

## Differences in adherence and motivation to HIV therapy—two independent assessments in 1998 and 2002

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### Abstract

**Objective** The aim of this study was to compare the level of adherence and motivation in two independent cross-sectional samples of HIV-infected patients conducted in 1998 and 2002, and to investigate the relationship between adherence and motivation. **Method** Consecutive HIV-infected patients on treatment at a Swedish clinic were asked to complete an anonymous questionnaire. In 1998, 60 patients participated and in 2002, 53 participated. In 2002, the 9-item Morisky Medication Adherence Scale (MMAS) was added to the questionnaire set.

**Main outcome measure** Self-reported adherence and motivation.

**Results** In 1998, 28.1% of the respondents were considered adherent, while the corresponding proportion

was 57.4% in 2002 ( $P = 0.002$ ). The mean summary score for MMAS was 10.7 in 2002 (13 = perfect adherence). The proportion considered motivated were 22.4% in the 1998 survey and 41.3% in 2002 ( $P = 0.038$ ). Of the respondents considered motivated in the 2002 survey, 46.7% scored the maximum summary score on the MMAS, while 8.7% of the non-motivated respondents did so ( $P = 0.016$ ).

**Conclusion** The respondents in 2002 were more adherent and motivated than the respondents in 1998 and a relationship between motivation and adherence was found. The difference in adherence and motivation might be due to a new treatment model at the clinic.

**Keywords** Acquired immunodeficiency syndrome · AIDS · HIV · Highly active antiretroviral therapy · MMAS · Patient adherence · Patient compliance · Patient motivation · Pharmacotherapy · Sweden

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### Impact of our findings on practice

- There is a relationship between motivation and adherence to treatment for HIV-infected patients
- It seems important to motivate HIV-infected patients continuously throughout the treatment in order to obtain good treatment outcome.
- Treatment models, similar to the one described, might be of interest for clinical practice.

### Introduction

The treatment of HIV infection has developed rapidly in the western world since the protease inhibitors were introduced in the mid-1990s [1–4]. The combinations of

drugs now available have better effect on the virus [5], require fewer food restrictions and provide easier dosing schedules [1–3]. Due to these progresses in the treatment, the care of HIV-infected patients has also been evolving, since today the HIV infection may be considered a chronic but still fatal disease [6].

Adherence to HIV treatment is one of the critical aspects of modern antiretroviral treatment. The degree of adherence must reach 95% in order to ensure treatment success and avoid virologic failure, a declining immune system and a reduction in survival [7]. Nevertheless, adherence in the HIV population often falls below this required level and the percentage of doses taken as prescribed varies between 53% and 93% according to different assessments [8–13].

Motivation is another important aspect of the care since antiretroviral treatment, despite the progress made, is still demanding, and the patients need to be motivated in order to be able to maintain the treatment, usually, for the rest of their life. Motivation to avoid AIDS has been shown to be a factor that increases adherence [14], whilst loss of motivation seems to be a predictor of non-adherence [15, 16].

There seems to be a relationship between adherence and motivation and there are some theoretical models supporting these empirical findings. According to the perceptions and practicalities model of adherence [17] adherence is dependent on a chain of events. The patient will, according to this approach, make a decision to follow the advice given regarding the treatment if it makes sense to them. Whether it makes sense or not for an individual is believed to depend on his or her beliefs about the illness and treatment and the expectations of outcome. If the treatment makes sense (i.e. the necessity of the treatment is seen as dominant) the patient will become motivated and an intention to adhere to medication is formed. If the patients also has the right practical conditions to be able to use the medication correctly, they will be adherent. In the Information, Motivation and Behavioural skills model of antiretroviral treatment adherence [18] motivation also plays an important part for the development of adherent behaviour. In this model, adherence-related information and motivation are central aspects for good adherence, together with the patient's objective and perceived skills to be adherent.

Sweden has seen the same development in treatment and care as in the rest of the western world [19], particularly at the largest HIV clinic in Sweden, the HIV clinic at Karolinska University Hospital-Huddinge, Stockholm. However, it is not known whether the patients' level of motivation and adherence had

also changed along with the changes in treatment and care.

### Aim of the study

The aim of this study was to explore the level of adherence and motivation in HIV-infected patients treated at Karolinska University Hospital-Huddinge in 1998 and 2002, since a new treatment model had been introduced in the interim and to investigate the relationship between adherence and motivation.

### Method

The study was a comparison of adherence assessments carried out in 1998 and 2002. The assessments were done as part of a larger questionnaire study carried out to investigate the quality of care. Only the parts pertaining to treatment and adherence related issues are presented in this article.

Data were collected for 3 weeks in 1998 and for 7 weeks in 2002. All patients on antiretroviral treatment who visited the clinic during the two collection periods were consecutively asked to fill out the questionnaire. The clinic's receptionists handed out the majority of the questionnaires in the reception area. Two of the authors (M.H. and B.S.) also occasionally handed out questionnaires. The respondents returned the questionnaires anonymously to a sealed box in the reception area.

Ethical approval as a research project was applied for, but not required, since the ethics committee at Karolinska Institutet classified the project as quality assurance.

In 1998, 72 patients agreed to consider participating in the study and were given questionnaires; in 2002, 77 patients agreed to consider participating.

### Questionnaire

The questionnaire was specifically developed for the 1998 study and contained questions about socio-demographic factors, adherence and level of motivation (at start of treatment and at the time of the study).

### *In-house adherence assessment in 1998 and 2002*

Data from two questions were combined to achieve an in-house adherence assessment. The first asked whether the respondents had forgotten any doses the day prior to completing the questionnaire, and the second asked how often doses were forgotten in general (ranging from "very often" to "never"). These items were

derived from two items in the Adult Aids Clinical Trials Groups adherence (AACTG) questionnaire [20] (original wording: “How many doses did you miss yesterday” and “When was the last time you missed taking any of your drugs”, respectively). Respondents, who reported that they had not forgotten a dose the day prior to the completion of the questionnaire and who also responded that they never forget doses, or only once a month, were categorized as adherent. We chose this strict definition of adherence, since the respondents providing us with these answers would theoretically reach the required adherence level of 95%.

#### *Morisky medication adherence scale in 2002*

The Swedish version of the 9-item Morisky medication adherence scale (MMAS) became available after 1998 and was added at the end of the original questionnaire in the 2002 assessment. The MMAS was added to allow for validation of the in-house adherence assessment. MMAS is a further development of the well-validated Morisky–Green test [21]. Internal consistency reliability measured by Cronbach  $\alpha$  had a value of 0.86 for the English version of MMAS (personal communication, Morisky 2002), which is superior to the Morisky–Green test, which has a Cronbach  $\alpha$  value of 0.61 [21]. MMAS has previously been used to measure adherence to antiretroviral treatment [22]. Respondents scoring 11 or above in the MMAS summary score were classified as adherent (scale ranging 1–13). This classification of adherence was based on how we believed the respondents would have to complete the MMAS in order for them to theoretically reach an adherence level of 95%.

#### *Motivation assessment in 1998 and 2002*

The motivation assessment consisted of two questions. The first concerned how motivated the respondents were to use the current treatment (measured by a Visual Analogue Scale (VAS) 0–100) and the second asked whether the respondents thought the treatment would prevent them from getting sick. The second question was derived from an item in the AACTG adherence questionnaire [20] (the original wording of the item was “How sure are you that the medication will have a positive effect on your health”). The respondents scoring in the fourth percentile on the VAS scale (i.e. 98 or above, according to the results from 1998), together with either one of the following responses; “The treatment will absolutely prevent disease progression” or “The treatment will probably prevent disease progression”, were regarded as motivated. We chose this definition of

the summary motivation assessment since we believed that the level of motivation needs to be high in order for the patients to achieve 95% adherence.

#### Statistical analysis

The data analysis was carried out using SPSS for Windows version 10 (SPSS Inc, Chicago, 2000). Chi-square (or Fisher’s exact test, if expected frequencies less than 5) was used to assess categorical data. Independent *t*-test was used when comparing means in normally distributed independent samples. Mann–Whitney test was used when comparing means where the measurements were not normally distributed and when analysing ordered qualitative variables. Cohen’s kappa was used when assessing agreement between adherence assessments. The level of significance was set at 0.05.

#### Results

In 1998, 60 of the 72 patients completed the questionnaire (response rate 83%). In 2002, the response rate was 69%, with 53 of the 77 patients completing the questionnaire. When the 1998 and the 2002 sample were compared, only two respondents provided us with similar demographic characteristics (and therefore *might* have been in both samples); hence the cross-sectional samples represent two independent samples. A comparison of the clinic’s patient population with the respondents completing the 1998 and 2002 questionnaires is presented in Table 1.

#### Background characteristics

Background characteristics of the respondents are presented in Table 2. The age distribution showed that the mean age of the respondents was higher in the 2002 assessment. The total time on HIV-treatment for the respondents doubled between 1998 and 2002 as did the time for which the respondents had been treated with their current treatment. When compared with the results from 1998, fewer respondents used adherence aids in 2002. The number of respondents who reported that they had no friends or relatives to talk to about the treatment more than doubled during the period. No significant difference was found regarding mode of transmission, proportion of homeless patients, side-effects, or treatment interruptions due to side-effects between the two assessments.

#### The level of adherence

Adherence levels are presented in Table 3. In the 1998 survey, 30% of the respondents reported that they

**Table 1** Comparison of the patient population at the clinic with the samples in 1998 and 2002, respectively

|  | 1998 <sup>a</sup> |            | 2002 <sup>b</sup> |            |
|--|-------------------|------------|-------------------|------------|
|  | Total clinic      | Sample (%) | Total clinic (%)  | Sample (%) |
| <i>Gender</i>                              |                   |            |                   |            |
| Male                                       | 66.3              | 75.0       | 66.4              | 76.9       |
| Female                                     | 33.7              | 25.0       | 33.6              | 23.1       |
| Total                                      | 100.0             | 100.0      | 100.0             | 100.0      |
| <i>Mode of transmission</i>                |                   |            |                   |            |
| Transmitted by intravenous drug use (IVDU) | 30.0              | 12.1       | 26.1              | 9.6        |
| Transmitted sexually                       | 65.4              | 82.8       | 68.2              | 73.1       |
| Blood products                             | 0.6               | 1.7        | 1.0               | 5.8        |
| Unknown transmission                       | 3.9               | 3.4        | 4.6               | 11.5       |
| Total                                      | 100.0             | 100.0      | 100.0             | 100.0      |

<sup>a</sup> Total clinic  $n = 649$ ; sample  $n = 60$

<sup>b</sup> Total clinic  $n = 691$ ; sample  $n = 53$

**Table 2** Background characteristics of the respondents in 1998 ( $n = 60$ ) and 2002 ( $n = 53$ ) year surveys, respectively

|   | 1998   |      | 2002   |      | <i>P</i> -value |
|---|--------|------|--------|------|-----------------|
|   | Number | %    | Number | %    |                 |
| <i>Age</i>  |        |      |        |      |                 |
| Mean age  | 41.0   |      | 46.9   |      | 0.001           |
| <i>Mode of transmission</i>                             |        |      |        |      |                 |
| Sexual  | 48     | 82.8 | 38     | 73.1 | 0.353           |
| Intravenous   | 7      | 12.1 | 5      | 9.6  |                 |
| Blood transfusion                                       | 1      | 1.7  | 3      | 5.8  |                 |
| Unknown   | 2      | 3.4  | 6      | 11.5 |                 |
| Total   | 58     |      | 52     |      |                 |
| <i>Years since tested positive</i>                      |        |      |        |      |                 |
| Mean years  | 7.7    |      | 11.4   |      | 0.000           |
| Homeless  | 5      | 8.3  | 5      | 9.4  | 1.000           |
| Total   | 60     |      | 53     |      |                 |
| <i>Time since start of any treatment</i>                |        |      |        |      |                 |
| Mean years  | 3.1    |      | 6.4    |      | 0.000           |
| <i>Time since start of current treatment</i>            |        |      |        |      |                 |
| Mean years  | 1.1    |      | 2.2    |      | 0.009           |
| <i>Side effects</i>                                     |        |      |        |      |                 |
| Total   | 33     | 57.9 | 26     | 52.0 | 0.819           |
| Total   | 57     |      | 50     |      |                 |
| <i>Treatment interruptions due to side effects</i>      |        |      |        |      |                 |
| Total   | 13     | 21.7 | 12     | 24.5 | 0.090           |
| Total   | 60     |      | 49     |      |                 |
| <i>Use adherence aids</i>                               |        |      |        |      |                 |
| Total   | 22     | 45.8 | 20     | 38.5 | 0.008           |
| Total   | 48     |      | 52     |      |                 |
| <i>Talk to friends or relatives about the treatment</i> |        |      |        |      |                 |
| Total   | 52     | 89.7 | 39     | 73.6 | 0.036           |
| Total   | 58     |      | 53     |      |                 |

never missed a dose. In 2002, the proportion was greater, at 58%. According to the in-house adherence assessment, 28% of the respondents were considered adherent in the 1998 survey, while the corresponding proportion was 57%, in 2002.

#### Morisky medication adherence scale

The Cronbach  $\alpha$  value for the MMAS was 0.74. The mean summary score was 10.7 (scale ranging from 1 to 13, where 13 indicates perfect adherence) and 20% of

the respondents scored 13; 62% scored 11 or above and were thus categorized as being adherent.

The agreement between the two adherence assessments (the in-house assessment and the MMAS) was good (Cohen's kappa 0.74).

#### Attitudes toward treatment

Attitudes toward treatment are presented in Table 4. The proportion of respondents who, at the start of their treatment, reported a high level of motivation

**Table 3** Adherence among the respondents in 1998 ( $n = 60$ ) and 2002 ( $n = 53$ ) year surveys, respectively

|                               | 1998   |      | 2002   |      | P-value |
|-------------------------------|--------|------|--------|------|---------|
|                               | Number | %    | Number | %    |         |
| Forgetting tablets            |        |      |        |      |         |
| Every day                     | 0      | 0.0  | 0      | 0.0  | 0.024   |
| Several times a week          | 2      | 3.5  | 0      | 0.0  |         |
| Once a week                   | 4      | 7.0  | 4      | 8.3  |         |
| Sometimes every month         | 34     | 59.6 | 16     | 33.3 |         |
| Never                         | 17     | 29.8 | 28     | 58.3 |         |
| Total                         | 57     |      | 48     |      |         |
| Forgotten a dose the last day | 5      | 8.5  | 3      | 5.7  | 0.700   |
| Total                         | 59     |      | 52     |      |         |
| Adherent <sup>a</sup>         |        |      |        |      |         |
| Yes                           | 16     | 28.1 | 27     | 57.4 | 0.003   |
| No                            | 41     | 71.9 | 20     | 42.6 |         |
| Total                         | 57     |      | 47     |      |         |

<sup>a</sup> Have not forgotten a dose last day and never forgets doses or forgets sometimes every month

**Table 4** Attitudes toward treatment among the respondents in 1998 ( $n = 60$ ) and 2002 ( $n = 53$ ) year surveys, respectively

|   | 1998   |      | 2002   |      | P-value |
|---|--------|------|--------|------|---------|
|   | Number | %    | Number | %    |         |
| Will treatment prevent you from getting sick? |        |      |        |      |         |
| Yes, absolutely                               | 9      | 15.3 | 11     | 22.4 | 0.419   |
| Yes, probably                                 | 26     | 44.1 | 25     | 51.0 |         |
| May be  | 22     | 37.3 | 11     | 20.8 |         |
| No, probably not                              | 1      | 1.7  | 2      | 4.1  |         |
| No, absolutely not                            | 1      | 1.7  | 0      | 0.0  |         |
| Total   | 59     |      | 49     |      |         |
| Motivation at start of treatment              |        |      |        |      |         |
| < 50  | 13     | 22.4 | 6      | 11.8 | 0.004   |
| 51–80   | 14     | 24.1 | 8      | 15.7 |         |
| 81–90   | 6      | 10.3 | 3      | 5.9  |         |
| 91–100  | 25     | 43.1 | 34     | 66.7 |         |
| Total   | 58     |      | 51     |      |         |
| Motivation to continue treatment today        |        |      |        |      |         |
| < 50  | 2      | 3.4  | 2      | 4.0  | 0.007   |
| 51–80   | 13     | 22.4 | 4      | 8.0  |         |
| 81–90   | 5      | 8.6  | 1      | 2.0  |         |
| 91–100  | 38     | 65.5 | 43     | 86.0 |         |
| Total   | 58     |      | 50     |      |         |
| Motivated <sup>a</sup>                        |        |      |        |      |         |
| Yes   | 13     | 22.4 | 19     | 41.3 | 0.038   |
| No  | 45     | 77.6 | 27     | 58.7 |         |
| Total   | 58     |      | 46     |      |         |

<sup>a</sup> VAS 98 or above together with yes, absolutely and yes, probably will the treatment prevent from getting sick

(VAS scores in the fourth percentile i.e. 97 or above), increased from 28% to 55%. The motivation to continue treatment at the time of the surveys (VAS score in the fourth percentile i.e. 98 or above) increased between the two time periods from 31% to 54%.

The proportion of the respondents who were considered motivated according to the motivation assessment increased from 22% to 41% between the two periods.

#### Impact of motivation on adherence according to MMAS

The impact of motivation on individual items in MMAS is presented in Table 5. The respondents categorized as non-motivated in the 2002 survey were less likely to score 13 on the MMAS when compared with the motivated patients (9% vs. 47%).

The respondents categorized as non-motivated in the 2002 survey were less likely to be categorized as

**Table 5** The impact of motivation on adherence according to the MMAS in 2002

|  | Not motivated (%) | Motivated (%) | <i>P</i> -value |
|--|-------------------|---------------|-----------------|
| Sometimes forgetting medicines ( <i>n</i> = 43)  |                   |               |                 |
| Yes  | 12 (46.2)         | 4 (23.5)      | 0.133           |
| No   | 14 (53.8)         | 13 (76.5)     |                 |
| Total  | 26 (100.0)        | 17 (100.0)    |                 |
| Forgotten medicines during the last 2 weeks ( <i>n</i> = 44)   |                   |               |                 |
| Yes  | 7 (28.0)          | 2 (10.5)      | 0.260           |
| No   | 18 (72.0)         | 17 (89.5)     |                 |
| Total  | 25 (100.0)        | 19 (100.0)    |                 |
| Reduced dose without doctor knowing it ( <i>n</i> = 43)  |                   |               |                 |
| Yes  | 5 (20.8)          | 2 (10.5)      | 0.437           |
| No   | 19 (79.2)         | 17 (89.5)     |                 |
| Total  | 24 (100.0)        | 19 (100.0)    |                 |
| Forgetting when travelling ( <i>n</i> = 44)  |                   |               |                 |
| Yes  | 9 (36.0)          | 2 (10.5)      | 0.081           |
| No   | 16 (64.0)         | 17 (89.5)     |                 |
| Total  | 25 (100.0)        | 19 (100.0)    |                 |
| Took medicines yesterday ( <i>n</i> = 44)  |                   |               |                 |
| Yes  | 24 (96.0)         | 19 (100.0)    | 1.000           |
| No   | 1 (4.0)           | 0 (0.0)       |                 |
| Total  | 25 (100.0)        | 19 (100.0)    |                 |
| Reminder system for medicines ( <i>n</i> = 43)   |                   |               |                 |
| Yes  | 8 (32.0)          | 11 (61.1)     | 0.058           |
| No   | 17 (68.0)         | 7 (38.9)      |                 |
| Total  | 25 (100.0)        | 18 (100.0)    |                 |
| Treatment interruptions because the patient feels that the infection is under control ( <i>n</i> = 42) |                   |               |                 |
| Yes  | 1 (4.2)           | 0 (0.0)       | 1.000           |
| No   | 23 (95.8)         | 18 (100.0)    |                 |
| Total  | 24 (100.0)        | 18 (100.0)    |                 |
| Difficult treatment ( <i>n</i> = 44)   |                   |               |                 |
| Yes  | 8 (32.0)          | 4 (21.1)      | 0.419           |
| No   | 17 (68.0)         | 15 (78.9)     |                 |
| Total  | 25 (100.0)        | 19 (100.0)    |                 |
| Difficulty remembering the treatment ( <i>n</i> = 44)  |                   |               |                 |
| Never/rarely   | 18 (72.0)         | 16 (84.2)     | 0.299           |
| Occasionally   | 5 (20.0)          | 3 (15.8)      |                 |
| Sometimes  | 2 (8.0)           | 0 (0.0)       |                 |
| Usually  | 0 (0.0)           | 0 (0.0)       |                 |
| Always   | 0 (0.0)           | 0 (0.0)       |                 |
| Total  | 25 (100.0)        | 19 (100.0)    |                 |
| Summary score ( <i>n</i> = 38) <sup>a</sup>  |                   |               |                 |
| Summary score = 13   | 2 (8.7)           | 7 (46.7)      | 0.016           |
| Summary < 13   | 21 (91.3)         | 8 (53.3)      |                 |
| Total  | 23 (100.0)        | 15 (100.0)    |                 |
| Non-adherent   | 9 (39.1)          | 4 (26.7)      | 0.429           |
| Adherent   | 14 (60.9)         | 11 (73.3)     |                 |
| Total  | 23 (100.0)        | 15 (100.0)    |                 |

<sup>a</sup> MMAS can be presented as a summary score where answers indicating adherent behaviour results in 1 point per item for the first eight items. The last item is scored 1–5 where 1 indicates the least adherent behaviour and 5 the most, giving a range for the summary score of 1–13. Adherent is defined as summary score  $\geq$  11

adherent according to the MMAS when compared with the motivated patients (61% vs. 73%) but this difference was not statistically significant (*P*-value 0.429).

## Discussion

### Limitations of the study

There are several limitations of the study, including the method for measuring adherence, selection bias, low

number of respondents, decreasing response rate over time and social desirability, which might affect the reliability of these results.

Since adherence aids are handed out to every patient at the clinic in accordance with the treatment model, adherence assessment based on self-reports was deemed to be most suitable. Medication Event Monitoring System could not be used with such devices [23] nor could pill counts, since the pills should not be transferred from the original container, for an accurate measurement. Pharmacy records could not be used,



due to limitations of the Swedish pharmacy computer system (data is anonymized two months after the prescription is dispensed). Measuring drug concentrations is only possible for some drugs and only provides information about a limited time-span [23]. Although self-reported adherence leads to overestimation of adherence, it shows a strong linear relationship with viral load [24, 25]. This method is less demanding than the other methods, inexpensive and allows patients to use adherence aids. The limitations of the alternative methods meant that only one measure was used to measure adherence although ideally multiple methods would be used. As a result, the level of adherence reported in this study might not fully correspond with the patients' actual adherence.

The second limitation of the study is selection bias, since more motivated patients might have been more likely to accept participation and thereby be over-represented among the respondents. Further, the decreasing response rate over time might mean that the selection bias was more pronounced in 2002, thereby compromising the comparison between 1998 and 2002. One reason for the decrease in response rate is possibly that the patients were more exposed to research projects in 2002 compared to 1998, with a negative impact on the willingness to participate. Fewer questionnaires were also distributed per unit of time in 2002 compared to 1998, possibly due to a higher workload in the clinic's reception.

In spite of the decreasing response rate, the respondents in 1998 and 2002 were almost identical concerning gender and mode of transmission, although both samples differed from the total patient population at the clinic. Intravenous drug users were underrepresented in both samples, while men and those who reported transmission of HIV through sexual intercourse were overrepresented. This suggests that selection bias might have occurred in these samples, but since both groups appear similarly effected, we believe the comparison over time to be valid.

The relatively low number of respondents means that the study might have been underpowered to detect some differences. On the other hand, the differences that were detected were likely to be large enough to be clinically relevant.

Due to the risk of social desirability, the receptionists usually handed out the questionnaires and they were instructed to ask all patients with treatment to complete the questionnaire. Hence, the risk of social desirability bias was reduced, as the health-care providers were not involved. This approach, together with both anonymous completion and anonymous return of the questionnaire (via a sealed box) was considered to reduce the risk of

respondents overestimating their adherence-related behaviour but this risk could not be eliminated.

#### Difference in adherence and motivation

The proportion categorized as adherent was 28% in 1998 and 57% in 2002. In 1998, 30% of the respondents reported they never missed a dose, while this proportion was 58% in 2002. The proportion of patients never missing a dose has been reported as 32%–41% in American studies [20, 25].

In 2002, the proportion of respondents categorized as adherent (62%) with the MMAS (scoring 11 or above at the summary score) was similar to the proportion (57%) found when using our own adherence assessment instrument. One of the items in MMAS is about whether the patient has missed a dose during the day prior to the distribution of the questionnaire and only 6% of the respondents in the 2002 assessment reported to have done so, compared to 11% in an similar American study [20] thus indicating potentially higher level of adherence in our sample.

The proportion of motivated patients was also higher in 1998 compared to 2002. In 1998 the proportion classified as motivated was 22% while this proportion was 41% in 2002.

There are several possible explanations for the increase in adherence and motivation. Since 1999, the studied HIV clinic has tried to improve adherence by means of a multi-professional treatment model [26], where doctors, nurses, counsellors, pharmacists, psychiatrists and dieticians collaborate in patient-centred teams. The aim is to increase the patients' motivation to follow the treatment regimen. The model combines several of the interventions found to impact on adherence (i.e. information, reinforcement, counselling and additional attention by health care provider) [27]. The focus was placed on increasing treatment motivation, since high motivation to follow the treatment has been shown to have a positive impact on adherence [14–16]. Although the model was mainly based on clinical experience, it has parallels with theoretical models regarding adherence (i.e. the perceptions and practicalities model of adherence [17] and the Information, Motivation and Behavioural skills model [18]).

In parallel with the introduction of the treatment model, a satellite pharmacy was opened at the clinic. At the satellite pharmacy, patients can get in depth information (both oral and written) about their HIV treatment while their prescriptions are dispensed. The pharmacy staffs also help the patients in their dealings with other pharmacies and offer personalized advice on how to increase the level of adherence [26].

The treatment regimen has also changed during this period. In 1998, the majority of patients were prescribed antiretroviral three times daily but, in 2002, twice-daily therapy was dominating. The level of adherence to HIV treatment has been shown to increase with fewer doses [28], and the reduction in the number of daily doses in our study may hence have contributed to the higher levels of adherence. However, according to one systematic review, which assessed electronic adherence monitoring in a variety of treatments, the difference in dose taking between three times daily and twice-daily regimens was not statistically significant [29].

Patients who were satisfied with their social support have been shown to be more adherent [16, 30, 31], as were patients using adherence aids [28]. Longer time on treatment is generally associated with a decreased level of adherence [32]. One would, therefore, expect to find that the level of adherence would have decreased from 1998 to 2002, since there was a lower level of social support, the time on treatment was greater and fewer respondents reported using adherence aids. However, this hypothesis was not supported by our findings. Similarly, Bangsberg and colleagues [33] also found that time on HIV-treatment is a factor that positively contributes to the level of adherence. The reduction in the proportion of respondents who used adherence aids between the measuring periods might be explained by the greater reported time on treatment. The patients who have been on treatment for long periods may not feel the need for such devices, as medication taking has become routine. Likewise, the need to discuss the treatment with friends or relatives is probably higher in the beginning of the treatment.

The respondents appeared to be more motivated in 2002 than in 1998. The treatment model was specifically developed to motivate the patients before initiating treatment and to maintain this motivation during their treatment and might hence be a possible explanation for this difference. High motivation was associated with better adherence in our patient group, with the motivated respondents scoring significantly higher on the MMAS. However, greater motivation, and the greater level of adherence, might be attributed to other factors. A randomized controlled study would be required to provide information about causality.

## Conclusion

It can be concluded that the respondents to the 2002 survey were more adherent and motivated than the

respondents in the 1998 survey, although the use of adherence aids and treatment support from friends or relatives was lower. According to these results, a relationship between motivation and adherence also seemed to exist. The treatment model, accompanying satellite pharmacy and simplified treatment regimen at the HIV clinic, may have effected the patients' levels of motivation and adherence, either separately or together. However, although we can generate this hypothesis, our study cannot attribute such causality.

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