CI 4.03–10.10), and concurrent hepatitis B or C infection (RR 2.13; 95% CI 1.45–3.13) in the univariate analysis, with history of lung diseases and jaundice remaining significant in the multivariate analysis (odds ratio (OR) 2.17, 95% CI 1.23–3.81; and OR 8.48; 95% CI 4.86–14.80, respectively). Univariate analysis showed that prisoners with HIV and TB were also more likely to have been treated for TB previously (RR 1.44; 95% CI 1.00–2.06) and to be on post-treatment anti-TB relapse therapy (RR 2.61; 95% CI 1.43–4.75). Prisoners had received between one and 23 cycles of therapy.

## DISCUSSION

This study is one of the largest (and the largest in Eastern Europe) population-based studies of TB patients with and without HIV infection. The study revealed worrying trends for those charged with the management of the HIV and TB epidemics in prisons. A high prevalence of HIV amongst prisoners with TB, particularly those who were IDUs, was found, and the rate of HIV was significantly higher than in civilian patients.

In the Samaran TB colony, nearly half of the prisoners admitted recreational drug use, with many using and sharing needles, which explained the relatively high rates of HIV and hepatitis B or C. The corresponding rates of HIV infection and intravenous drug use in 1,522 male civilians who were interviewed during the same time period were significantly lower at 2.4% and 3.3% (both  $p > 0.05$ ), respectively. Other studies have demonstrated a widespread and early introduction to injecting drugs in civilian society, which must underpin the prison situation; for example, one study in Moscow showed that 4% of school children used drugs, some as young as 13–15 yrs [22]. Intravenous drug use remains a problem within prisons across the industrialised world [13]; for example, in the UK, it is estimated that 24% of prisoners are IDUs, and, of those, 20% have hepatitis B and 30% hepatitis C. In Norway, 28% of prisoners are imprisoned for drug-related offences [14].

The comparative analysis of TB patients co-infected with HIV and other TB patients supports the importance of intravenous drug abuse as the principal vector of HIV (and blood-borne

**TABLE 2** Significant differences in clinical, social and sexual health factors between male civilians and prisoners with tuberculosis

Variable	Levels	Civilians n	Prisoners n	p-value <sup>#</sup>	OR (95% CI) univariate	OR <sup>#</sup> (95% CI) multivariate
<b>Demographic</b>						
Own flat	Yes	1075	892	0.08	1.16 (0.98–1.36)	0.48 (0.24–0.93)
	No	441	423			
Wooden house	Yes	308	359	<0.0001	0.68 (0.57–0.81)	0.42 (0.20–0.85)
	No	1207	955			
<b>Clinical current symptoms</b>						
Cough and phlegm	Yes	973	1102	<0.0001	0.35 (0.30–0.42)	0.53 (0.33–0.85)
	No	543	218			
Chest pain	Yes	300	638	<0.0001	0.26 (0.22–0.31)	0.34 (0.22–0.52)
	No	1213	678			
<b>Previous history of illness</b>						
Previously treated	Yes	1016	1174	<0.0001	0.26 (0.21–0.31)	0.12 (0.07–0.19)
	No	505	150			
COPD	Yes	299	38	<0.0001	8.57 (6.05–12.13)	28.75 (12.10–68.30)
	No	1005	1094			
<b>Radiology<sup>†</sup></b>						
Localised	Yes	614	314	<0.0001	1.49 (1.26–1.77)	2.04 (1.35–3.08)
	No	957	873			
Diffuse	Yes	34	54	0.001	0.49 (0.32–0.76)	0.29 (0.11–0.79)
	No	1433	1117			
Post-operative	Yes	80	8	<0.0001	8.39 (4.04–17.43)	8.41 (2.28–31.01)
	No	1387	1164			
<b>Recreational activities</b>						
Smoking	Yes	1149	1276	<0.0001	0.11 (0.08–0.15)	0.25 (0.11–0.53)
	No	372	44			
Drug use	Yes	61	650	<0.0001	0.04 (0.03–0.06)	0.04 (0.02–0.08)
	No	1451	691			
Saunas	Yes	292	769	<0.0001	0.17 (0.14–0.20)	0.05 (0.04–0.08)
	No	1228	545			
Concert hall	Yes	83	22	<0.0001	3.52 (2.18–5.66)	3.70 (1.19–11.47)
	No	1205	1123			
Cinema	Yes	113	32	<0.0001	3.32 (2.23–4.96)	5.95 (2.44–14.52)
	No	1185	1115			
<b>Sexually transmitted infections</b>						
Syphilis	Yes	42	115	<0.0001	0.30 (0.20–0.43)	0.25 (0.11–0.57)
	No	1469	2662			
Herpes	Yes	10	117	<0.0001	0.05 (0.03–0.10)	0.03 (0.01–0.11)
	No	1501	931			

OR: odds ratio; CI: confidence interval; COPD: chronic obstructive pulmonary disease. <sup>#</sup>: statistically significant variables from univariate analysis included in final model;

<sup>†</sup>: includes pathological-based description (more typically used in Russian radiological description) and zone-based description.

viral spread). Higher rates of sexually transmitted diseases, such as gonorrhoea, amongst prisoners also suggest the increasing importance of STIs as a facilitator of HIV transmission in this group. Saunas are an important nonsexual social event for Russians of both sexes; traditionally, the steam produced has been considered to be helpful for respiratory illnesses, and this may help to propagate and spread bacilli.

High rates of multiple drug resistance have been reported in Samara, particularly within the prison TB colony [23]. The overall prevalence of isoniazid, rifampicin, streptomycin, ethambutol and pyrazinamide resistance amongst TB cases in

prisoners was 62.7%, 37.3%, 71.4%, 33.3% and 13.0%, respectively. The prevalence of MDRTB in new prison cases was 37.3% [24], nearly twice as high as the rate among civilian TB patients.

There have been problems with maintenance of the drug supply, which, together with limited access to high-quality, fixed-dose combination drugs, leads to frequent changes of drug therapy and relatively poor continuity of treatment. The higher probability of both underlying (alcohol, viral hepatitis, *etc.*) and TB treatment-related hepatotoxicity in this group reinforces potential underdosing and the development of drug

**TABLE 3** Factors associated with both tuberculosis (TB) and HIV co-infection in prisoners

Variable	Levels	HIV+ve prisoners n	HIV-ve prisoners n	RR (95% CI)
<b>Clinical</b>				
Losing weight	Yes	43	273	0.63 (0.43–0.92)
	No	109	434	
Fever	Yes	45	151	1.55 (1.04–2.29)
	No	107	555	
SOB	Yes	72	420	0.62 (0.44–0.88)
	No	80	290	
Previous lung disease	Yes	127	482	2.42 (1.54–3.83)
	No	25	230	
Chest pain	Yes	88	352	1.39 (0.98–1.98)
	No	64	356	
<b>Treatment types</b>				
Previously on treatment	Yes	96	382	1.44 (1.00–2.06)
	No	57	326	
On anti-TB relapse treatment	Yes	18	34	2.61 (1.43–4.75)
	No	136	670	
<b>Previous medical history</b>				
Liver disease	Yes	45	167	4.90 (2.99–8.02)
	No	30	545	
<b>Radiology</b>				
Localised	Yes	37	157	2.12 (1.35–3.33)
	No	56	504	
Tuberculoma	Yes	12	29	3.96 (1.93–8.12)
	No	66	631	
Fibro-cavernous	Yes	19	76	2.15 (1.23–3.77)
	No	68	585	
≥2 damaged zones	Yes	33	473	0.81 (0.51–1.28)
	No	50	580	
≥2 damaged zones/ cavities	Yes	38	513	0.87 (0.51–1.28)
	No	46	540	
<b>TB contact</b>				
Any contact	Yes	82	290	1.68 (1.18–2.39)
	No	71	422	
<b>Social and sexual history</b>				
Alcohol	Yes	146	641	2.34 (1.06–5.20)
	No	7	72	
Jaundice	Yes	46	45	6.38 (4.03–10.10)
	No	107	668	
HCV/HBV	Yes	51	141	2.13 (1.45–3.13)
	No	97	571	
Unprotected sex	Yes	31	224	0.55 (0.36–0.84)
	No	122	485	
Gonorrhoea	Yes	15	41	1.80 (0.97–3.35)
	No	135	665	

+ve: positive; -ve: negative; RR: relative risk; CI: confidence interval; SOB: shortness of breath; HCV: hepatitis C virus; HBV: hepatitis C virus.

function test abnormality than, for example, that which is recommended in UK and USA guidelines [27–31]. Prisoners will be released at the end of their sentence (as in Western European countries), and, if treatment is not completed, therapy will be continued in the civilian sector, although many patients are lost to follow-up. This, coupled with the reintroduction of therapy when repeat offenders are screened for TB fluorographically, contributes to the frequent “pulses” of inadequate chemotherapy.

Prisons (and pre-trial detention centres called SIZOs) are likely to be major drivers of the TB epidemic in Samara due to the following: 1) multiple partial treatment courses, as prisoners with TB had frequently been in prison several times; 2) the subsequent high loss to follow-up in the civilian sector, which has been reported elsewhere [1, 32, 33]; and 3) the existence of “perverse” incentives that discourage cure, such as better food, disability allowances and no work requirement whilst in the TB colony rather than in the main prison.

The system for ensuring continuity of TB therapy from prison to civilian sectors currently fails for the following reasons: 1) the address given by the prisoner might not be the intended destination; 2) there is a lack of incentives to attract ex-prisoners, unless they are highly symptomatic on release, into further institutional care, which is largely in-patient based; and 3) many prisoners are diagnosed with TB on admission from the SIZOs, suggesting that reducing the number of prisoners entering the penal system is as important as successfully treating those who leave it. A previous lack of unequivocal standardised treatment regimens and the reliance on in-patient therapy have encouraged the institutional spread of strains within institutions such as prisons and hospitals.

Several measures have now been undertaken at a regional level to address issues of emerging TB resistance, including the strengthening of bacteriological services, standardised World Health Organization/International Union Against Tuberculosis and Lung Disease treatment and outcome monitoring systems, increased ambulatory care, and improved prison-to-civilian interaction together with the provision of support to former prisoners. At a federal level, a new law covering all of Russia has been introduced [34]. This emphasises the importance of standardised regimens, uninterrupted drug supply, and bacteriological as well as radiological diagnosis. Today, only patients with smear-negative TB can be released early through amnesties. Recent changes in the Russian penal code have also led to a fall in those entering the SIZO system.

This study emphasises the importance of practical interventions to reduce the transmission of HIV targeted at individuals with high-risk behaviour, such as IDUs, including campaigns to reduce the spread of blood-borne viruses (e.g. needle-exchange programmes). Information needs to be delivered in prisons to both inmates and administrators, as well as to IDUs outside. Although literacy rates in Samara (and in Russia as a whole) are high, there is anecdotal evidence that literacy is poor amongst many prisoners. Prisons need to improve literacy, particularly amongst teenage offenders, as part of any information campaign.

Prisons should be one of the main sites for HIV harm-reduction activities, including needle exchange, provision of

resistance. Standard doses of rifampicin have been low in previous Russian treatment guidelines [25, 26], with a discontinuation of treatment occurring at lower levels of liver

bleaches and condoms. Needle-exchange programmes are necessary, but politically difficult everywhere since this requires an admission that intravenous drug abuse is occurring within the prison, although STERN [13] has argued that prisons generally have individuals who use illegal drugs. The introduction of methadone programmes to both improve adherence of TB therapy in IDUs and prisoners, as well as directly observed TB therapy, has been shown to be successful and useful in preventing the transmission of HIV in congregated settings in other countries, such as Spain [35].

It is reasonable to conclude that imprisonment is contributing to both HIV and TB epidemics in the Samara region and, by implication, in Russia as a whole. Multiple incomplete treatment cycles, particularly in prisoners, with frequent loss to follow-up when discharged lead to drug resistance and low cure rates in TB patients. Intravenous drug abuse, in particular, is spreading blood-borne viruses. By systematically analysing the population over a 1-yr period, coupled with the high response rate, the current authors believe that this study has produced a definitive evidence base on which health-policy changes can be established. Greater coordination and integration between traditionally vertical TB and HIV programmes with a combined medical, social and behavioural approach would facilitate the management of both diseases.

Worldwide, prisons are full of marginalised people often living in overcrowded conditions, but prison health impacts on civil society when prisoners are released. Improvements in health-care in prisons are likely to be of benefit to all.

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