

# The HIV care cascade in Switzerland: reaching the UNAIDS/WHO targets for patients diagnosed with HIV

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**Objectives:** To describe the HIV care cascade for Switzerland in the year 2012.

**Design/methods:** Six levels were defined: (i) HIV-infected, (ii) HIV-diagnosed, (iii) linked to care, (iv) retained in care, (v) on antiretroviral treatment (ART), and (vi) with suppressed viral load. We used data from the Swiss HIV Cohort Study (SHCS) complemented by a nationwide survey among SHCS physicians to estimate the number of HIV-patients not registered in the cohort. We also used Swiss ART sales data to estimate the number of patients treated outside the SHCS network. Based on the number of patients retained in care, we inferred the estimates for levels (i) to (iii) from previously published data.

**Results:** We estimate that (i) 15 200 HIV-infected individuals lived in Switzerland in 2012 (margins of uncertainty, 13 400–19 300). Of those, (ii) 12 300 (81%) were diagnosed, (iii) 12 200 (80%) linked, and (iv) 11 900 (79%) retained in care. Broadly based on SHCS network data, (v) 10 800 (71%) patients were receiving ART, and (vi) 10 400 (68%) had suppressed (<200 copies/ml) viral loads. The vast majority (95%) of patients retained in care were followed within the SHCS network, with 76% registered in the cohort.

**Conclusion:** Our estimate for HIV-infected individuals in Switzerland is substantially lower than previously reported, halving previous national HIV prevalence estimates to 0.2%. In Switzerland in 2012, 91% of patients in care were receiving ART, and 96% of patients on ART had suppressed viral load, meeting recent UNAIDS/WHO targets.

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## Introduction

Optimal management of HIV-infected individuals depends on early diagnosis and effective treatment of patients with HIV-infection [1–3]. Both, diagnosis and treatment result in a marked reduction of onward transmission and have thus an important impact on public health [4–6]. Maintaining patients in medical care is another key element of high-quality HIV management [1].

In 2011, Gardner *et al.* published a review article based on CDC-data on the spectrum of engagement in HIV care in the US [7]. The authors described seven different levels, ranging from ‘unaware of HIV infection’ to ‘fully engaged in HIV care with suppressed viral load’. This publication has fuelled the discussion about HIV management, and a number of experts and decision bodies in the US have used this analysis to promote improvement of medical care, treatment uptake and maintenance [8,9]. Particularly the potential impact of test-and-treat strategies on HIV prevention is being heavily debated in light of these results [1,10]. Subsequent publications have provided more up-to date estimations for the United States [9,11]. According to the latest article, 14% of HIV-positive individuals in the US are unaware of their infection and 30% of HIV-infected individuals were under a fully suppressive HIV-therapy in 2011. Many authors have replaced Gardner’s chosen label with ‘HIV treatment cascade’. We feel that this replacement unnecessarily shifts the focus to aspects of clinical performance and thus suggests the broader label ‘HIV care cascade’.

In 2014, Raymond *et al.* published a comparative analysis on the HIV care cascade in Europe and high-income countries. They showed large disparities across countries and identified so-called key breakpoints, describing the principal gaps between different steps of the cascade [12]. Lately, the World Health Organisation (WHO) and UNAIDS have promoted their ‘90–90–90’ targets (90% – diagnosed, 90% – on-treatment, 90% – suppressed) for the year 2020 [13]. Better knowledge of the HIV care cascade in Switzerland and identification of key breakpoints could help to implement targeted interventions.

We aimed at estimating the number of HIV-infected individuals and HIV prevalence, the proportion of HIV-diagnosed individuals, and the quality of HIV care: proportions of patients linked to and retained in care, with antiretroviral treatment (ART), and suppressed viral load.

## Methods

### HIV care cascade

We defined six levels within the spectrum of engagement in HIV-care:

1. HIV-infected,
2. HIV-diagnosed,
3. linked to care (having had at least one HIV monitoring),
4. retained in care (having had a HIV monitoring in the last 6 months),
5. on ART,
6. suppressed viral load (<200 copies/ml).

### Data sources

All data refer to the year 2012 if not stated otherwise. We mainly used data from the Swiss HIV Cohort Study (SHCS) for the calculation of (iv), (v), and (vi). The SHCS is a prospective cohort study of HIV-diagnosed patients in Switzerland aged 16 years or older [14]. Socio-demographic, clinical, and laboratory data are recorded in 6-monthly intervals. Informed consent is obtained from all participants. As physicians within the SHCS network also monitor HIV-positive patients not participating in the SHCS, we complemented these data by adding information gathered by a survey within the SHCS network (see supplementary file). We used ART sales data for Switzerland to adjust for non-SHCS-network patients. For the estimation of levels (ii) and (iii), we back-calculated from (iv) using 2010 data generated by the European men-who-have-sex-with-men Internet survey (EMIS) [15,16], a 25-language online survey for men-who-have-sex-with-men (MSM) in 2010, covering 38 European countries, with an analytic sample of 174 209 MSM, including 13 353 with self-reported diagnosed HIV infection. Level (i) – adding the unknown number of undiagnosed individuals – was calculated using different estimates for MSM/IDU vs. other transmission groups. For all six levels, we calculated an upper and lower margin of uncertainty (Fig. 1).

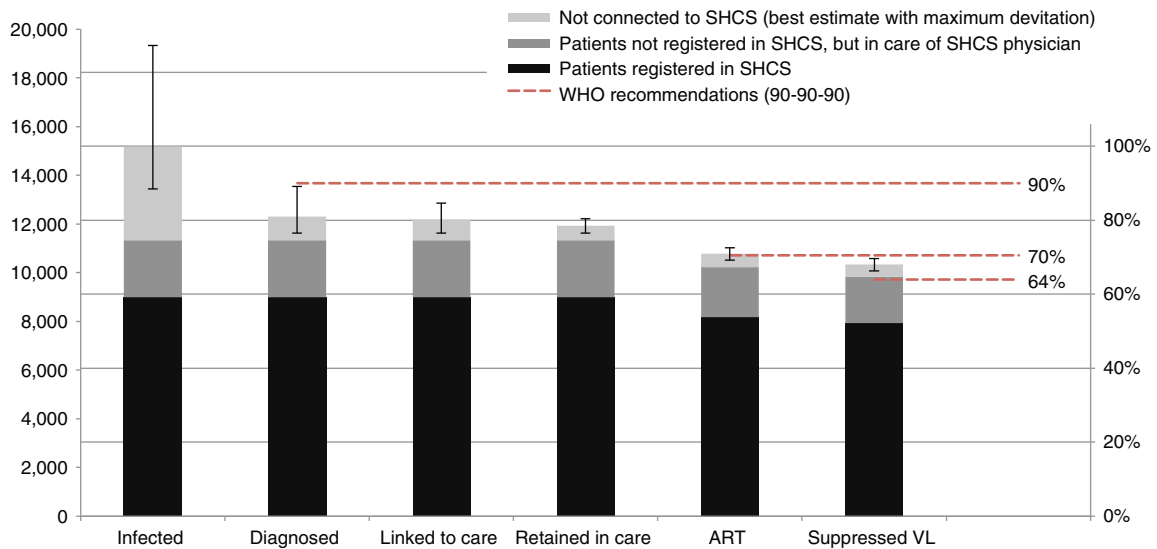
### Calculation of different levels of HIV care

The six levels of the HIV care cascade in Switzerland are listed according to the sequence of calculations.

### Level (iv): people with diagnosed HIV retained in care

We used the SHCS database of 12/2014 to count SHCS patients with at least one viral load measurement in 2012 (Table 1, Level (vi), Data source: SHCS). SHCS patients are monitored either in an SHCS centre, an affiliated hospital or a private practice. Since a minority of patients in care by SHCS physicians is not registered in the SHCS, we complemented our data from with information from the SHCS network survey (Table 1, Level (vi), Data source: Survey). Missing answers from physicians in affiliated hospitals or private practices were imputed based on the proportions of their patients who were registered in the cohort. Because of this imputation, the respective numbers in Table 1 are labelled as ‘partly based on estimates’.

For the calculation of the number of patients in care *outside* the SHCS network, we asked survey participants for how many patients in other private practices they



**Fig. 1. HIV care cascade for Switzerland in 2012.** Numbers and proportions (estimated total of infected individuals = 100%). Red horizontal lines indicate the 2014 UNAIDS/WHO targets of 90% of the previous level, translating into 90, 71, and 64% of the total. Columns are sub-divided by reliability. SHCS, Swiss HIV Cohort Study. Vertical error bars indicate the margins of uncertainty.

served as consultants. In a last step, after adding data from level (v), we extrapolated with the antiretrovirally treated proportion of patients cared for by private practices, to have an estimate for the remaining HIV patients in Switzerland (Table 1, Level (vi), Data source: Estimate). The margins of uncertainty for patients monitored outside the SHCS network (Fig. 1) was defined by the lowest and highest ART proportion in the three different network categories, and also by the lowest and highest ART coverage value.

**Level (v): people with diagnosed HIV on antiretroviral therapy**

For all SHCS patients, we determined the measurement of the viral load closest to June 30, 2012. Patients who started ART before this date were considered to be under

treatment. For non-SHCS patients, we used the survey results to calculate the numbers and proportions of patients receiving ART, as in level (iv). Swiss ART sales data (IMS Health GmbH, Hergiswil, Switzerland) were used to estimate the number of patients treated outside the SHCS network. We compared sales data of the three most commonly prescribed reverse transcriptase inhibitors (*tenofovir disoproxil fumarate*, *emtricitabine*, and *lamivudine*) with prescription data (type of drug, start and stop date) among patients registered in the SHCS. The number of sold tablets was corrected for hepatitis-B-treatment, based on the number of SHCS patients treated with *tenofovir*, but not with *emtricitabine*.

Possibly over-estimating the number of treated patients, we assumed a certain fraction of the medication not being

**Table 1. HIV care cascade in Switzerland. Level (iv): number of patients retained in HIV care; level (v): number (proportion) of patients on antiretroviral treatment [ART level (vi): number (proportion) of patients with suppressed (<200 copies/ml)] viral load; all by type of caregiver and inclusion in SHCS.**

Caregiver	N	SHCS network (N = 10 832)						Outside network (N = 1645)	
		SHCS centres		Affiliated hospitals		Affiliated private practices		Other private practices	Unknown
Data source		SHCS	Survey	SHCS	Survey	SHCS	Survey	Survey	Estimate
Level (iv) Retained in care		5059	556	884	652	3051	631	498	608
Level (v) ART (% <sup>a</sup> )		4577 (90)	455 (82)	788 (89)	581 (89)	2814 (92)	567 (90)	459 (92)	552 <sup>c</sup> (91)
Level (vi) Suppressed viral load (% <sup>b</sup> )		4442 (97)	395 (87)	755 (96)	531 (91)	2729 (97)	537 (95)	437 (95)	525 (95)

Based on SHCS and survey data. Partly based on estimates. SHCS, Swiss HIV Cohort Study; ART, antiretroviral therapy; viral load, viral load. <sup>a</sup>% of patients on ART among those retained in care (UNAIDS/WHO target: 90%). <sup>b</sup>% of patients with suppressed viral load among those on ART (UNAIDS/WHO target: 90%). <sup>c</sup>198/552 patients indirectly cared for by physicians participating in our survey.

consumed by the patient due to change of the ART regimen or due to expiration. Assuming that with a change of the ART regimen, two of three medication packages are discarded, we calculated the number of lost packets based on the number of ART changes in the SHCS for 2012.

Given the number of treated patients in the SHCS and the corrected coverage, the number of patients treated outside the SHCS was calculated (Table 1, Level (v), Data source: Estimate). The margins of uncertainty for patients monitored outside the SHCS network was defined as described above.

### Level (vi): suppressed viral load

For the determination of the number of treated SHCS patients with suppressed viral load, we extracted those patients identified in (v) with an HIV-RNA <200 copies/ml in the measurement closest to June 30, 2012 between January 1st and December 31st, 2012.

For non-SHCS patients, answers to the respective questions of the survey were used. Similarly to the previous calculations, the proportion of non-SHCS patients with suppressed viral load being treated by SHCS physicians not responding to the survey was extrapolated.

For patients treated by non-SHCS physicians in private practices, we imputed the respective proportion for patients on ART with suppressed viral load of the non-SHCS physicians who participated in the survey (Table 1). The margins of uncertainty for viral suppression outside the SHCS network was defined by the lowest and highest proportion in the different categories (SHCS database, survey data for SHCS centres, SHCS-affiliated hospitals and SHCS-affiliated private practices).

### Level (iii): people with diagnosed HIV linked to care

At any point in time, there will be people with diagnosed HIV who have been linked to care but for whatever reason dropped out of regular monitoring of their HIV infection. The number of people linked to care was calculated by dividing the estimated number of people retained in care by the proportion of EMIS participants who had seen a health professional for monitoring their HIV infection in the last 6 months (definition for retention in care) among those who ever did so (definition for linkage to care). For other transmission groups than MSM, the same proportion was used.

### Level (ii): people with diagnosed HIV

Accordingly, the number of people diagnosed with HIV was calculated by dividing the estimated number of people linked to care by the proportion of EMIS participants who ever had their HIV infection monitored among those who ever had been HIV diagnosed. All

Western European countries including Switzerland provide universal access to healthcare including free access to HIV monitoring and treatment. For that reason, we assumed 95% and 100% to be a realistic range for both retention and linkage to HIV care (margins of uncertainty, see Fig. 1).

### Level (i): HIV-infected individuals

For the estimation of the number of HIV-infected but undiagnosed individuals, we assumed that the distribution of MSM and injection drug users (IDU) would be the same in the overall HIV population as in the SHCS (together 57%). We then based our calculations for MSM on a recent modelling study, where 13.5% of all HIV-infected MSM were found to be undiagnosed [17]. We assumed this would be equally valid for IDU who are also frequently tested. For other transmission groups we assumed a respective proportion of 25% to account for known differences in HIV-testing rates and late presentation [18]. We used the above-mentioned fraction of 13.5% as a lower limit, and a fraction of 30% as an upper limit to determine the margins of uncertainty. The denominator for the prevalence calculation (Swiss population) was based on official data of the Swiss Federal Office of Statistics [19].

## Results

### Summary of the cascade, rounded numbers

In 2012, we estimate that (i) 15 200 individuals (plausible range: 13 400–19 300) infected with HIV were living in Switzerland, corresponding to an overall prevalence of 0.19% (plausible range, 0.17–0.24%). Of those, (ii) 12 300 (81%) had been diagnosed, (iii) 12 200 (80% of the estimated total) were linked, and (iv) 11 900 (79%) were retained in care. Broadly based on SHCS network data, (v) 10 800 (71%) patients were receiving ART. Only about 550 of those cases (5%) were estimated based on sales data alone. As for treatment success (vi), 10 400 (68%) had suppressed viral loads. The vast majority (95%) of Swiss HIV patients estimated to be retained in care was followed within the SHCS network, with 76% registered in the SHCS. Figure 1 visualizes the numbers and proportions in all six levels of the HIV care cascade.

### Detailed description of levels (ii) and (iii)

According to EMIS data from Switzerland, based on 453 MSM with diagnosed HIV, 98.8% of MSM diagnosed with HIV had been linked to care, and of those, 98.0% had been retained in care. These proportions correspond well with the respective proportions for the 18 EMIS countries within the WHO Region of Western Europe: Out of 12 444 respondents diagnosed with HIV 98.3% (range 97.2–100%) had been linked to care, and of those, 96.5% (range 96.6–100%) had been retained in care.

### Detailed description of levels (iv), (v), and (vi)

Table 1 gives a detailed overview on the number of patients in levels (iv) to (vi).

#### SHCS data

In 2012, 8994 patients were followed within the SHCS, either in a cohort centre (5059), in an affiliated hospital (884), or in an affiliated private practice (3051).

#### SHCS network survey data

The overall response rate to our survey requesting information on additional patients not participating in the SHCS was 100% for the SHCS centres, 86% in SHCS-affiliated hospitals, and 92% for SHCS-affiliated private practices. All survey participants answered that their numbers were extracted from their respective data bases. Through this approach, exact treatment information was available for additional 1701 non-SHCS patients.

#### Combined

Thus, a total number of 10 832 patients was estimated to be (retained) in care by a physician within the SHCS network. Based on the survey, 498 patients were identified being cared for in private practices outside the SHCS network.

The corrected SHCS coverage rate of the number of ART treatments in Switzerland (based on sales data) was found to be 75.8% in 2012, equalling a total of 10 793 patients on ART. Based on the SHCS data and the results of our survey, we identified 10 241 patients being treated in 2012, resulting in 552 additional patients on ART being cared by physicians not participating in our survey.

#### ART sales data

In 2012, 215 309 packages were sold, and 159 621 were prescribed within the cohort (coverage: 74.1%). Adjustment for 1770 therapy stops/changes resulted in a coverage of 75.8%, reaching from 74.1% for *emtricitabine* to 77.8% for *lamivudine*.

#### UNAIDS/WHO clinical targets

The overall proportion of patients retained in care who were under ART was 91% (patients registered in the SHCS: 91%; patients not registered, but within SHCS network: 87%). Accordingly, the overall proportion of treated patients with suppressed viral load was 96% (patients registered in the SHCS: 97%; patients not registered, but within SHCS network: 91%).

## Discussion

This is the first effort to describe the HIV care cascade for Switzerland and to estimate the number of people living with HIV in Switzerland based on clinical (as opposed to notification) data. Our estimates for the

overall number of HIV-infected individuals and thus HIV prevalence are substantially lower than previously published. ART coverage as well as effectiveness of ART for patients in Switzerland was high: 91% of patients retained in care (and 88% of HIV-diagnosed patients) were treated; and of those 96% had had suppressed viral load, thus (nearly) reaching the UNAIDS/WHO targets (Fig. 1) [13].

A strength of our study is that a majority of HIV-infected patients in Switzerland is followed within the SHCS network, allowing us to report highly reliable data on treatment and treatment success for most patients. Because of the high percentage of patients followed within the SHCS network, and because sales data and SHCS network data on ART use were nearly identical, we think that our absolute figures for (iv) to (vi) are solid. Even when applying a stricter lower limit of detection than 200 copies/ml, 93% among the 8179 patients registered in the SHCS and receiving ART had less than 50 copies/ml. (This proportion increased to 98.8% when applying 1000 copies as a lower limit of detection.)

We did not consider ART-packages used for postexposure prophylaxis (PEP). Even if every working day in Switzerland one intervention with PEP had been prescribed, this would only account for 22 patient packages years. We considered this number to be negligible. However, adjusting for ART coverage had the strongest impact on the estimated numbers in all levels. We thus included the margins of uncertainty as described above. Applying the current coverage estimate of 75.8% led to an estimated number of 552 patients on ART (or 608 patients with diagnosed HIV) being monitored by unidentified physicians. We feel that this number is realistic. We might however slightly underestimate discarded medication, which would mean that the true numbers of individuals in all levels are lower than reported here (but within our margins of uncertainty).

We might over-estimate the proportions linked to/retained in care. We are aware that the proportions for the calculations of levels (ii) and (iii) are based on small numbers. However, because of almost identical proportions based on more than 12 000 respondents from Western Europe, the proportions we used do not seem to be biased by small numbers. Nonetheless, our figures for levels (ii) and (iii) are based on MSM only, and the extrapolation of those figures to the general HIV-diagnosed population, and particularly to migrants, can be questioned. However we have no reason to assume that the differential regarding linkage to and retention in care is large, as the distribution of the transmission groups in the SHCS vs. new notification data in Switzerland is quite similar.

We did not estimate the number of individuals in need of ART, as there is increasing evidence for a benefit from

early treatment, and because in Switzerland many patients choose to start ART for being sexually noninfectious, irrespective of their CD4<sup>+</sup> cell count [20,21,22].

Our estimate for HIV-infected individuals, and thus overall HIV prevalence, is substantially lower than previously published data: Based on cumulated case reporting within the Swiss surveillance system (adjusted for mortality), 22 000 to 29 000 persons have been estimated to be living with HIV in Switzerland in 2012 [23]. This number is however not adjusted for emigration, and uses 30% for the undiagnosed fraction. Our estimates for people living with HIV in Switzerland, even when using 30% as the undiagnosed fraction of all transmission groups (including MSM and IDU) in addition to all other upper margins of uncertainty, are still lower than 20 000. According to the UNAIDS-Report, the global HIV prevalence (for adults between 15 and 49 years of age) in the year 2011 was 0.8%, ranging from 0.1% in East Asia to 4.9% in Sub-Saharan Africa. For Switzerland, the HIV prevalence was estimated at 0.4% (0.3–0.5%) [24]. Using the same age-restricted denominator (without respective adjustment of the numerator), our estimated HIV-prevalence for Switzerland would be 0.29%, with margins of uncertainty of 0.26 and 0.37%.

The number of HIV-infected individuals who are unaware of their diagnosis cannot be measured directly. In most versions of the HIV care cascade, it is based on back-calculation models, or on using the proportion of individuals who tested positive but were unaware of their diagnosis in samples that are assumed to be representative for the underlying population. On the one hand, this population represents the most important gap in the HIV care cascade for Switzerland. The risk of onward transmission of HIV is high in this group given their nonsuppressed viral load. A certain proportion of these individuals present with a low CD4<sup>+</sup> cell count at time of diagnosis, which has been shown to be associated with higher HIV-related morbidity and premature mortality [4]. It has also been shown that risky behaviour with respect to HIV transmission is reduced after patients become aware of their HIV diagnosis [25]. Thus, minimizing this gap could be a very effective intervention to improve both individual and public HIV-associated health aspects. On the other hand, in most publications on the topic, the number of undiagnosed HIV-infected individuals is the level of the HIV care cascade with the highest degree of uncertainty. Because of this problem, reported cascade proportions that are based on the estimated number of HIV-infected individuals must be interpreted with caution, as they largely depend on the assumptions included in the respective models. We could conclude that our proportion of 68% with suppressed viral load among all HIV-infected individuals is high compared to data from other Western countries, with Australia achieving the second highest rate with 62% [12]. However, this difference exists because of different

assumptions regarding the undiagnosed fraction, and has nothing to do with clinical performance. Therefore, we think it is crucial to relate measures of clinical effectiveness only to the previous level, and not to recalculate the UNAIDS/WHO 90% targets to overall 90–81–73%. Based on the numbers presented here, these targets translate to 90–70–64% in Switzerland, as visualized in Fig. 1.

The high rate of successfully treated patients in Switzerland might partly be explained by the fact that the vast majority of HIV-diagnosed patients are being linked to and treated within the SHCS network. No difference in treatment effectiveness has been found between patients being cared by SHCS centres and those by SHCS physicians in private practice [26]. If the same is true for patients cared by physicians outside the SHCS network remains unclear. Of note, according to our own data the proportion of patients being treated outside the SHCS network has been increasing in recent years.

## Conclusions and recommendations

Our estimate for HIV-infected individuals in Switzerland is substantially lower than previously reported, halving national HIV prevalence to 0.2%. Interventions aiming at improving the current situation of HIV care in Switzerland will most likely have the greatest impact if applied to individuals unaware of their HIV infection.

Although there is strong evidence that the clinical UNAIDS/WHO 90% targets are met in Switzerland, we cannot assume that 90% of the HIV-infected population is also tested and diagnosed. Despite a high treatment quality of HIV-diagnosed patients, reaching all three UNAIDS/WHO 90% targets remains a challenge even for high-income countries with well-established HIV treatment networks. We recommend separating the calculation and discussion of UNAIDS/WHO targets based on outreach and testing vs. those based on clinical performance.

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Contributions: P.K. and A.J.S. wrote the manuscript. P.V. initiated and coordinated the project and obtained financial support. All authors designed the analysis plan and contributed to the calculation of the different levels. P.V. and P.K. designed and executed the national SHCS network survey. A.J.S. coordinated the European MSM Internet Survey (EMIS). All co-authors have read and approved the final manuscript.

### Conflicts of interest

All authors have seen and approved the manuscript and have significantly contributed to the work. Parts of the data have been presented at the CROI Conference Feb 23–26, 2015 in Seattle. The study was financed by the Swiss Federal Office of Public Health (FOPH). There is no potential conflict of interest for any of the contributing authors.

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