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Kouyoumjian, SP; Mumtaz, GR; Hilmi, N; Zidouh, A; El Rhilani, H; Alami, K; Bennani, A; Gouws, E; Ghys, PD; Abu-Raddad, LJ (2013) The epidemiology of HIV infection in Morocco: systematic review and data synthesis. *International journal of STD & AIDS*, 24 (7). pp. 507-16. ISSN 0956-4624 DOI: <https://doi.org/10.1177/0956462413477971>

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The epidemiology of HIV infection in Morocco: systematic review and data synthesis

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Summary: Morocco has made significant strides in building its HIV research capacity. Based on a wealth of empirical data, the objective of this study was to conduct a comprehensive and systematic literature review and analytical synthesis of HIV epidemiological evidence in this country. Data were retrieved using three major sources of literature and data. HIV transmission dynamics were found to be focused in high-risk populations, with female sex workers (FSWs) and clients contributing the largest share of new HIV infections. There is a pattern of emerging epidemics among some high-risk populations, and some epidemics, particularly among FSWS, appear to be established and stable. The scale of the local HIV epidemics and populations affected show highly heterogeneous geographical distribution. To optimize the national HIV response, surveillance and prevention efforts need to be expanded among high-risk populations and in geographic settings where low intensity and possibly concentrated HIV epidemics are emerging or are already endemic.

Keywords: Review, HIV, AIDS, epidemiology, Morocco, prevalence, sexually transmitted infection

INTRODUCTION

Morocco is an Arab and Muslim state situated at the North-West corner of the African continent with a population of over 32 million people.¹ It is one of the few Middle East and North Africa (MENA) countries that have made significant strides in building its HIV research capacity. With a relatively interpretable volume of HIV epidemiological data, the objective of this study was to conduct a comprehensive systematic literature review and analytical synthesis of all available HIV epidemiological evidence in this country. This is, to our knowledge, the first study to provide such an in-depth analysis of the HIV epidemic in a specific country in the MENA region. The overarching aim of our study is to provide the epidemiological evidence necessary for the formulation of country-specific HIV policies and programmes that are optimized to the context of the epidemic in Morocco. The study also aims to inform resource allocation of the HIV response at a time of financial challenges and competing priorities.

METHODS

We conducted a systematic literature review of HIV and related data in Morocco. Studies and data were identified using three sources:

- (1) The MENA HIV/AIDS Epidemiology Synthesis Project.^{2,3} The Synthesis Project is a comprehensive gathering, compilation, review and synthesis of all available biological, behavioural and contextual data about HIV in MENA. The project is the largest HIV epidemiology study in the MENA region to date and is conducted through a joint partnership with the World Bank, the MENA Regional Support Team (RST) of the Joint United Nations Programme on HIV/AIDS (UNAIDS) and the Eastern Mediterranean Regional Office (EMRO) of the World Health Organization (WHO). The study covers all countries in MENA including Morocco. All studies relevant to HIV epidemiology in Morocco identified through the Synthesis Project were included in the present study. The methodology including search strategies of the Synthesis Project are described in previous publications,^{2,3} and are summarized in Section 1 of the Supplementary Information (SI) appendix.
- (2) Systematic literature search in PubMed and Embase databases. A detailed search focused specifically on published HIV scientific literature in Morocco was conducted using a strategy with both free text and MeSH/*Emtree* headings, and with no language or year limitations. The following

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search criteria were used in PubMed: ('HIV'[Mesh] OR 'HIV Seropositivity'[Mesh] OR 'HIV Antibodies'[Mesh] OR 'HIV Infections'[Mesh] OR 'HIV Seroprevalence'[Mesh] OR HIV [Text] or 'Human immunodeficiency virus'[Text]) AND ('Morocco'[Mesh] OR 'Morocco'[Text]). The following search criteria were used in Embase: (HIV.mp. or exp Human immunodeficiency virus/) AND (Morocco.mp. or exp Morocco/). This search was undertaken for further reassurance that no studies on HIV in Morocco were missed through the Synthesis Project search. The closing date for this search was 6 October 2012.

- (3) The Morocco HIV Modes of Transmission (MoT) Project.^{4,5} A number of studies and data sources were provided by the Morocco Ministry of Health through the conduct of the MoT study in Morocco. The additional literature and data included country-level reports and unpublished data such as summary measures on HIV case notifications.

RESULTS

Data sources

Most of the publications and data relevant to this study were identified through the Synthesis Project. Out of all included studies and/or data sources, 36 were *exclusively* identified through the Synthesis Project, 31 were identified through the PubMed and Embase searches, and 13 were identified through the Morocco MoT Project.^{4,5} These contributions are summarized in Supplementary Table S2.1. Of notice is that these numbers refer to studies and/or *sources of data*, and any one source of data may contribute more than one data point. An example to this end is the US Census Bureau International Database,⁶ which is counted as one source of data through the Synthesis Project search, but contributed hundreds of data points to this study.

HIV-infected population and HIV incidence

The number of people living with HIV (PLHIV) in Morocco in 2009 was estimated by the SPECTRUM model⁷ to be 26,000 with a range of 19,000–34,000.^{8,9} Supplementary Figure S2.1 depicts an increasing trend in the number of PLHIV starting from 3400 in 1991 reaching up to 26,000 in 2009.⁹ The SPECTRUM model also estimated a range of 1200–5800 new HIV infections in 2009 (Supplementary Table S2.2). Meanwhile, the MoT model¹⁰ estimated 3447 new HIV infections with a range of 2500–4400 in 2010.^{4,5}

High-risk populations and HIV

Female sex workers and HIV

Table 1 and Figure 1 describe available HIV point-prevalence measures among female sex workers (FSWs) and other high-risk populations. Figure 1, which includes only national data or data with a wide geographical coverage, suggests that HIV prevalence among FSWs at the national level has hovered around 2% and appeared rather stable for over a decade now. This conclusion is supported by the fact that these data come from different sources including both sentinel surveillance of different types of FSWs, as well as a large volume of voluntary HIV counselling and testing (VCT) data. This national-level

prevalence estimate, however, masks variability across the regions. In the region of Sous Massa Draa for example, HIV prevalence increased from 3.18% in 2005 to 8.14% in 2009 (Supplementary Table S2.3).¹⁵

In terms of the prevalence of female sex work, a study among women hospital-attendees indicated that 0.5% of women reported ever practicing sex work.¹⁷ As for available evidence on sexual practices among FSWs, 70% of FSWs in one study reported that they had more than four clients per week.¹⁴ The average number of clients during the last seven days was 4.3 clients in another study, with 20.8% of them reporting one non-paying sexual partner and 5.1% reporting multiple such partners.¹⁸ Among those who were using different kinds of drugs, 3.7% reported injecting drugs.¹⁸

As for condom use, 59.5% of FSWs reported consistent condom use during vaginal sex in the last 30 days with their clients, while during anal and oral sex, only 26.1% and 16.9% of them had used condoms, respectively (Supplementary Table S2.4).¹⁸ The main reason for non-condom use by 40% of FSWs was reported to be objection of the client.¹⁸ Still, nearly half of the sample reported refusal of sex in case no condom was available.¹⁸ The levels of HIV/AIDS knowledge among FSWs were fairly high (Supplementary Table S2.5).

Men who have sex with men and HIV

HIV prevalence among men who have sex with men (MSM) ranged between 0% and 11% in different point-prevalence measures (Table 1). Data on the prevalence of male to male sex are limited. In a study among youth, 3.7% of men aged 15–24 reported ever having anal sex with a man.¹⁹ In a study among a group of truck drivers, 8.7% reported having a same-sex sexual partner during the last year.²⁰

Injecting drug users and HIV

HIV prevalence among injecting drug users (IDUs) ranged between 0% and 38% in different point-prevalence measures and settings (Table 1). The prevalence of injecting drug use is estimated at 0.1% with 18,500 IDUs in the country.²¹ In a study conducted among a sample of drug users, the proportion of IDUs among men was 75.3% and among women 66.2%.²² Of the total IDUs in this study, 13.9% were women.²² Also, 59.9% of all IDUs were unemployed.²² The study reported that 63.9% of IDUs shared syringes; 76.9% of them would disinfect a shared syringe before use with only 15.6% using proper means to do so.²²

IDUs appear to engage in high-risk sexual behaviour as 47.6% of men and 70.1% of women of this group of mainly IDUs reported multiple sexual partners in the last 12 months.²² Moreover, 13.1% of men reported having same-sex sexual relations, and 64.6% and 74.0% of men and women, respectively, reported selling or paying for sex.²² Only 5.9% of male IDUs and 19.5% of female IDUs reported consistent condom use (Supplementary Table S2.4).²² IDUs tended to have low levels of comprehensive HIV/AIDS knowledge (Supplementary Table S2.5).

Potential bridging populations and HIV

Available data on HIV prevalence among potential bridging populations, such as truck drivers, seamen and military personnel, suggest low HIV prevalence, generally well below 1%

Table 1 HIV prevalence among different high-risk populations in Morocco as reported in different studies

Population	Source	Year	Sample size	Prev. HIV1	Prev. HIV2	Comments
FSWs	US Census Bureau ⁶	1984–1987	27	3.7%		Casablanca
	US Census Bureau ⁶	1989	28	7.14%		Casablanca
	US Census Bureau ⁶	1989	28		0.00%	Casablanca
	US Census Bureau ⁶	2001	217	2.30%		
	WHO/EMRO Database ¹¹			1.4%		
	Ministry of Health, 2010 ¹²	2001	217	2.30%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2002	350	3.14%		Sentinel surveillance, incarcerated
	US Census Bureau ⁶	2003	264	2.27%		Sentinel surveillance
	Khattabi, 2005 ¹³	2003		2.52%		Sentinel surveillance, STI clinics
	Ministry of Health, 2010 ¹²	2003	148	2.03%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2003	116	2.59%		Sentinel surveillance, medical centres
	Ministry of Health, 2010 ¹²	2003	264	2.27%		Sentinel surveillance, total FSWs
	Ministry of Health, 2010 ¹²	2004	332	0.90%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2004	272	4.41%		Sentinel surveillance, medical centres
	Ministry of Health, 2010 ¹²	2004	167	0.00%		Sentinel surveillance, STI clinics
	Ministry of Health, 2010 ¹²	2004	771	1.95%		Sentinel surveillance, total FSWs
	Ministry of Health, 2010 ¹²	2005	90	3.33%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2005	125	1.60%		Sentinel surveillance, medical centres
	Ministry of Health, 2010 ¹²	2005	215	2.33%		Sentinel surveillance, total FSWs
	Ministry of Health, 2010 ¹²	2006	228	0.00%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2006	303	0.33%		Sentinel surveillance, medical centres
	Ministry of Health, 2010 ¹²	2006	119	0.00%		Sentinel surveillance, STI clinics
	Ministry of Health, 2010 ¹²	2006	650	0.15%		Sentinel surveillance, total FSWs
	Ministry of Health, 2010 ¹²	2007	178	3.37%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2007	476	2.73%		Sentinel surveillance, medical centres
	Ministry of Health, 2010 ¹²	2007	156	1.28%		Sentinel surveillance, STI clinics
	Ministry of Health, 2010 ¹²	2007	810	2.59%		Sentinel surveillance, total FSWs
	Ministry of Health, 2008 ¹⁴	2007	141	1.5%		STD clinics, Agadir, Rabat, Salé & Tanger
	Ministry of Health, 2010 ¹²	2008	126	3.97%		Sentinel surveillance, incarcerated
	Ministry of Health, 2010 ¹²	2008	712	1.83%		Sentinel surveillance, medical centres
Ministry of Health, 2010 ¹²	2008	241	2.07%		Sentinel surveillance, STI clinics	
Ministry of Health, 2010 ¹²	2008	1,079	2.13%		Sentinel surveillance, total FSWs	
Ministry of Health, 2010 ¹²	2009	151	3.97%		Sentinel surveillance, incarcerated	
Ministry of Health, 2010 ¹²	2009	367	4.09%		Sentinel surveillance, medical centres	
Ministry of Health, 2010 ¹²	2009	447	0.45%		Sentinel surveillance, STI clinics	
Ministry of Health, 2010 ¹²	2009	965	2.38%		Sentinel surveillance, total FSWs	
Ministry of Health, 2010 ¹²	2008	3461	1.2%		VCT attendees	
Ministry of Health, 2010 ¹²	2009	5024	1.5%		VCT attendees	
MSM	US Census Bureau, ⁶	1984–1987	52	3.85%		Casablanca
	WHO/EMRO Database ¹¹	1989	55	10.9%		
	Ministry of Health, 2010 ¹²	2008	89	4.49%		Sentinel surveillance
	Ministry of Health, 2010 ¹²	2008	1147	1.2%		VCT attendees
	Ministry of Health, 2010 ¹²	2009	1216	2.2%		VCT attendees
	Ministry of Health, 2010 ¹²	2009	39	0.00%		Sentinel surveillance
IDUs	Ministry of Health, 2010 ¹⁵	2008		37.8%		Nador
	Ministry of Health, 2010 ¹²	2005	133	0.0%		Sentinel surveillance
	Ministry of Health, 2010 ¹²	2006	147	0.0%		Sentinel surveillance
	Mathers 2008, ¹⁶	2006		6.5%		Data from registration/case notification
	Ministry of Health, 2010 ¹²	2007	30	0.0%		Sentinel surveillance
	Ministry of Health, 2010 ¹²	2008	61	1.6%		Sentinel surveillance
	Ministry of Health, 2010 ¹²	2008	77	1.3%		VCT attendees
	Ministry of health, 2010 ¹⁵	2008		0.0%		RSA, Al-Hoceima
	Ministry of Health, 2010 ¹²	2009	16	6.3%		VCT attendees
Ministry of Health, 2010 ¹²	2009	66	0.0%		Sentinel surveillance	
NIDUs	Ministry of Health, 2010 ¹²	2008	95	0.0%		Sentinel surveillance
	Ministry of Health, 2010 ¹²	2009	146	2.05%		Sentinel surveillance
Suspected HIV persons and those reporting risky behaviour	US Census Bureau ⁶	1991–1998		5.5%		National Center of Diagnosis
	US Census Bureau ⁶	1991–1999	12,981	5.05%		National Center of Diagnosis
	US Census Bureau ⁶	1999		8.0%		National Center of Diagnosis

FSWs = female sex workers; MSM = men who have sex with men; IDUs = injecting drug users; Prev = prevalence; NIDUs = non-injecting drug users; STIs = sexually transmitted infections; STD = sexually transmitted disease; VCT = voluntary HIV counselling and testing; RSA = rapid situation assessment

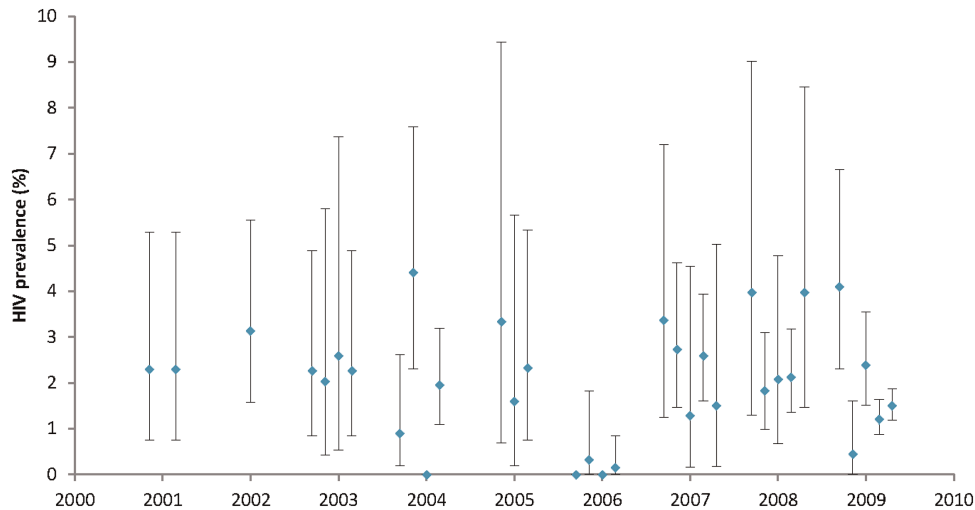


Figure 1 HIV prevalence among female sex workers in Morocco as reported in different studies, 2001–2009

(Supplementary Table S2.6). Nevertheless, these populations report relatively high levels of risk behaviour. Among truck drivers in one study, 25% had more than 24 FSW partners over the last year, 8.7% had same-sex sexual relations (Supplementary Table S2.7) and 1.3% reported injecting drug use.²⁰ Only 29% of these truck drivers used a condom during last sex (Supplementary Table S2.4).²⁰ Though basic HIV knowledge was high among these truck drivers, levels of misinformation and negative attitudes towards PLHIV were also high (Supplementary Table S2.5).

Prisoners and HIV

HIV prevalence among different prisoner samples ranged from 0% to 2% (Supplementary Table S2.8). Imprisonment in Morocco is rather high at 174 per 100,000 persons.^{23,24} Prisoners reported higher levels of risk behaviour compared with the general population, even prior to incarceration. Female prisoners reported an average of 5.17 lifetime sexual partners.²⁵ Only 9% of them reported regular condom use with all partners (Supplementary Table S2.4), and 2% reported injecting drug use.²⁵ In a study of mainly IDUs, 45.9% had a history of incarceration for drug use and 19.8% injected drugs while in prison.²²

General population and HIV

HIV prevalence among the general population is very low and there appears to be very limited HIV transmission within the general population (Supplementary Table S2.9). Data on sexual behaviour among this part of the population continue to be rather limited. In one study among general population women, almost 20% reported more than one lifetime sexual partner, 2% reported more than three partners and 2% reported having non-spousal sexual partners.¹⁷ The study reported a mean lifetime sexual partners of 1.3, a median of 1, and a range of 1–4. The median age at first sex was 18 years.¹⁷ Polygamous unions were reported by 12% of the women, and only 16% of them ever used condoms (Supplementary Table S2.4).¹⁷ Though basic HIV/AIDS knowledge in the

general population is reported to be high, misinformation and misconceptions were found abundant in different studies (Supplementary Table S2.5).

Youth and HIV

Most of notified HIV infections in Morocco (63%) are among young single persons,²⁶ and 40% of recorded sexually transmitted infection (STI) cases are also among youth aged 15–29 years.^{26,27} In a study among youth, 20.6% and 15.2% reported ever having vaginal and anal sex, respectively.¹⁹ In the same study, 67.2% of sexually active men reported ever having sex with a FSW,¹⁹ and 43.1% of sexually active men and women reported using no condom in the last month¹⁹ (Supplementary Table S2.4). The levels of comprehensive HIV/AIDS knowledge varied among youth with both high and low levels being reported as well as positive and negative attitudes towards PLHIV (Supplementary Table S2.5). Female adolescents appeared to have higher levels of knowledge than male adolescents.²⁸

Facility-based HIV surveillance

Facility-based HIV surveillance data indicate generally low HIV prevalence among STI clinic attendees, VCT attendees and tuberculosis patients among other facility-defined populations (Supplementary Table S2.10).

HIV/AIDS notified cases

During 1986–2009 a total of 4972 HIV/AIDS cases were notified, of which 31.1% were asymptomatic HIV infections.¹⁵ More than half of HIV/AIDS cases (53.9%) were reported during the period of 2005–2009 (Figure 2). The percentage of women among notified HIV/AIDS cases increased steadily from 19.3% in 1986–1989 to 47.9% in 2005–2009.¹⁵ In 2005–2009, out of the total number of asymptomatic HIV cases, 61.6% were women.¹⁵ The 25–34 years and 35–44 years age groups accounted for 38.4% and 32.1% of the total asymptomatic HIV cases in 2005–2009, respectively.¹⁵

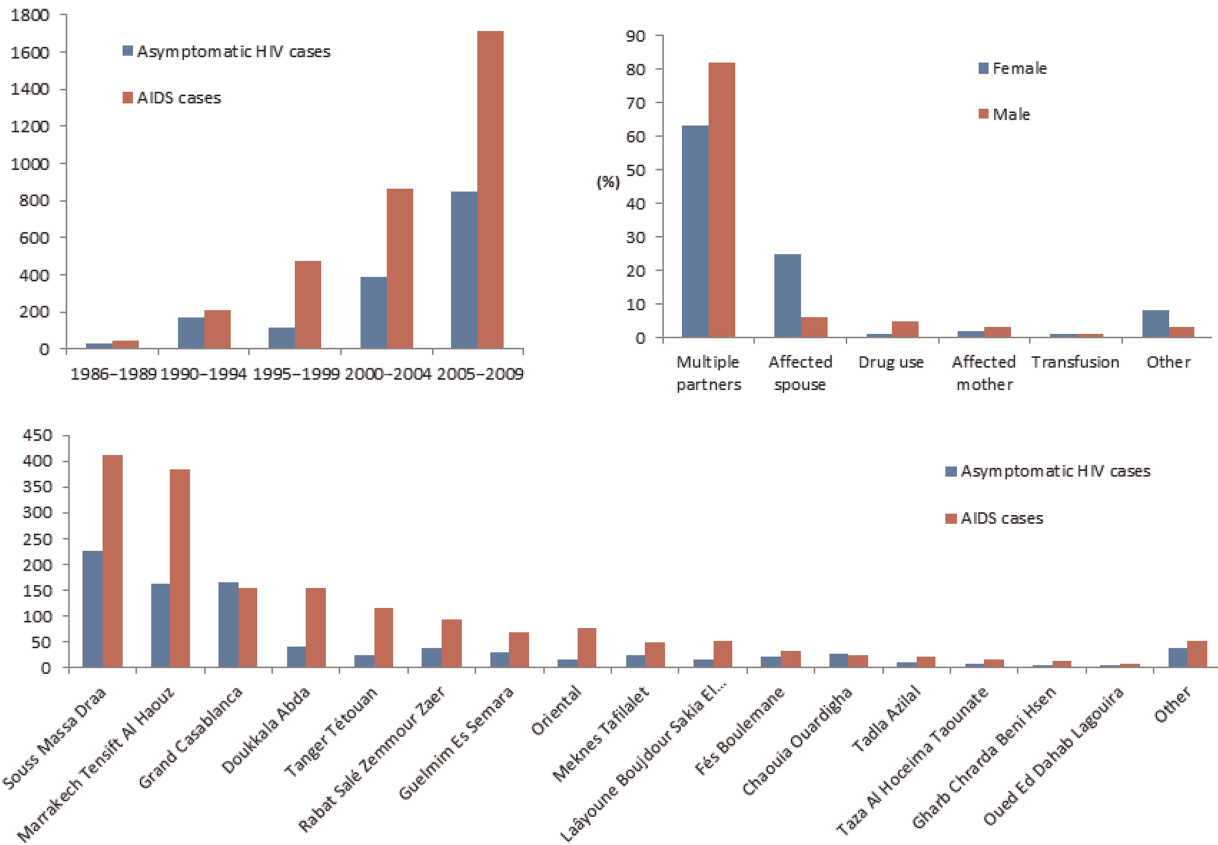
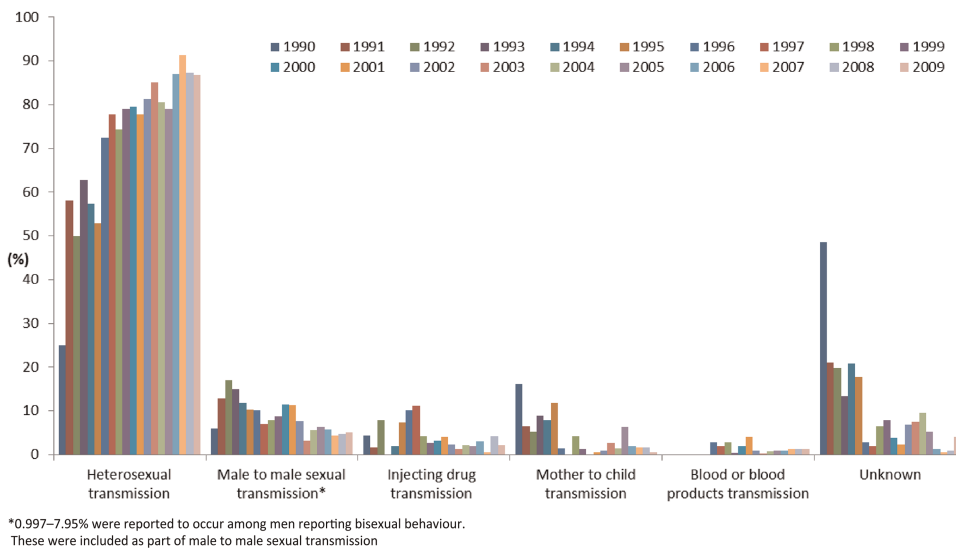


Figure 2 Analysis of notified HIV/AIDS cases by period, risk factor and geographic distribution in Morocco, 2005–2009¹⁵



*0.997–7.95% were reported to occur among men reporting bisexual behaviour. These were included as part of male to male sexual transmission

Figure 3 Distribution of notified asymptomatic HIV cases by modes of transmission, 1990–2009.¹²

Multiple partnerships and an affected spouse were the main risk factors accounting for 74% and 15% of HIV/AIDS notified cases (all HIV infected, including AIDS patients) in 2005–2009, respectively (Figure 2).¹⁵ In 2005–2009, Sous Massa Draa accounted for about 25% of the total HIV/AIDS notified cases, followed by Marrakech Tensift Al Haouz (21%) and Grand Casablanca (12%) (Figure 2).¹⁵ Heterosexual transmission continues as the predominant mode of transmission

among notified asymptomatic HIV cases (Figure 3),¹² as well as HIV/AIDS cases (Supplementary Table S2.11). The data also suggest that the contribution of heterosexual transmission among notified cases has been increasing in recent years. Nevertheless, this increase may not strictly reflect a larger contribution, as much as increased HIV diagnoses thanks to the large expansion of VCTs targeting commercial sex networks over the last few years. An additional factor, which may have

contributed to this apparent trend, is the improved quality of HIV notifications. The percentage of notifications with an 'unknown' mode of exposure has diminished drastically over the last few years.

Parenteral HIV transmission other than injecting drug use

Available data suggest that HIV prevalence is low and below 1% among populations at risk of HIV parenteral acquisition (other than IDUs) such as haemodialysis patients, haemophiliacs and poly-transfused patients (Supplementary Table S2.12). However, occupational injuries among health-care workers are common though rarely declared.²⁹⁻³¹ Fifty-nine percent of health-care workers in one study reported a needle stick injury in the previous year.³¹ Hepatitis C virus (HCV) incidence among haemodialysis patients was found to be very high at 9.41 per 100 person-years.³² Supplementary Table S2.13 shows considerable HCV prevalence among populations at risk of HIV parenteral acquisition such as haemodialysis patients, but very low HCV prevalence in the general population.

Prevalence of STIs

Table 2 summarizes available prevalence measures of other STIs in Morocco including human papillomavirus, herpes simplex virus type 2 (HSV-2), syphilis, gonorrhoea and chlamydia. STI prevalence levels are substantial in settings of high risk such as among FSWs. Significant levels of STI prevalence can also be found in other population groups, though at much lower prevalence.

HIV molecular epidemiology

HIV subtype B is the dominant HIV strain in Morocco and accounted for 93.5% of infections in the 1990s.⁴¹ Nevertheless, recent data suggest increasing diversity of strains with over 25% of the infections being of non-B subtypes, including several circulating recombinant forms.⁴²⁻⁴⁵ A recent phylogenetic analysis showed that 39% of the recombinant strains (CRF02_AG) were closely connected with reference strains from Morocco, and 61% clustered with reference strains from eight West African and three European countries.⁴⁴

DISCUSSION

Based on the data reviewed and synthesized above, there is no evidence for an HIV epidemic in the general population of Morocco. However, similar to what is observed in other MENA countries,^{2,3,46,47} a trend of rising epidemics among high-risk populations seems to be emerging if not establishing itself in Morocco, though at relatively low prevalence for the last decade. HIV prevalence among potentially bridging populations appears to be limited. Although the risk of parenteral HIV transmission (beyond injecting drugs) may be present at low level in some specific population groups such as haemodialysis patients, this mode of transmission appears to be very rare in the general population as suggested by the low HCV prevalence in this population (Supplementary Table S2.13).

There is considerable evidence for HIV transmission among FSWs and their clients in much of Morocco with a national HIV prevalence among FSWs of about 2%. The HIV epidemic among FSWs appears to be concentrated in the southern part of the country, specifically in Agadir, where HIV prevalence exceeds 5%, the threshold conventionally defining a concentrated epidemic.⁴⁸ There is also evidence for substantial levels of STIs other than HIV among FSWs. FSWs appear to engage in high-risk sexual behaviours at variable levels, but consistent condom use appears also to be high with about half of coital acts being protected by a condom. The HIV epidemic among FSWs, though seemingly stable and with rather low prevalence, is more intense than in most other MENA countries.^{2,3} The size of commercial heterosexual-sex networks in Morocco appears to be within the range found in other MENA countries, as expressed by the prevalence of sex work among women,^{2,3} but it is somewhat towards the higher end of this range.

Commercial heterosexual-sex networks appear to be the largest driver of HIV infection transmission in Morocco, as confirmed by the recent MoT analysis of new HIV infections.^{4,5} However, the size of the epidemic in these networks seems to have been curtailed by the universal coverage of male circumcision and the strong HIV response among FSWs. Multiple non-governmental organizations (NGOs) with support and collaboration with national authorities provide HIV-related services to FSWs. There is a good coverage of VCT services among FSWs particularly in the main cities, and it is estimated that about 25% of VCT attendees in Morocco are FSWs.⁴⁹ The high level of condom use among FSWs, unlike any other population group (Supplementary Table S2.4), testifies to the success of HIV response in commercial sex networks. In this regard, Morocco is a pioneer and a leader in MENA in adapting its HIV response to where needs are, and in implementing programmes among hidden high-risk and vulnerable populations.

Data on MSM continue to be limited in Morocco, though studies are planned or ongoing to address this gap at least in part. Available evidence suggests that HIV is circulating among MSM, but that the size of the epidemic currently seems to be rather moderate. Similarly, there is evidence for HIV transmission among IDUs, but the contribution of this mode of transmission to HIV case notifications appears to be relatively small, and the fraction of the population injecting drugs appears to be smaller than that in the eastern part of MENA.^{2,3}

The scattered data among MSM and IDUs suggest the possibility of concentrated epidemics, but with a highly heterogeneous geographic distribution. The majority of HIV transmission among MSM appears to be focused in the southern part of Morocco, specifically in Agadir and Marrakech. HIV transmission among IDUs appears to be focused in the north of Morocco, particularly in Nador where a large HIV epidemic has been identified recently.¹⁵ Nonetheless, we do not yet have enough HIV surveillance data of good quality among MSM and IDUs that can provide a representative picture of the HIV epidemic in these populations. Localized hidden HIV epidemics among MSM and IDUs might be present in different areas, but are yet to be identified and characterized. There is also potential for further HIV epidemics among these populations in light of the risk-behaviour environment and the context of emerging HIV epidemics among MSM and IDUs in the MENA region.^{2,3,46,47}

The analysis of notified HIV/AIDS cases indicates that multiple heterosexual-sex partnerships is the leading risk factor

Table 2 Sexually transmitted infection (STI) prevalence among different population groups in Morocco, as reported in different studies

STI	Population	Comment	Source	Prevalence		
HPV	General population	Controls, hospital-based case-control study	17	21.0%		
HSV-2	General population	Men	11	10.0%		
		ANC attendees	33	12.7%		
		ANC attendees	34	12.9%		
		Women	11	13.0%		
		Family planning centre attendees	33	18.3%		
		Urban women with a median age of 40 years	35	26.0%		
		Facility based population	STD clinic attendees	11	6.7%	
			Male HIV sentinel surveillance attendees	34	9.2%	
			Male HIV sentinel surveillance attendees	11	16.2%	
			Military personnel	34	6.5%	
		Syphilis	General population	Male labourers	13	0.0%
				Hotel staff	13	0.4%
				Pregnant women	36	0.73%
				Hotel staff	36	0.94%
Pregnant women	13			1.0%		
Blood donors	37			1.3%		
ANC attendees	33			1.6%		
Seasonal female labourers	36			2.17%		
	11			2.8%		
Seasonal female labourers	13			2.9%		
Pregnant women	37			3.0%		
Family planning centre attendees	38			3.4%		
Family planning centre attendees	33			3.5%		
Male labourers	36			4.51%		
Symptomatic primary health-care centre attendees	38			5.6%		
Facility-based population	TB patients			13	2.3%	
	Females STD clinic attendees			14	2.40%	
	Females STD clinic attendees			11	2.70%	
	STD clinic attendees			13	3.80%	
	TB patients			36	4.0%	
	STD clinic attendees			11	4.0%	
	STD clinic attendees			36	4.92%	
	STD clinic attendees			39	13.2%	
	STD clinic attendees			38	18.4%	
	Vulnerable population			Male prisoners	13	4.03%
Male prisoners				13	4.8%	
Female prisoners				13	7.8%	
Female prisoners imprisoned for sex work				13	9.6%	
Female prisoners imprisoned for sex work				36	11.76%	
Female prisoners				36	16.39%	
Female prisoners		25	23%			
Potential bridging population		Sailors	13	1.9%		
		Sailors	36	3.37%		
		Truck drivers	13	9.55%		
High-risk population	FSWs	13	9.0%			
	FSWs	13	12.1%			
	FSWs	36	13.29%			
	FSWs	14	13.8%			
	FSWs	11	17.0%			
Gonorrhoea	General population	ANC attendees	33	0.7%		
		Family planning centre attendees	33	1.0%		
		Family planning centre attendees	38	3.2%		
		Symptomatic primary health-care centre attendees	38	5.4%		
	Facility-based population	Female STD clinic attendees	11	0.8%		
		Female STD clinic attendees	39	1.74%		
		Female STD clinic attendees	14	1.0%		
		Male STD clinic attendees	39	7.07%		
		STD clinic attendees	38	10.0%		
		STD clinic attendees	11	42%		
	High-risk population	STD clinic attendees	40	52.4%		
		FSWs	11	3.5%		
		FSWs	14	7.1%		
		Chlamydia	General population	Family planning centre attendees	38	2.6%
ANC attendees	33			2.7%		
Family planning centre attendees	33			5.2%		
Symptomatic primary health-care centre attendees	38			6.3%		

(Continued)

Table 2 Continued

STI	Population	Comment	Source	Prevalence
	Facility based population			
		STD clinic attendees	38	5.0%
		Female STD clinic attendees	14	5.6%
		STD clinic attendees	11	6.0%
		STD clinic attendees	40	17.1%
		STD clinic attendees	39	51.5%
	High-risk population	FSWs	14	19.1%

ANC = antenatal clinic; FSWs = female sex workers; HPV = human papillomavirus; TB = tuberculosis; HSV-2 = herpes simplex virus type 2; STD = sexually transmitted disease; STI = sexually transmitted infection

for HIV acquisition, further confirming the dominance of the heterosexual mode of HIV transmission in Morocco. The burden of HIV infection appears to be shifting from male dominance to more or less equal distribution among men and women. Thanks to VCT programmes expansion, the fraction of asymptomatic HIV cases among all HIV/AIDS diagnosed cases in 2005–2009 has increased compared with earlier years (Figure 2). Nevertheless, case notifications still show that most cases are being diagnosed at later stages suggesting an overall low coverage of HIV testing among the populations most affected by HIV. In Marrakech, 60.4% of newly diagnosed HIV/AIDS cases were at an advanced stage of immunosuppression (<200 CD4+ cells/mm³), reflecting the delay in the diagnosis of HIV.⁵⁰ Other STIs are also often diagnosed in advanced stages. In one study of syphilis patients, 70.2% were identified as late latent cases.⁵¹

In line with what is observed elsewhere in MENA,³ most of the sexual risk behaviour appears to be practiced by men in Morocco.^{4,5} Women are exposed to HIV through their infected husbands or partners who are usually unaware of their infections.⁵² The acquisition of STIs was also found to be associated with male rather than female sexual behaviour.³⁸ The age-gap in marriage appears to be yet another factor increasing the risk of STIs among women in Morocco.¹⁷

The prevalence of STIs other than HIV in the population at large (Table 2) is rather on the low side compared with global levels, but is on the high side compared with other MENA countries.³ For example, while the roughly 10% prevalence of HSV-2 is lower than the levels found in other regions,^{53–55} it is higher than what is found in other MENA countries.⁵⁶ This pattern may relate to the relative size of commercial heterosexual-sex networks in Morocco. While sexual behaviour among the general population in Morocco is probably broadly similar to that in other MENA countries,³ larger fraction of men may be frequenting FSWs in Morocco compared with most other MENA countries.

The dominant HIV strain in Morocco is subtype B reflecting transmission pathways of West European origins and affirming the introduction of the virus to Morocco through the sizable migration and tourism links between this country and West Europe.^{41,45,46} However, recent data indicate increasing diversity of HIV-1 variants reflecting sub-Saharan African immigration to Europe via Morocco or possibly acquisitions by Moroccans traveling in sub-Saharan Africa.^{41–45} However, the Africanization of subtypes, that is, the increased appearance in Morocco of subtypes circulating in sub-Saharan Africa, should not be interpreted as a major role for African migrants in HIV transmission dynamics in Morocco. Though migration contributed to the introduction of new HIV subtypes, the

totality of the epidemiological evidence synthesized here indicates that the vast majority of HIV transmissions in this country are linked to the domestic high-risk networks.

One limitation of the present study is that the quantity and quality of data varied between different risk groups and geographic regions. There were not sufficient data on MSM and IDUs to characterize satisfactorily HIV transmission in these populations. Most data were from cross-sectional surveys using convenience sampling, and only recently representative data from integrated bio-behavioural surveillance surveys (IBBSS) became available. Sexual behaviour data were rather limited, and conventional limitations of self-reported data could have affected their quality. Though there is a substantial improvement in the quality of HIV data with time, earlier studies suffered from methodological limitations and/or were mostly descriptive and qualitative in nature. Despite these limitations, we have synthesized and corroborated findings from different types of data sources such as HIV prevalence, notified HIV/AIDS cases and sexual risk behaviour, among other related and contextual data. Our search criteria were expansive, and covered different sources of literature. Our integrated data synthesis allowed us to address, at least in part, potential limitations in any one line of evidence, and to draw a comprehensive assessment of the HIV epidemic status in Morocco.

CONCLUSION

The HIV epidemic in Morocco shares similarities with the HIV epidemics found in the MENA region.^{2,3,46,47} HIV prevalence is at very low levels in the general population and the dynamics of HIV transmission are centred in the networks of high-risk populations. HIV epidemics appear to be emerging among high-risk populations, and some, particularly among FSWs, appear to be established and rather stable.

Morocco has probably the most developed HIV surveillance system, research capacity and response in the Arab World. Yet, the current surveillance systems are focused on sentinel surveillance, mainly covering general population groups and FSWs, in addition to passive reporting of HIV/AIDS notified cases. Only recently, sentinel surveillance has been extended to include MSM and IDUs, but still with limited geographic coverage. A critical need in terms of HIV surveillance is the conduct of IBBSS surveys among high-risk populations across the country. This has been initiated recently among IDUs in north of Morocco, and among MSM in Southern Morocco. While this is an important progress, IBBSS surveillance should be extended to all high-risk populations with wide geographic coverage. There is a possibility that hidden HIV epidemics

among IDUs and MSM exist, but have not yet been captured by the current surveillance infrastructure.

To optimize HIV control and to prioritize prevention interventions at a time of competing priorities, HIV programmes should focus on access to counselling, testing, care and treatment services among high-risk populations and in geographic settings where low intensity or concentrated epidemics are emerging or are already established. Morocco has made admirable strides in tackling the HIV public-health challenge and in establishing HIV programmes. The new challenges for HIV policy in this country is a refocus of efforts towards where most-pressing needs are.

ACKNOWLEDGEMENTS

The study team would like to acknowledge the Ministry of Health and National AIDS Programme in Morocco, and the Joint United Nations Programme on HIV/AIDS (UNAIDS) headquarters and Morocco country office for providing valuable input and support in the conduct of this study. The Morocco HIV Modes of Transmission (MoT) Project was funded by the Joint United Nations Programme on HIV/AIDS (UNAIDS).

Conflict of interest: None.

Funding: This study was funded by the Qatar National Research Fund (NPRP 4-924-3-251), the Joint United Nations Programme on HIV/AIDS, and the Biostatistics, Epidemiology, and Biomathematics Research Core at the Weill Cornell Medical College in Qatar.

REFERENCES

- Clock OMP. Official Moroccan Population Clock
- Abu-Raddad LJ, Hilmi N, Mumtaz G, *et al.* Epidemiology of HIV infection in the Middle East and North Africa. *AIDS* 2010;24(Suppl. 2):S5–23
- Abu-Raddad L, Akala FA, Semini I, Riedner G, Wilson D, Tawil O. *Characterizing the HIV/AIDS Epidemic in the Middle East and North Africa: Time for Strategic Action. Middle East and North Africa HIV/AIDS Epidemiology Synthesis Project. World Bank/UNAIDS/WHO Publication.* Washington DC: The World Bank Press, 2010
- Mumtaz GR, Kouyoumjian SP, Hilmi N, *et al.* The distribution of new HIV infections by mode of exposure in Morocco. *Sex Transm Infect* 2013 (Epub ahead of print)
- Mumtaz G, Hilmi N, Zidouh A, *et al.* HIV modes of transmission analysis in Morocco. Kingdom of Morocco Ministry of Health and National STI/AIDS Programme, Joint United Nations Programme on HIV/AIDS, and Weill Cornell Medical College – Qatar. 2010
- US Census Bureau International Database. Washington, DC, USA
- UNAIDS. UNAIDS. Epidemiological software and tools. Spectrum model
- UNAIDS. UNAIDS Country Database
- UNAIDS. UNAIDS Report on the Global AIDS Epidemic 2010
- UNAIDS. UNAIDS. Epidemiological software and tools. Modes of transmission model
- WHO/EMRO. Regional database on HIV/AIDS. WHO Regional Office for the Eastern Mediterranean. Cairo, Egypt
- Morocco Ministry of Health. National database of HIV data. National AIDS Program, Rabat, Morocco, 2010
- Khattabi H, Alami K. *Surveillance sentinelle du VIH, Résultats 2004 et tendance de la séroprévalence du VIH.* Ministry of Health. UNAIDS, Rabat, Morocco, 2005
- Ministère de la Santé au Maroc and Programme National de lutte contre les IST/SIDA. Etudes de prévalence des IST chez les femmes qui consultent pour pertes vaginales et/ou douleurs du bas ventre, Rabat, Morocco 2008
- Ministère de la Santé au Maroc and DELM/PNLS. Situation épidémiologique du VIH/Sida et des IST au Maroc, Rabat, Morocco, February 2010
- Mathers BM, Degenhardt L, Phillips B, *et al.* Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *Lancet* 2008;372:1733–45
- Chaouki N, Bosch FX, Munoz N, *et al.* The viral origin of cervical cancer in Rabat, Morocco. *Int J Cancer* 1998;75:546–54
- Ministère de la Santé au Maroc. Surveillance des comportements à risque: le cas des professionnelles du sexe, Rabat, Morocco 2008
- Ministère de la Santé au Maroc and GTZ. *Enquête 'Connaissances, attitudes, et pratiques des jeunes concernant les IST et le SIDA' (French) [A Survey on the Knowledge, Attitude and Behavior of Youth in Relation to STIs and AIDS]*. Rabat, Morocco, 2007
- Association de Lutte Contre le Sida, Fonds Mondial and Total Maroc. Etude des caractéristiques, connaissances, attitudes et pratiques des routiers en matière des IST/Sida sur les grands axes du trafic au Maroc. Rapport Préliminaire (French) [A study of the characteristics, knowledge, attitude and behavior of truck drivers in Morocco in relation to STIs/HIV. Preliminary report], Rabat, Morocco
- Aceijas C, Friedman SR, Cooper HL, Wiessing L, Stimson GV, Hickman M. Estimates of injecting drug users at the national and local level in developing and transitional countries, and gender and age distribution. *Sex Transm Infect* 2006;82(Suppl. 3):iii10–7
- Ministère de la Santé au Maroc, Direction de l'Épidémiologie et de Lutte contre les Maladies and Programme de lutte contre la toxicomanie. Evaluation rapide de la situation sur le risque d'infection à VIH en relation avec l'usage des drogues injectées et injectables et à problème au Maroc, Rabat, Morocco, 2005
- Dolan K, Kite B, Black E, Aceijas C, Stimson GV. HIV in prison in low-income and middle-income countries. *Lancet Infect Dis* 2007;7:32–41
- International Centre for Prison Studies. World prison brief country profiles. 2006. See www.prisonstudies.org (last accessed 6 March 2013)
- El Ghrari K, Terrab Z, Benchikhi H, Lakhdar H, Jroundi I, Bennani M. [Prevalence of syphilis and HIV infection in female prison population in Morocco]. *East Mediterr Health J* 2007;13:774–9
- Jenkins C, Robalino DA. *HIV in the Middle East and North Africa: The Cost of Inaction. Orientations in Development Series*, World Bank. 2003
- Roudi-Fahimi F, Ashford L. *Sexual & Reproductive Health in the Middle East and North Africa. Population Reference Bureau. A Guide for Reporters*, 2008
- Boneberger A, Ruckinger S, Guthold R, Kann L, Riley L. HIV/AIDS related knowledge among school-going adolescents from the Middle East and North Africa. *Sex health* 2012;9:196–8
- Belefqh B, Tagajdid M, El Annaz H, *et al.* Epidemiological profile of occupational blood exposure accident in the Mohamed 5th military teaching hospital. *Clin Chem Lab Med* 2012;50:A144
- Hossini CH, Tripodi D, Rahhali AE, *et al.* [Knowledge and attitudes of health care professionals with respect to AIDS and the risk of occupational transmission of HIV in 2 Moroccan hospitals]. *Santé* 2000;10:315–21
- Laraoui O, Laraoui S, Tripodi D, *et al.* [Assessing knowledge, attitude, and practice on occupational blood exposure in caregiving facilities, in Morocco]. *Med Mal Infect* 2008;38:658–66
- Sekkat S, Kamal N, Benali B, *et al.* [Prevalence of anti-HCV antibodies and seroconversion incidence in five haemodialysis units in Morocco]. *Nephrol Ther* 2008;4:105–10
- Ministère de la Santé au Maroc. Etude de prévalence des IST chez les femmes consultantes en SMI/PF al Wilaya de Rabat-Sale, Rabat, Morocco
- Cowan FM, French RS, Mayaud P, *et al.* Seroepidemiological study of herpes simplex virus types 1 and 2 in Brazil, Estonia, India, Morocco, and Sri Lanka. *Sex Transm Infect* 2003;79:286–90
- Patnaik P, Herrero R, Morrow RA, *et al.* Type-specific seroprevalence of herpes simplex virus type 2 and associated risk factors in middle-aged women from 6 countries: the IARC multicentric study. *Sex Transm Dis* 2007;34:1019–24
- Bennani A, Alami K. *Surveillance sentinelle VIH, résultats 2005 et tendances de la séroprévalence du VIH.* Ministry of Health. UNAIDS, Rabat, Morocco 2006
- WHO/EMRO. Report on the intercountry workshop on STD prevalence study, Amman, Jordan, 1998
- Ryan CA, Zidouh A, Manhart LE, *et al.* Reproductive tract infections in primary healthcare, family planning, and dermatovenereology clinics: evaluation of syndromic management in Morocco. *Sex Transm Infect* 1998;74(Suppl. 1):S95–105
- Heikel J, Sekkat S, Bouqdir F, *et al.* The prevalence of sexually transmitted pathogens in patients presenting to a Casablanca STD clinic. *Eur J Epidemiol* 1999;15:711–5
- Alami K, Ait Mbarek N, Akrim M, *et al.* Urethral discharge in Morocco: prevalence of microorganisms and susceptibility of gonococci. *East Mediterr Health J* 2002;8:794–804
- Elharti E, Elaouad R, Amzazi S, *et al.* HIV-1 diversity in Morocco. *Aids* 1997;11:1781–3

- 42 Bakhouch K, Oulad-Lahcen A, Bensghir R, *et al.* The prevalence of resistance-associated mutations to protease and reverse transcriptase inhibitors in treatment-naïve (HIV1)-infected individuals in Casablanca, Morocco. *J Infect Dev Ctries* 2009;**3**:380–91
- 43 El Annaz H, Recordon-Pinson P, Baba N, Sedrati O, Mrani S, Fleury H. Presence of drug resistance mutations among drug-naïve patients in Morocco. *AIDS Res Hum Retroviruses* 2011;**27**:917–20
- 44 Miri L, Ouladlahsen A, Kettani A, Bensghir R, Marhoum Elfilali K, Wakrim L. Characterization of protease resistance associated mutations in HIV-1 drug naïve patients following the increasing prevalence of CRF02_AG strain in Morocco. *AIDS Res Hum Retroviruses* 2011
- 45 Akrim M, Lemrabet S, Elharti E, *et al.* HIV-1 Subtype distribution in Morocco based on national sentinel surveillance data 2004–2005. *AIDS Res Ther* 2012;**9**:1–8
- 46 Mumtaz G, Hilmi N, Akala FA, *et al.* HIV-1 molecular epidemiology evidence and transmission patterns in the Middle East and North Africa. *Sex Transm Infect* 2011;**87**:101–6
- 47 Mumtaz G, Hilmi N, McFarland W, *et al.* Are HIV epidemics among men who have sex with men emerging in the Middle East and North Africa?: a systematic review and data synthesis. *PLoS Med* 2010;**8**:e1000444
- 48 UNAIDS/WHO Working Group on Global HIV/AIDS and STI Surveillance. *Guidelines for Second Generation HIV Surveillance: An Update: Know your Epidemic*. Geneva, Switzerland: WHO Press, 2011
- 49 El-Rhilani H. *National VCT Database*. UNAIDS Morocco Office, Rabat, Morocco, 2010
- 50 Admou B, Elharti E, Oumzil H, *et al.* Clinical and immunological status of a newly diagnosed HIV positive population, in Marrakech, Morocco. *Afr Health Sci* 2010;**10**:325–31
- 51 Gallouj S, Bendahhou K, Baybay H, *et al.* [Syphilis: 57 observations in Fez, Morocco]. *Med Trop Rev Corps Sante Colon* 2011;**71**:275–7
- 52 McGirk J. Religious leaders key in the Middle East's HIV/AIDS fight. *Lancet* 2008;**372**:279–80
- 53 O'Farrell N. Increasing prevalence of genital herpes in developing countries: implications for heterosexual HIV transmission and STI control programmes. *Sex Transm Infect*. 1999;**75**:377–84
- 54 Smith JS, Robinson NJ. Age-specific prevalence of infection with herpes simplex virus types 2 and 1: a global review. *J Infect Dis* 2002;**186**(Suppl. 1):S3–28
- 55 Weiss H. Epidemiology of herpes simplex virus type 2 infection in the developing world. *Herpes* 2004;**11**(Suppl. 1):24A–35A
- 56 Abu-Raddad LJ, Schiffer JT, Ashley R, *et al.* HSV-2 serology can be predictive of HIV epidemic potential and hidden sexual risk behavior in the Middle East and North Africa. *Epidemics* 2010;**2**:173–82

(Accepted 12 December 2012)