

**Does treatment collection and observation each day keep the patient away?
Analysing the determinants of adherence among patients with Tuberculosis in
South Africa.**

Stephen Birch^{1,2}, Veloshnee Govender², Jana Fried¹, John Eyles^{1,3}, Vanessa Daries²,
Mosa Moshabela³, Susan Cleary²

1. McMaster University, Canada
2. University of Cape Town, South Africa
3. Witwatersrand University, Johannesburg, South Africa

Abstract: Directly observed treatment short course (DOTS) was developed as an alternative to inpatient treatment for TB. It involves the often facility-based observation of patients' medication intake to promote adherence. However, the additional burden of daily visits including travelling costs and waiting times has potential impacts on access to care. Using a mixed methods approach, we consider (1) whether self-reported non-adherence differs systematically with different frequencies of clinic-based TB treatment delivery and (2) whether frequency of delivery interacts with affordability and acceptability factors in explaining variations in adherence. Data were collected on 1200 TB patients in four different South African provinces. Additionally, 17 in-depth interviews were completed with patients on TB treatment. After controlling for socioeconomic and demographic factors, patient type and treatment duration, the analyses showed that daily attending patients were 2.5 times as likely to report having missed a clinic visit ($p < 0.001$) and over twice as likely to report having missed a dose of treatment ($p = 0.002$) compared to patients required to attend clinics for treatment collection less frequently. Missed visits increased with treatment duration ($p = 0.01$), indicating that sustaining daily visits over time may be problematic. The qualitative analysis identified treatment cost and duration, patients' physical condition and the role of varying social contexts (family, community and work) as important influences on adherence. These findings suggest that the common strategy of daily clinic visits may require reconsideration if resources for the care of TB patients are to be used efficiently. The importance of adopting an approach that puts patient interests at the centre of TB treatment delivery would appear to be of high priority, particularly in countries where TB prevalence is high and resources for TB care are highly constrained.

Introduction:

Tuberculosis (TB) remains a major public health problem in many low and middle income countries (WHO 2011). Although effective treatments are available, success depends crucially on adherence to a treatment regimen of daily drugs (WHO 2010). Given the infectious nature of the condition, attempts to control the level and spread of the disease depend on achieving high levels of adherence. In order to promote adherence among TB patients in resource-limited settings, a directly observed treatment short course (DOTS) was developed by the WHO in 1995 as the recommended strategy for TB control (WHO 1997). The strategy was originally developed as an alternative to inpatient treatment for TB and remains a standard form of service delivery in many jurisdictions. In some settings, the implementation of this strategy requires patients to attend the clinic on a daily basis where the provider observes the patient taking the drugs and hence is able to ensure adherence among attending patients. However, this strategy simply shifts the adherence issue away from whether patients take the prescribed drug, to whether patients attend clinics to be observed taking the drug. Although the drug may be provided free ‘at the point of delivery’, the way the drug is delivered may impose additional costs on the patient and hence impact on access to care.

WHO has suggested that while direct observation of therapy (DOT) may help ensure patients take their drugs regularly and complete treatment, supervision must be carried out in a context-specific and patient-sensitive manner. Depending on the local conditions, supervision may be undertaken at a health facility, in the workplace, in the community or at home. The WHO further argues that care should be taken to overcome patient access barriers (WHO and Stop TB Partnership 2006). “The whole purpose of treatment observation would be defeated if it were to limit access to care, turn patients away from treatment, or add to their hardships.” (WHO 2010 p. 77).

A systematic review of randomised control trials compared institutional-based DOT, community-based DOT and self administration of the drug without any direct observation by a third party (Volmink and Garner 2007). The studies included in the review covered both high income and low or middle income countries and also ranged in terms of the burden of TB within the population. The authors reported that there was no quantitatively important advantage of DOT, whether administered at an institution or in the community, over patient self administration in terms of either adherence or cure. Although there are some published studies that find higher levels

of adherence under DOT than under self administration (Juan, Lloret et al. 2006; Kapella, Anuwatnonthakate et al. 2009), these involve populations with low levels of TB burden and are based on non-experimental research designs limiting both the validity and applicability of the findings to South Africa. In an early study of South African patients, those undergoing retreatment for TB fared worse under DOT than self administration (Zwarenstein, Schoeman et al. 1998). In contrast, a systematic review of qualitative studies of patient adherence identified the organisation of treatment and care as an important determinant of adherence (Munro, Lewin et al. 2007). The general message emerging from these reviews is that DOT seems to offer no advantage over self administration.

In South Africa, TB is a growing problem as evidenced by the 400% increase in incidence in the past 15 years (SANAC 2011). WHO estimates place South Africa third in the ranking of TB burden (0.4 – 0.59 million cases), after India (2.0 – 2.5 million) and China (0.9 – 1.2 million) (WHO 2011). TB services, along with other services in the public health system are based on a decentralised model. While the National Department of Health determines overall health policy direction, provincial departments are charged with implementation via the district health system, based on assessments of local populations and contexts. In many cases, implementation challenges on the ground lead to between-community differences in service delivery. In the case of TB, a National Tuberculosis Control Programme (NTCP) was developed in 1995 based on the WHO DOTS strategy and strategic plans were developed with implementation targets for the 2001-2005 (National Department of Health 2000) and 2007-2011 periods (National Department of Health 2007). The most recent treatment guidelines state that DOT is recommended for all TB clients for the entire period of treatment (National Department of Health 2009). On the ground, this may mean that some communities follow a daily clinic-based DOT approach, while in other communities a more flexible approach may be adopted with patients being required to attend the clinic either weekly or monthly to collect the supply of drugs. In these instances, community or workplace daily supervision should be provided depending on local implementation practice. This variation in service delivery provides an opportunity to study the impact of differences in programme delivery on overall adherence with drug consumption as a measure of access to TB treatment.

McIntyre et al (2009) presented a conceptual framework in which access to care is represented by the degree of fit between the characteristics and contexts of

individuals with health care needs and the way the service is provided. The framework identifies three separate dimensions of access; affordability (does the individual have the ability to incur the costs of receiving care?), availability (is the appropriate care supplied?) and acceptability (is care supplied in a way that meets the reasonable expectations of patients?). Given the infectious nature of tuberculosis and increasing levels of drug-resistance (Singh, Upshur et al. 2007), there is public interest in ensuring high levels of adherence. Hence attempts to promote equitable access to care and the efficient use of resources devoted to TB must be based on a broad understanding of barriers to utilisation among individuals with needs for TB treatment. Requiring patients to attend the clinic on a daily basis is likely to impose substantial costs on patients in terms of time and transport costs of travelling to and from the clinic as well as other aspects of opportunity costs (e.g., having to arrange for child care, or cover for other normal daily activities that can no longer be fulfilled). The requirement for daily attendance at clinics might therefore do more harm than good if the improvement in adherence in taking the drugs among those patients who can and do attend on a daily basis is more than offset by the number of patients who are unable or unwilling to attend each day.

In this paper, we consider whether access to care, as measured by self-reported non-adherence, differs systematically between communities with different frequencies of clinic-based TB treatment delivery (daily observed treatment at clinics, versus less frequent treatment collection), after controlling for other determinants of access to care. We then consider whether particular elements of the access framework impact differently on patients coming to the clinic on a daily basis as compared to patients who receive their medication through weekly or monthly clinic visits. In other words - do observations of differences in adherence between service models correspond with differences in affordability and acceptability factors?

Methods: In this study, we adopt a mixed method approach. In the past decade, mixed methods have become an increasingly utilized approach as researchers do not replace quantitative or qualitative phases but build on the strengths and minimize the weaknesses of both in a single study or across studies (Johnson and Onwuegbuzie 2004). We used a sequential mixed method design in that the quantitative preceded the qualitative in data collection, although the research tools in each arm were developed at the same time. This process evolved from design in 2008 to data

collection ending in December 2010. The quantitative and qualitative designs permit the collecting of multiple data using different strategies to obtain complementary data (Johnson and Turner 2003). Indeed this is the rationale for a mixed method approach, i.e. to ensure comprehensiveness and the triangulation of results (Creswell and Plano Clark 2006). For this to be effective, it is vital that analytic procedures are precise and well-articulated with data being reduced in both arms by conventional means (e.g. descriptive statistics, regression analysis, codes, themes) and using narrative to report some quantitative results and counts to report some qualitative ones (Onwuegbuzie and Teddlie 2003). Our results and discussion sections draw on and compare and integrate material from both designs. Such integration is a keystone of mixed methods but it must not be assumed that results are always confirmatory or complementarily (Bryman 2007; O'Cathain, Murphy et al. 2007). In our discussion section, we examine our results for any inconsistencies or incongruities between the two arms (Wagner, Davidson et al. 2012).

Quantitative methods:

Sampling: Four health sub-districts in different provinces were selected as sites for this research, two in urban areas (Mitchells Plain in the Western Cape and Soweto Region D in Gauteng) and two in rural areas (Bushbuckridge in Mpumalanga and Hlabisa in KwaZulu-Natal). The sampling of these sites was designed to reflect different geographic locations (rural-urban mix) and to allow for differences in governance contexts, given that provinces in South Africa have considerable decision-making autonomy in the provision of health services. Key officials in the national and provincial health departments were consulted in finalising the selection of sub-districts.

A two-stage sampling approach was used in each sub-district, first selecting a representative sample of health facilities, then within these facilities, a representative sample of users. As most public health facilities provide TB services, a minimum of five facilities were selected in each sub-district and probability proportional to size (PPS) methods were used to select facilities using routine data on the total number of users in each facility at the time of the research. Within each chosen facility, a random sample of patients was interviewed until the proposed facility sample size was reached. In total, a minimum of 300 patients were interviewed per sub-district; the planned sample size was therefore 1,200 respondents. Respondents were included

provided that they were over 18 years of age and had been on TB treatment for at least 8 weeks.

Data collection and capture: Patient exit interview questionnaires were developed to collect demographic and socioeconomic data as well as information on health service use, direct costs associated with health care and aspects of access to health care. The questionnaire was administered by trained interviewers in the language of the respondent's choice. Completed questionnaires were checked for accuracy by data collection coordinators within each site and double entered into a data entry platform specifically designed for this purpose in Epidata.

Data analysis: Data were analysed using Stata/IC 11.0. In addition to summary statistics, two series of regressions were computed. In all instances, regression models were developed through the inclusion of conceptually relevant variables, and Akaike's information criteria were used to choose the most parsimonious model.

Two separate sets of regressions were run. The first series of logistic regressions focussed on assessing the socioeconomic, demographic and service related characteristics associated with self-reported adherence to TB treatment. Regressions were run using two outcome measures of adherence. These were self-reported missed clinic visits and self-reported missed treatment doses. Socioeconomic variables included employment, education, and a composite asset index. The asset index allocated individuals to socioeconomic classes based on household characteristics (including type of house, walls, toilet facility, roof, water supply, electricity for cooking etc), and assets (including fridge, stove, DVD player, television, cellphone, bicycle etc). We constructed the index through performing a Multiple Correspondence Analysis (MCA). While the construction of asset indices is commonly achieved using Principal Components Analysis (PCA) (Booyesen, Van Der Berg et al. 2008), such a technique is more appropriate for use with continuous, normally distributed data as opposed to the predominantly categorical data often used in asset indices development (Howe, Hargreaves et al. 2008).

Observing adherence at a point in time among a population of TB patients involves observing patients with different durations of treatment. Some will have recently started on the treatment while others will be well into the course of treatment. As a result, those patients with longer durations of treatment have had a longer period

for potentially having failed to adhere with treatment requirements, i.e., they have been at risk for non-adherence for longer. It is therefore important to control for duration of treatment. However, the impact of duration on adherence may differ systematically between the different forms of service delivery. For example, although patients might be able to accommodate visits to clinics in the short term, over longer periods these daily visits may be more difficult to sustain. Arrangements made to cover normal activities, whether that involves time away from formal employment or informal/household activities, may be temporary. However, this sustainability might be particularly problematic for daily patients because the amount of time (and hence other activities) that has to be replaced is much larger for them. Hence, we might expect the impact of duration of treatment on adherence to differ systematically between daily patients and non-daily patients. We therefore include duration of treatment as an independent variable and re-estimate the equation with the addition of an interaction term for frequency and duration of treatment to test for variation in adherence with duration of treatment.

If we find support for the impact of duration being greater among daily clinic observed patients, this would suggest that moving away from clinic-based observation for TB treatment has the potential to improve adherence in the TB population in both the short term but also in terms of being able to maintain compliance over the duration of the course of treatment.

Patient-related characteristics included age, sex and whether the patient was a new or re-treatment case. We controlled for rural/urban location given that access barriers are likely to differ systematically within these settings. Finally, given our focus on the impact of treatment frequency collection on access and adherence, we included a variable that summarized whether the patient was required to collect treatment on a daily versus less frequent (weekly or monthly) basis.

In the second series of logistic and linear regressions, we further unpacked our findings to understand the affordability and acceptability access barriers associated with different treatment collection frequencies at clinics. In these models, affordability outcome variables included: (1) monthly visit expenditure (including transport costs, and other costs incurred while waiting at the clinic); (2) borrowing money to pay for health care costs during the preceding one month period; and (3) incurring health care costs in excess of 10% of household expenditure (as a measure of catastrophic expenditure). Acceptability access variables included: (1) feeling that

the queues in TB facilities were too long; (2) feeling disrespected by TB facility staff; and (3) feeling that the TB facility was dirty. In these regressions, we controlled for age, sex, the asset index, education, employment, urban/rural setting, duration on treatment, and whether the patient was a new or retreatment TB case.

Because our interest in these analyses was on the impact of the frequency of tablet collection on adherence and access, we excluded re-treatment patients receiving daily streptomycin injections from our sample.

Qualitative methods:

Sampling: The qualitative results draw on 17 in-depth interviews with patients on TB treatment in three out of four of the sites included in the quantitative phase. One of the rural sub-districts was excluded from the qualitative phase owing to research funding constraints. Patients were purposively selected to reflect a range of patient treatment experiences (i.e. TB successful¹, re-treatment² and defaulting³), as defined by the World Health Organisation (WHO 2009). This required recruiting patients from within the facilities and outside in the community. Providers facilitated the recruitment of patients within the facilities while assistance was sought from non-governmental organisations offering TB services and patient networks for recruiting patients who were considered unsuccessful and defaulters.

Data collection and capture: Interview guides covered a range of issues exploring patient's life histories (i.e. social support systems, education, income, migration, work), illness trajectories (i.e. from illness onset to diagnosis and treatment, treatment seeking, stigma) and experiences with the health system (i.e. barriers constraining access and engagements with health care providers). The life and illness histories were told as narratives which linked, as the patient saw it, the role of TB and its treatment in everyday life.

Patients were interviewed by trained field workers in their first language. Follow-up interviews were conducted with seven of the patients and provided an

¹ "A patient who was cured or who completed treatment." WHO (2009). Global Tuberculosis Control: Epidemiology, Strategy, Financing. Geneva, World Health Organization. p. 174.

² "A patient previously treated for TB, who is started on a re-treatment regimen after previous treatment has failed (treatment after failure), who returns to treatment having previously defaulted, or who was previously declared cured or treatment completed and is diagnosed with bacteriologically positive (sputum smear or culture) TB (relapse) *ibid.* p. 174.

³ "A patient whose treatment was interrupted for 2 consecutive months or more" *ibid.* p. 174.

opportunity for either clarification or exploration or both. Interviews were audio-taped, transcribed and translated into English. All patients were assigned pseudonyms to protect confidentiality.

Data analysis: The transcripts were thematically coded in ATLAS ti.6 by two members of the research team. The researchers worked independently in reading and re-reading the transcripts and identified an initial set of codes, from which emerged several major themes such as transport costs and dependency on family members and friends. The researchers then compared the similarities and divergences between their codes and themes to ensure reliability. These codes and themes were then shared with the larger group who assessed the salience of the codes and quotations given the research questions for this paper. Any suggested modifications were discussed and consensus was reached on themes and quotations. The larger themes were finally grouped into four central themes; 1) location and distance of facilities, 2) transport costs, 3) dependency on family members and friends, and 4) conflict between treatment, work and domestic responsibilities. Presented quotations were selected not only for vividness and good descriptions of the illness trajectory but to give voice to as many respondents as possible.

Ethical issues

Ethical approval for the study was granted by committees at the University of Cape Town, the University of the Witwatersrand and the University of KwaZulu-Natal. Permission from health department officials and individual facility managers was obtained to conduct the study in the selected facilities. Written informed consent to participate in the study was obtained from each participant.

Results:

Quantitative findings

Table 1 summarizes the characteristics of TB patients in our sample according to socioeconomic and demographic variables and treatment characteristics. After excluding patients that were receiving daily streptomycin injections, the overall sample included 1,190 individuals, of whom 13% and 14% reported missing clinic visits and missing treatment doses respectively. In total, 32% of patients received their treatment through daily clinic observation; among patients who reported missed clinic

visits and missed treatment doses this value increased to 66% and 56%, respectively. Just over 80% of the sample were new (as opposed to retreatment) patients, of whom 64% and 70% reported missing clinic visits and treatment doses. A higher proportion of the wealthier respondents reported lower adherence than the poorer group.

Table 2 presents the adjusted odds ratios (AOR) for the dependent variables based on the estimated coefficients in the logistic regressions for the two outcomes, missed visits and missed doses. Controlling for socioeconomic and demographic factors, as well as for type of patient (new or retreatment case) and duration of treatment, frequency of treatment collection is highly significant with daily patients being 2.5 times as likely to report having missed a clinic visit ($p < 0.001$) and over twice as likely to report having missed a dose of treatment ($p = 0.002$) compared to patients that collect their treatment less frequently (weekly or monthly visits). Patients undergoing re-treatment were significantly more likely to have missed visits ($p = 0.003$) and missed doses ($p = 0.031$). Patients in urban settings were significantly more likely to report missing visits and missing doses even after allowing for differences in mode of delivery between settings.

As mentioned above, we wanted to see if the frequency of treatment collection effect differed significantly between different durations of treatment. The logistic regressions were re-estimated with interaction terms for frequency and duration of treatment (results not presented here but available from authors). The adjusted odds ratio for the interaction term exceeded 1 for both missed visits and missed doses but was significant only for missed visits ($p = 0.01$). This suggests that the problem of missed visits increases with duration of treatment. In other words, daily treatment observation at clinics might appear to be a successful strategy for ensuring adherence among patients at the start of treatment but less so among patients further along the treatment episode. This is consistent with the hypothesis that daily visits are difficult to sustain over a period of time. That there is not the same level of non-adherence in longer duration for non-daily patients would seem to imply that this has less to do with patients' perceptions of the need for completing the course of treatment and more with the higher cost to the patient of daily visits.

Turning to possible factors that might explain these observed differences in adherence, Table 3 reports summary statistics and adjusted odds ratios (or in the case of mean expenditure on clinic visits, the estimated coefficient) for three affordability variables (monthly visit expenditures, borrowing to pay for care and health care

expenditure exceeding 10% of household spending) and three acceptability variables (reporting that queues at the facility are too long, feeling disrespected by staff and believing facilities are dirty). Regressions were run controlling for all the factors included in the adherence equations. Each of the factors is found to be significantly greater among daily patients than non-daily patients except for having to borrow to pay for health care (also greater for daily patients but marginally insignificant, $p=0.057$). This suggests that the prevalence of affordability and acceptability barriers to care are significantly greater among daily patients.

Qualitative findings

The qualitative findings were derived from 17 participants ranged in age from 23 to 53 years; 7 women and 10 men. Six patients were 'successful' (i.e. were cured or had completed treatment). All participants were unemployed, except for one who worked part-time in the informal sector. In such circumstances, access to social grants may provide an important source of income. Four participants received a Disability Grant and a further three received a Child Support Grant. One participant received both a Disability and a Child Support Grant. Another reported that he was intending to apply for a Disability Grant. In the absence of these social grants, most participants depended on their spouses, parents and siblings for assistance.

Location and distance from facilities

Facility-based DOT requires patients to travel daily to facilities to receive their treatment under the supervision of a health care provider. The affordability of travelling to the facility is a challenge in a context of widespread unemployment. For many patients, this means that they have little choice but to walk. People with TB often suffer severe weight loss and physical malaise and they often speak of how physically demanding travelling by foot to receive their treatment is:

But I won't be able to make it to the clinic every day. But I don't have a choice I must come... That is about forty five minutes...Like today if I feel it is not near, it is a distance. And at first they told me she [DOT supporter] will be there at three o'clock and I went there three o'clock and they told me no after six. And I came back to the clinic because I did not get my pills. I had to wait for strength...they [clinic staff] said ... she will be there at seven o'clock in the evening because she is working. I can't make it, it is dark that time and

*it is far and there is no way I can go there.... I walk more than an hour where normally it took me an half an hour to get here in the past. Every time I have to sit on the pavement to catch my breath and the pain in the chest. (emphasis added) ...I only get my three pills then I have to walk back home. **Mark, urban site***

*I took the small taxi, like when I was serious [too ill to walk]... and when I was walking, there must be someone standing next to me because I did not have balance to stand alone (emphasis added). **Mathew, urban site***

Transport costs

For those who were unable to walk to the facilities for reasons of poor physical health, access to affordable transport was essential. In the absence of it, patients spoke of being unable to seek daily treatment from the health facility with implications for treatment adherence:

*It was difficult for me because when coming to the clinic, I have to use the little amount that I have and it costs me R26.00 to come and return... sometimes I don't have money to come to the clinic. **Mdiduzi, rural site***

*Me, I stayed away too many days... because I can't make it every day...if I had taxi fare, then I would have come here to the clinic...some of them [other patients] live around the corner and I live far. I can't walk every day. **Mark, urban site***

Dependency on family and friends

The location of the clinics in relation to where patients live might be a factor which not only limits physical access for TB patients but also indirectly requires access to transport. In a context of poverty, high unemployment and dependency on social grants, patients often speak of having to depend on family members and friends to either transport them to the facilities or provide them with the means to pay for it:

*My wife gave the money because some of her customers paid her. [Without her money]... I would not come because [it] is too far from my place up to here. **Mdiduzi, rural site***

*I borrowed money [for taxi fare]... I asked him R30.00 to buy me something to eat as well because you get hungry there because you sit long. **Cintle, urban site***

Conflict between treatment, work and domestic responsibilities

Besides the implications for physical access and associated transport costs, daily visits to the facility also carry significant opportunity costs of time, particularly for those who are working. Patients often face a dilemma between work and treatment and this is often in the context of patients who are the head of households:

*I must work because there at home, there is nothing [food]. I can't come here every day. What is my child going to eat and she is going to school? **Mathew, urban site***

*Yes, I didn't have money. There was no food in the house because those tablets, you can't take them without food in the stomach. I tried to borrow some money from someone to sell some cheap stuff at home, so that I can eat because even my children were not working. They were looking to me to bring food on the table. That is why I look like someone who is taking treatment wrongly [defaulting treatment]. Then, after I sold those things, then I saw the profit; there was food in the house. Then I always came in here... always. So when I started having some money, I always came to the clinic always. **Jama, urban site***

Jama's reference to 'taking treatment wrongly' also speaks to her concern that she is being judged and unfairly labelled as a defaulter when in fact there are factors beyond her control which constrain her ability to adhere to the recommended treatment.

In addition, having to wait at the clinic entails a significant opportunity cost of time for patients:

*Say we went to the clinic eight o'clock and we sat there till one o'clock and still waiting for this sister... they are negligent. They let you sit long. **Funeka, urban site***

Discussion:

The development of the DOTS approach to TB treatment was based on avoiding unnecessary hospitalisation of individuals with TB. Treating patients in their own communities had the potential to reduce system costs, release hospital beds for other important uses and allow individuals to return to their normal activities. However, the requirement for daily observation of drug consumption at clinics imposes substantial costs on individuals which may impact adversely on adherence. In principle, the daily observation need not require clinic visits, with South African treatment guidelines allowing for community health workers, workplace supervisors, or, in limited circumstances, for family members to be potential observers (National Department of Health 2009). In this study, however, particular locations retained drug supplies at the clinic and required patients to attend the clinic for the daily dose to be received and observed. It is quite possible that in other areas daily observation was still the basis of service delivery but this was arranged within the community and hence did not require daily clinic visits. Hence our study population could be divided between those on programmes that required daily clinic visits to receive the dose and those that did not.

Expanding on Volmink and Garner's (2007) review and adding to Zwarenstein's (1998) findings, we identify a clear association between mode of delivery and levels of self-reported adherence among TB patients. Moreover, this association appeared to correspond to the distribution of affordability and acceptability factors in the study population. Adherence does not appear to suffer in patients that are not required to come to the clinic on a daily basis but the burden of treatment on patients is lower. Daily visits impose substantial burdens on the patients and their families as well as on the health care system in terms of human resource requirements. Our mixed method design allowed for the explicit emergence of these burdens, especially on patients, highlighting not only cost and duration of treatment but also the importance of the physical condition of the patient and the role of varying contexts (family, community and work). The qualitative phase thus largely confirms the quantitative one but also enhances its explanatory strength with respect to the nature of the contexts affecting adherence.

It is worth noting that in most cases the 'daily' patients were provided with sufficient drugs to last for a weekend and hence daily directly observed treatment became 'working day' observed treatment. Providers seemed willing to trust patients to adhere to treatment over the weekend (times at which providers may not have the

time or inclination to observe treatment), but not during the normal work week. It may be that the redesign of the service in this way has more to do with satisfying the demands of providers than improving adherence among patients.

Attempts to improve adherence might therefore benefit from a more patient-focused approach to the organisation of TB treatment. For example, Macq et al. (2003) argue that DOT use should be part of a complex set of interventions for TB treatment that is responsive to patient contexts. Orr (2011) studied adherence to TB treatment in Canadian aboriginal populations and concluded that the design of care programmes must be responsive to patient needs given the particular characteristics of these populations. In many aboriginal communities, adults may be absent from their normal community for substantial periods of time, undermining any attempt to improve compliance through a DOT approach.

Our study is limited by the cross-sectional design and the implications that has for the interpretation of the results. In particular, it limits the study to observations of differences between populations without allowing us to make any statements about the impact of changing the organisation of care on adherence within communities. Such conclusions would require longitudinal data collection over a period of time in which care delivery changed. A second limitation involves the absence of any information on health status and hence we cannot determine whether differences in adherence among the different modality groups are associated with different outcomes. However, the systematic review does suggest that differences in adherence between treatment modalities are also reflected in differences in outcomes (Volmink and Garner 2007). A third limitation is that there may be some selection bias in that patients identified as less adherent may be required to visit facilities on a daily basis.

Notwithstanding these limitations, the results of this study do suggest that consideration is required on whether the continuation of requiring daily clinic visits represents an efficient use of resources for the care of TB patients in South Africa. Observation of drug taking does not require clinical expertise and hence would seem to be manageable through means that do not involve daily clinic visits, if observation is needed at all. The importance of adopting a more patient focussed approach to the delivery of TB treatment would appear to be of high priority, particularly in countries where TB prevalence is high and resources for TB care are highly constrained as is the case in South Africa.

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Table 1: Characteristics of TB users, in total, and by self-reported adherence measures

	All respondents (n=1,190)	Respondents reporting missed visits (n=156; 13%)	Respondents reporting missed doses (n=172; 14%)
Variables:			
Age (median)	35.00	32.00	33.00
Male sex	47.23%	48.72%	48.84%
Employed	16.48%	21.79%	19.19%
Asset index (wealthier)	50.34%	61.54%	60.47%
Urban setting	50.76%	82.69%	74.42%
None or basic education	37.51%	33.55%	33.92%
Some secondary education	42.72%	49.68%	47.37%
Completed secondary education	19.76%	16.78%	18.71%
Daily treatment observation at clinics	32.15%	65.58%	56.40%
New patient (versus re- treatment)	80.07%	64.47%	70.00%
Duration on treatment (median)	4.00	5.00	5.00

Table 2: Regression results for determinants of missed visits and missed doses

	Missed visits		Missed doses	
	AOR	p-value	AOR	p-value
Variables:				
Age	0.97	0.006	0.97	0.005
Male sex (versus female)	1.12	0.560	1.10	0.597
Employed (versus unemployed)	1.32	0.257	1.10	0.677
Asset index (wealthier versus poorer)	1.00	0.991	1.14	0.533
Urban (versus rural) setting	3.85	0.000	2.00	0.012
Education:				
Some secondary (versus basic or none)	0.98	0.930	0.94	0.760
Completed secondary (versus basic or none)	0.65	0.183	0.71	0.238
Daily clinic treatment collection versus other	2.54	0.000	2.08	0.002
New (versus re-treatment) patient	0.53	0.003	0.64	0.031
Duration on treatment	1.05	0.008	1.03	0.086

AOR = Adjusted Odds Ratio

Table 3: Access barriers by treatment collection frequency, and regression results for access associations

	Descriptive statistics			Estimated regressions	
	All respondents	Respondents on clinic DOT	Other	AOR or coefficient	p-value
Outcome variables:					
Monthly direct visit expenditure (mean ZAR)	39.16	71.50	23.83	0.78	<0.001
Borrowing to pay for health care (%)	18.77	10.99	22.46	1.82	0.057
Incurring health care expenditure >10% household expenditure (%)	32.85	32.47	33.04	5.02	<0.001
Feel that queues are too long (%)	28.14	34.91	24.94	3.32	<0.001
Feel disrespected by facility staff (%)	18.89	17.28	19.65	2.44	0.001
Feel that facilities are dirty (%)	11.97	12.07	11.93	2.68	0.002

Regressions are run controlling for age, sex, asset index, education, employment, urban/rural setting, duration on treatment, and whether a new or re-treatment TB case; given the skewed nature of cost data, monthly direct visit expenditure was logged prior to running the linear regression.