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# CONCEPT OF ADHERENCE RELATED TO ANTI- RETROVIRAL THERAPY (ART) AND ITS THEORETICAL MODELS

**Matin Ahmad Khan[1*], Ramji Lal Agarwal[2], Arun Kumar[3], Lakshman Lal[4], Shubhshish Sircar[5], Binod Kumar[6], Uma Shankar Singh[7], Indrajeet Kumar[8], Asish Kumar Biswas[9]**

Associate Professor, Dept of Biochemistry, Patliputra Medical College & Hospital, Dhanbad, Jharkhand, India
Associate Professor, Dept of Medicine, Rohilkhand Medical College, Bareilly, Uttar Pradesh, India.
Principal & Professor Dept of PSM, Patliputra Medical College & Hospital, Dhanbad, Jharkhand, India.
Professor & HOD, Dept of Biochemistry, MGM Medical College, Jamshedpur, Jharkhand, India.
Associate Professor, Dept of PSM, MGM Medical College, Jamshedpur, Jharkhand, India.
Assistant Professor, Dept of Pathology, MGM Medical College, Jamshedpur, Jharkhand, India.
Assistant Professor, Dept of Pathology, MGM Medical College, Jamshedpur, Jharkhand, India
Lecturer, Dept of PSM, MGM Medical College, Jamshedpur, India.
Associate Professor, Dept of Pharmacology Patliputra Medical College & Hospital, Dhanbad, Jharkhand, India.

**ABSTRACT**

Medication adherence means sticking firmly to an HIV regimen—taking HIV medicines every day and exactly as prescribed HIV medicines prevent HIV from multiplying, which protects the immune system and reduces the risk of both drug resistance and HIV treatment failure. Medication adherence lets HIV medicines do their job. Adherence can be difficult for many reasons. For example, side effects from some HIV medicines can make it hard to stick to an HIV regimen In both clinical trials and clinical practice, non-adherence to medications is widespread among patients with chronic diseases. The shift to combination therapies for treating human immunodeficiency virus (HIV)-infected individuals has increased adherence challenges for both patients and health-care providers. Estimates of average rates of non-adherence to antiretroviral therapy range from 50% to 70%. Adherence rates of <80% are associated with detectable viremia in a majority of patients and hence > 95% of level of adherence is always required for ART to do its job. The principal factors associated with non-adherence appear to be patient-related, including substance and alcohol abuse. However, other factors may also contribute, such as inconvenient dosing frequency, dietary restrictions, pill burden, and side effects; patient-health-care provider relationships; and the system of care. We discuss the major reasons reported by HIV-infected individuals for not taking their medications. Improving adherence probably requires clarifying the treatment regimen and tailoring it to patient life styles. Strategies to help maintain adherence include using a 7-day pill box and setting daily pill reminders on a smartphone.This review contributes by describing the commonly cited health behaviour theories, presenting the evidence and critique for each; discussing the applicability of these theories to adherence behaviour; and highlighting several recommendations for research and theory development

**Key words:** Adherence, Theories, HAART , Resistance.

## INTRODUCTION

The term ‘compliance’ has been defined as ‘the extent to which a person’s behavior coincides with medical or health advice’ or ‘the degree of conformity between treatment behavior and treatment standards’. The first of these definitions suggests a degree of paternalism on the part of the clinician, whereas the latter, more recent

Corresponding Author :- **Matin Ahmad Khan** Email:- mak5962@hotmail.com

definition, acknowledges the role of the patient in treatment decisions.

The greater use of the term 'adherence', instead of 'compliance' also reflects current thinking of less paternalism in treatment decisions.

Adherence is defined as 'the act or quality of sticking to something—to adhere to something'. In the context of treatment with medications, adherence means a more collaborative process between the patient and provider. The patient plays a more active role in his treatment and makes a commitment to follow the prescribed regimen as best as possible. How is it different from 'Compliance'? The dictionary defines compliance as 'the act of conforming, yielding or acquiescing' implying thereby a lack of patient participation.

The definitions of compliance and adherence given above appear to take a clinical perspective on patient's behaviour towards their treatment. But what are the perceptions of patients? Kuipers (1996) suggests that patients may choose to not adhere to treatment because their perception or experience is that it is inappropriate or inaccessible. It would be desirable to obtain more information from patients as to the reasons why they do or do not adhere to their medications. Some discussion is warranted of how patients' feel about their medications, their understanding of their treatment, and the extent to which they feel committed to their treatment. This perception is particularly important in schizophrenia as, because of the chronic nature of the illness, patients are often on medication on a long-term basis.

The assumption is made that non-adherence takes place only after patients initially agree to the prescribing of medication to alleviate their symptoms associated with the illness.

Here Adherence means "to stick firmly." So for people with HIV, medication adherence means sticking firmly to an HIV regimen—taking HIV medicines every day and exactly as prescribed.

**STATUS OF ADHERENCE IN ANTI RETRO VIRAL THERAPY**

The success of treatment as prevention is highly dependent upon people adhering to their treatment. It is widely agreed that once treatment is initiated it should not be interrupted, as incomplete viral suppression causes the more sensitive strains of HIV to be suppressed and the resistant strains to become dominant. Resistant strains are harder to treat.

Adherence is an issue even where treatment is widely available. In 2011, one study from the United States of America (USA) reported that 15 years after the initiation of highly active antiretroviral therapy (HAART), and four years after the introduction of combination prevention, only 19% of 1.1 million people living with HIV in the country had an undetectable viral load. In South Africa which has the largest treatment program in the world, a study found that only 64% of people who were initiated on treatment between 2002 and 2007 were still in care three years on

**ADHERENCE TO ART in INDIA**

There are studies in India which have demonstrated the sub optimal adherence to ART. Basavaprabhu Achappa et al has found- in one study that out of 116 participants, 63.7% reported adherence ≥ 95% , and mean adherence index was 91.25%. Financial constraints, forgetting to take medication, lack of family care, depression, alcohol use, social stigma and side effects to antiretroviral therapy were barriers for adherence in our study.

**JHARKHAND**

There is only one study done before regarding adherence to ART by Sandeep Rai et al which examines the effect of optimal adherence to ART on survival status of HIV infected patients attending ART centers in Jharkhand, India.

Optimal adherence was assessed using pill count methods; patients who took <95% of the specified regimens were identified as non-adherent. The mortality rate was higher among patients who were non-adherent to ART) than who were adherent. The risk of mortality was fourfold higher among individuals who were non-adherent to ART than who were adherent They conclude that Adherence to ART is associated with a higher chance of survival of HIV infected patients, ascertaining the need for interventions to improve the ART adherence and early initiation of ART [1].

**EVOLUTION OF CONCEPT OF ADHERENCE DURING ANTI RETRO VIRAL THERAPY (ART or HAART)**

HAART consists of three or more antiretroviral medications to be taken in combination. In addition to antiretroviral medications, patients also have to take medications for treatment or prevention of opportunistic infections. All these medications can add up to 16 to 20 pills a day with multiple dosing throughout the day, especially with protease inhibitor containing regimens. The enormous pill burden is a major challenge. In addition some antiretroviral medications also require specific food and fluid restrictions. For example, patients would need to take Crixivan or Indinavir 1 hour before or 2 hours after meals and patients should drink at least 1.5 litres of water or fluids daily to prevent formation of kidney stones.

Furthermore, HAART can often lead to adverse events that may be temporary such as nausea, vomiting, diarrhea, fatigue etc., or longer lasting such as neuropathy, lipoatrophy/lipodystrophy, metabolic dysfunction etc. Side effects have been seen to be a major reason for patients discontinuing their medications. Antiretroviral medications control HIV virus replication or multiplication. Even when

the virus becomes undetectable in the blood with successful ART, there are some sites in the body where drugs are unable to reach the virus. These sites are called sanctuary sites [2].

Therefore the virus cannot be completely eradicated from the body and continues to remain hidden in these sanctuary sites. The virus emerges when ART fails or is stopped. As the virus cannot be eradicated, antiretroviral medications have to be taken regularly, long-term, for the rest of the patient's life. HIV infection can therefore be managed but not cured. Drug resistance can develop as HIV multiplies in the body. When HIV multiplies, the virus sometimes mutates (changes form) and makes variations of itself. Variations of HIV that develop while a person is taking HIV medicines can lead to new, drug-resistant strains of HIV. HIV medicines that used to suppress the person's HIV are not effective against the new drug-resistant HIV. In other words, the person's HIV continues to multiply.

When patients take their medications irregularly or when providers prescribe inappropriate doses or combinations of medications the virus is exposed to inadequate (sub-inhibitory) concentrations of antiretroviral medications. This in turn leads to ongoing viral replication and to the development of resistance to antiretroviral medications. Resistance to antiretroviral medications accounts for a large portion of treatment failures. The critical problem is the issue of 'cross-resistance'. Once the virus becomes resistant to a particular antiretroviral medication, the virus may also exhibit resistance to other medications of the same class that have not yet been prescribed to that patient. This limits the choice of drugs available to replace the failing regimen. For example, resistance to Nevirapine would mean that the patient cannot use other NNRTI medications such as Delavirdine (Rescriptor) or Efavirenz (Sustiva). The second issue with viral resistance is that resistant strains of the virus can be transmitted. It has been seen that some patients diagnosed for the first time with HIV, who have never taken ARVs, are already resistant to some anti-retroviral medications. This is a major public health problem in resource-limited situations where the choice of medications is already restricted due to high costs and limited availability. It becomes all the more important for patients to take their medications regularly and correctly to avoid the emergence of resistance. Taking HIV medicines every day prevents HIV from multiplying, which reduces the risk that HIV will mutate and produce drug-resistant HIV. Skipping HIV medicines allows HIV to multiply, which increases the risk of drug-resistant HIV being developed .Research shows that a person's first HIV regimen offers the best chance for long-term treatment success. So adherence is important from the start—when a person first begins taking HIV medicines. The goal of HAART (Highly Active Antiretroviral Therapy) is to suppress viral load in the blood to undetectable levels (levels that are no longer detectable in routine viral load assays). Adherence to treatment is critical to obtain full benefits of HAART: maximal and durable suppression of viral replication, reduced destruction of CD4 cells, prevention of viral resistance, promotion of immune reconstitution and slowed disease progression. Paterson and colleagues found that adherence greater than 95% is needed to achieve virologic success, especially for protease inhibitor containing regimens. As adherence decreased, viral loads increased sharply in a dose response effect. The study showed that 22% patients with adherence of greater than 95%, 61% of patients with adherence between 80–94.9% and 80% of patients with adherence levels of less than 80% demonstrated virological failure. Virological failure was defined as detectable viral loads [3,4]. What does 95% adherence translate into? For example Zerit (D4T) is taken twice a day. A patient should take 60 pills over one month (30 days). To achieve 95% adherence a patient must take at least 57 of his 60 tablets. Missing four pills or doses would result in 93% adherence and missing five pills would result in 91% adherence.

Unfortunately, non-adherence is common among individuals treated with HAART. Several studies have shown varying levels of adherence: more than 10% of patients report missing one or more medication doses on any given day, and more than 33% report missing doses in the past two to four weeks [5]. Chesney estimated that the average non-adherence to ARV therapy ranged from 50 to 70 percent among patients in the US. Physicians and nurses cannot accurately guess whether a person will be adherent or non-adherent.

Most information on adherence is coming from western countries. It is seen that the rates of non-adherence to HIV therapies are comparable to those for other chronic illnesses. In the case of chronic diseases such as hypertension or diabetes lower levels of adherence, around 70–80%, are considered adequate to achieve treatment goals. In the case of ART, near perfect adherence (adherence levels greater than 95%) is required to obtain a successful treatment outcome. As has been mentioned earlier, very high levels of adherence (near perfect adherence) are required to achieve the full benefits of HAART. Non-adherence can lead to inadequate suppression of viral replication, continued destruction of CD4 cells, progressive decline in immune function and disease progression. Non-adherence is also an important reason for the emergence of viral resistance to one or more antiretroviral medications. Adherence to an HIV regimen gives HIV medicines the chance to do their job: to prevent HIV from multiplying and destroying the immune system. HIV medicines help people with HIV live longer, healthier lives. HIV medicines also reduce the risk of HIV transmission. Once drug-resistant HIV develops, it remains in the body. Drug resistance limits the number of HIV medicines available to include in a current or future HIV regimen.

**PROBLEM OF NONADHERENCE**

Adherence to an HIV regimen can be difficult for several reasons. For example, side effects from some HIV medicines, such as nausea or diarrhea, can make it hard to follow an HIV regimen. When an HIV regimen includes several HIV medicines, it's easy to forget how many pills to take and when to take them. The following factors can also make medication adherence difficult:

- Side effects from interactions between HIV medicines and other medicines a person may take
- Trouble swallowing pills or other difficulty taking medicines
- A busy schedule, shift work, or travel away from home that makes it hard to take medicines on time
- Illness or depression
- Alcohol or drug use that interferes with the activities of daily life
- Fear of disclosing one's HIV-positive status to others
- Lack of health insurance to cover the cost of HIV medicines

Before starting HIV medicines, it helps to have strategies in place to maintain adherence. Strategies may include using a 7-day pill box or using an app to set daily pill reminders. Also, health care providers can provide helpful referrals and resources for anticipated adherence challenges. People can work with their health care providers to select an HIV regimen that works best for their needs and lifestyle. Non-adherence can vary from missing one dose of a medication to missing a single dose of all three or four medications to missing multiple doses or all doses a day or week. Not observing instructions regarding dietary or fluid intake or not taking medications at prescribed time intervals also constitutes non-adherence Poor adherence to an HIV regimen allows HIV to destroy the immune system. A damaged immune system makes it hard for the body to fight off infections and certain cancers. Poor adherence also increases the risk of drug resistance and HIV treatment failure.

Factors that influence adherence can be categorized to include: patient factors, treatment regimen, disease characteristics, patient–provider relationship and clinical setting. Non-adherence can refer to medication, to a therapy or to services. As it relates in medicines, non-adherence covers a range of rates of missing medication across individuals. Some patients may only miss a few dosages while others may consistently not take their medication as prescribed. Non-adherence can also be classified as relating to (a) failure to fill a prescription; (b) filling the prescription but failing to take the medication; (c) taking only a portion of the prescription; and (d) not following the frequency or dose instruction of the prescription. Across illnesses, non-adherence to medication is estimated to account for 135,000 deaths in the US per year [4]. Little is known about attitudes of schizophrenia patients towards their medications.

**THEORETICAL MODELS**

In a chapter of the book 'Patient Treatment Adherence' edited by Bosworth, Oddone and Weinberger, Bowsorth and Voils (2008) present several theoretical models that have been identified to try to understand treatment adherence. These include Locus of Control Theories, Theory of Reasoned Action, Protection Motivation Theory, the Health Belief Model and the Trans theoretical Model. Discussion of these models has sought to describe their application to a variety of health behaviours. These may be relating to preventative behaviours such as breast self-examination, smoking cessation or exercise adherence, to behaviours during treatment, such as medication adherence and behavioural changes sought through interventions to improve adherence. Discussion of theoretical models also covers the various stages of treatment: from seeking and accepting treatment, to starting and maintaining treatment. For the most part, the application of theoretical models in this area has focussed on the understanding of preventive behaviours and the initiation of treatment. There exists less understanding of the maintenance phase of treatment[5,6].

**Rotter's and Wallston's The Locus of Control Theories**

Rotter sets out that there are internal and external dimensions to locus of control. Internal locus of control is the degree to which an individual perceives that reinforcement is contingent on one's behaviour. External locus of control is based on believing that reinforcement is contingent on outside forces such as luck or fate. Wallstron expanded on these concepts by distinguishing external locus of control beliefs which stem from relying on powerful others, such as a physician, as opposed to unknown external forces. Locus of control theories suggest that individuals with good internal locus of control are more likely to adhere to their medical treatment. An individual who believes that by taking their medication as prescribed they will get better is more likely to adhere.

**Social Learning Theory and self-efficacy**

Bandura's concept of Social Learning Theory is also based around expectations. This theory postulates that human behaviour is determined by expectancies and incentives. Three main categories of expectancies are described as expectancies about environmental cues, expectancies about the consequences of one's own actions and expectancies about one's ability to achieve a desired outcome. The last of these is termed self efficacy, and suggests that behaviour is based on both an individual's belief in their ability to perform the behaviour and their opinion of the likely outcomes of the behaviour. The value which the individual places on the desired outcome determines the incentive. Self-efficacy relates well to medical adherence in that if a patient feels that what is asked of them in managing their health condition is not

outside of their ability, they will follow that behaviour as directed. The role of expectation on remaining adherent to medication is, however, less applicable. It is likely that any patient will perceive there to be little difficulty in taking medications. Non-adherence to medication is likely to occur as a result of experiencing side-effects or the patient feeling like they no longer require the medication. In these cases, it is in improving adherence that these concepts can be applied, such as in explaining the consequences of missed dosages [7].

**The Theory of Reasoned Action/Theory of Planned Behaviour**

The Theory of Reasoned Action suggests that attitude towards behaviour and the perception of how others feel about the behaviour will predict whether or not an individual will follow the behaviour. The Theory of Planned Behaviour adds the notion that perception of control over performing behaviour not only predicts behavioural intention, but will also predict whether or not they actually perform the behaviour. This relates to self-efficacy. The difficulties cited in applying this theory to medical behaviour relate to its inability to explain and account for changes in behaviour over time and the possible divergence between intentions and actual behaviour. It has been found that the type of behaviour and cognitive and personality variables affect the level of consistency between intentions and actual behaviour. By introducing implementation intentions, in effect cues to help determine when, where and how behaviour is to be performed, can assist in improving adherence. For example, a patient could be told to take their medication each day with their evening meal to help create a pattern for completing the behaviour of medication taking [8].

**Protection Motivation Theory**

The Protection Motivation Theory relates to decision making in the face of health threats. The theory suggests that an individual will follow a prescribed behaviour if they are susceptible to a threat, the threat is severe and the individual is fearful of the threat. This theory is particularly relevant in encouraging preventative behaviours, such as condom use, and in medication adherence where physicians can highlight the deleterious consequences of non-adherence.

**The Health Belief Model**

The Health Belief Model suggests that personal beliefs and perceived susceptibility, severity, benefits and barriers all combine to determine health behaviours [7,8]. Susceptibility refers to the subjective perception of personal vulnerability to a particular health problem. Severity is the subjective perception of severity or dangerousness of a health problem and its effects. Benefits are the perceived effectiveness of a range of interventions to 21 treat the health problem and barriers are the perceived negative aspects of a particular action taken to reduce or eliminate the health problem. These beliefs are thought to be determined by demographic factors and psychological characteristics. The model is most relevant to the context of adopting preventing behaviours and stopping harmful behaviours. Bosworth and Voil's (2008) review found no evidence that the health belief model has predictive validity in relation to medication adherence. There are studies, however, which do suggest a correlation between dimensions of the health belief model and adherence in schizophrenia. Budd et al (1996) found an association between beliefs around susceptibility and adherence status. That is, those who did adhere to medication perceived themselves to be more susceptible to relapse than non-adherers. Adams and Scott (2000) reported that perceived severity of illness and perceived benefits of treatment explained 43% of the variation in adherence behaviour [9,10].

**The Self-Regulatory Model of Illness**

This model is similar in concepts to those of the self-efficacy model. In a health behaviour context, the model defines there to be three stages of self-regulation: representation of the illness, development and implementation of a plan to cope with the illness and evaluation of the coping mechanism. Individuals are thought to move from one stage to another, in no particular direction. For example, an individual may have a coping mechanism, evaluate it to be ineffective and therefore move back to the stage of development and implementation of a new plan to cope with their illness. This model relates well to acute illnesses, where a cognitive response to a threat to adherence is likely, but does not well explain sustained behaviour in chronic diseases where immediate threats of impact on health are not immediately experienced (for example, hypertension).

**The Trans theoretical Model and the Precaution Adoption Model**

The Trans theoretical and Precaution Adoption models define stages of behavioural changes. The maintenance stage is only one stage of these. The advantage of these stages is in understanding that the different stages of behavioural change differ significantly. For example the factors that encourage a patient to begin to follow a prescribed behaviour may be very different from those that encourage maintaining the behaviour in the long term. These models assert that intervention to promote behaviour should be specific to the stage the individual is in.

**The Self-Medication Hypothesis**

The Self-Medication Hypothesis states that patients decide to start, adjust or stop prescribed medication according to perceived health needs and those decisions are conducted intentionally and rationally, given

the information available to the patients and their understanding of their condition. Mitchell (2007) asserts that there is evidence that patients with a mental illness do interrupt or stop medication both intentionally and unintentionally, based largely on how they are feeling, which partly supports the self-medication hypothesis.

It is difficult to assess these theories in empirical analysis. One noted deficit of research of adherence can be explained with the example of schizophrenia patients where the developmental process of decision relating to medication taking is not taken into account (Marland and Cash 2005). Alternative approaches to understating medication taking have been suggested. Demyttenaere (1997) discusses the relevance of considering a medical psychology approach to understand why each individual patient, with his or her specific symptoms, relational context and therapeutic alliance is or is not adherent. Within this approach, the theory of constraints asks the question 'what constrains this patient from more effectively managing his or her condition?' Weiden (2007) suggests a similar approach in defining a more flexible approach to adherence theory that is more applicable to clinical practice. He suggests five theories regarding medication adherence in patients with schizophrenia. These are: (1) Adherence is not a clinical outcome and only matters as it interferes with outcome (2) Adherence problems are often entangled with efficacy limitations of antipsychotic medications (3) Adherence can be viewed as a behaviour (taking/not taking) or as an attitude (prefers taking/prefers stopping medication) (4) When considering adherence attitudes, patient beliefs are always reality 23 (5) Adherence behaviour changes and fluctuates over time and should be considered part of the illness. The ambiguity arising from the application of these theories can be illustrated by considering responses to the third of these theorems. If adherence is viewed as a behaviour, approaches to improve adherence should address whatever logistic problems prevent patients from taking their medications as prescribed. On the other hand, if adherence is viewed as an attitude, their physician must seek ways to educate and convince the patient of the benefits of their medication. As described by Weiden, non-adherence to medication in schizophrenia typically is not both behavioural and attitudinal. The theoretical models discussed set out to understand the factors that explain adherence related behaviours. These cover a range of adherent behaviours from preventative behaviours to adherence during the maintenance phase of treatment in chronic illnesses and responses to improve adherence. These models have led to successful strategies, primarily in the area of eliciting healthy behaviours. But these changes in behaviours are often not maintained. Models which further focus on the understanding the behavioural responses to being in the maintenance phase of prescribed medications in chronic diseases are needed. Such models will encourage the development of strategies of intervening to prevent maintenance phase non-adherence before it occurs [11].

**Information-Motivation-Behavior (IMB) adherence model**

The IMB model has been used to inform the development of HIV preventative interventions (Ware, et al, 2006) and being considered as a model approach for adherence. IMB has its roots in social psychology and health, and it depicts adherence as a three-pronged situation: 1) Information refers to the relevant knowledge about an individual's health-related problem; 2) Motivation refers to the perceived benefits of a medical regimen and available social supports; and, 3) Behavior refers to the individual's ability to perform the skills and tasks necessary for adherence, as well as a sense of self-efficacy (Ware et al., 2004). Missing from the model, according to Ware et al, are "conceptual domains that, if made more salient in the IMB model, might increase validity" (2006: .S22). These conceptual "domains are: 1) Access to therapy; 2) social context, and 3) culture" (Ware et al., 2006). Within any socio-economic environment or culture, there are distinct barriers and support within each of these conceptual domains. Commonly, these barriers would include difficulties with transportation, stock-outs of medication, poverty, and gender inequality, while supports might include treatment partners and access to extended family [12].

**CONCLUSIONS**

Theories may assist in the design of behaviour change interventions in various ways by promoting an understanding of health behaviour, directing research and facilitating the transferability of an intervention from one health issue, geographical area or healthcare setting to another Here behaviour change theories have been reviewed which may be applicable to long-term treatment adherence; assesses the evidence for their effectiveness in predicting behavior change; and examines the implications of these findings for developing strategies to improve HIV/AIDS medication adherence Suboptimal treatment adherence remains a barrier to the control of many infectious diseases, including tuberculosis and HIV/AIDS, which contribute significantly to the global disease burden. However, few of the many interventions developed to address this issue explicitly draw on theories of health behaviour. Such theories could contribute to the design of more effective interventions to promote treatment adherence and to improving assessments of the transferability of these interventions across different health issues and settings.

**REFERENCES**


1. Eccles M, Grimshaw J, Walker A, Johnston M, Pitts N, Changing the behavior of healthcare professionals, The use of theory in promoting the uptake of research findings. *J Clin Epidemiol*, 58, 2005, 107-112.
2. Michie S, Abraham C, Interventions to change health behaviours, Evidence-based or evidence-inspired? *Psychol Health*, 19, 2004, 29-49.
3. Bangsberg DR, Moss AR, Deeks SG, Paradoxes of adherence and drug resistance to HIV antiretroviral therapy. *J Antimicrob Chemother*, 53, 2004, 696-699.
4. Paterson DL, Swindells S, Mohr J, Brester M, Vergis EN, Squier C, et al, Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Ann Intern Med*, 133(1), 2000, 21-30.
5. WHO, Adherence to Long-Term Therapies - Evidence for action. 2003, Geneva, World Health Organization.
6. Malta M, Petersen ML, Clair S, Freitas F, Bastos FI, Adherence to antiretroviral therapy, a qualitative study with physicians from Rio de Janeiro, Brazil. *Cad Sude Publica*, 21(5), 2005, 1424-32.
7. Simoni JM, Frick PA, Pantalone DW, Turner BJ, Antiretroviral adherence interventions, a review of current literature and ongoing studies. *Top HIV Med*, 11, 2003, 185-198.
8. Weidle PJ, Wamai N, Solberg P, Liechty C, Sendagala S, Were W, et al, Adherence to antiretroviral therapy in a home-based AIDS care programme in rural Uganda. *Lancet*, 368 (9547), 2006, 1587-94.
9. Sabin LL, Desilva MB, Hamer DH, Keyi X, Yue Y, Wen F, et al, Barriers to adherence to antiretroviral medications among patients living with HIV in southern China, a qualitative study. *AIDS Care*, 20(10), 2008, 1242-50.
10. Simoni JM, Kurth AE, Pearson CR, Pantalone DW, Merrill JO, Frick PA, Self-Report Measure of Antiretroviral Therapy Adherence, A Review with Recommendations for HIV Research and Clinical Management. *AIDS behave*, 10(3), 2006, 227-10.
11. Ammassari A, Trotta MP, Murri R, Castelli F, Narciso P, Noto P, et al, Correlates and predictors of adherence to highly active antiretroviral therapy, Overview of published literature. *Jaids J Acquir Immune Defic Syndr*, 31, 2002, 123-127.
12. The Economic Times. Anti-AIDS medicine project likely to take off at Sonagachi. 2015. http, //articles. economictimes.indiatimes.com/2015-01-01/news/57581530_ 1_hiv-infection-hiv-virus-aids-society, accessed on May 18, 2016.