Original Article

# DECENTRALIZED DOTS SHORTENS DELAY TO TB TREATMENT SIGNIFICANTLY IN CAMBODIA

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**Abstract** [SETTING] Rural districts in Cambodia with and without decentralized health center based DOTS program. [OBJECTIVE] To compare delays to treatment and behavior of patients up to diagnosis, between the pilot districts where DOTS is decentralized through the health centers, and the control districts where DOTS is provided through hospitals. [DESIGN] A cross sectional study with structured questionnaire interviews to all new smear-positive TB patients aged 15 years or older who were registered in the study sites from May 1st to July 31st in 2002. [RESULTS] The total delay in the pilot districts was significantly shorter than that in the control districts (median 58 days vs. 232 days, $p<0.01$). The median doctors' delay within TB service in the pilot districts was 10 days and that in the control was 6 days. The period between first consultation to any health care provider and first visit to a TB service center, subsequent contact delay, was longer than any other type of delay and significantly different (24 days in pilot vs. 185 days in control, $p<0.01$). The distance and travel costs to a TB service center were the factors associated with delay in seeking diagnosis of tuberculosis. No other variables had any significant association with the delay. [CONCLUSION] Decentralizing DOTS to primary care health centers is highly effective in reducing the delay to TB treatment in Cambodia.

**Key words**: Tuberculosis, DOTS, Delay analysis, Cambodia, Decentralization

## Introduction

Cambodia is one of the 22 countries with the highest burden of tuberculosis (TB) in the world. The annual incidence rate of smear-positive pulmonary TB was estimated at 241 per 100,000 inhabitants in 1997[1].

The international strategy for TB control, known as DOTS (Directly Observed Treatment, Short-course), has been adopted in Cambodia since 1994. Up to 1998, DOTS was provided through a hospital-based approach in which TB diagnosis and treatment were available through provincial and district hospitals. The World Health Organization (WHO) acknowledged that Cambodia achieved a remarkable success with a high cure rate, increasing from 68% in 1994 to 89% in 1998, but case detection rate was still low at only 51% in 1998[1] Moreover, a long delay in TB diagnosis has been common. The reason might be due to the TB Control Program not being available in rural areas, including in the health centers (HC), which constitute the core of primary health care services[2,3]

The effective involvement of the peripheral health care facilities is imperative to achieve total geographical and patient coverage in TB[4]. The National Tuberculosis Control Program (NTP), therefore, developed a new strategy to decentralize DOTS into the district health system through health center networks in 2000 in close collaboration with WHO and the JICA National TB Control Project. In the initial phase of the implementation of this strategy, three pilot districts were selected from three different provinces in rural Cambodia.

The duration of the delay to TB diagnosis varies from country to country: two months in Australia[5] and Malawi[6]; three months in Malaysia[7] and five months in Tanzania[8]. A number of studies on delay to TB treatment have explained the delay from two perspectives: patients' delay in seeking care, and doctors' delay to correct diagnosis and treatment[9,11,12].

Distance is one of the major causes of patients' delay. Some studies found that distance between the patient's home and health facilities could lead to a long patients' delay in

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TB[8) 12) 13)] Because long distances can be real obstacles to reach health facilities, they can be a disincentive to health seeking behavior[14)] The effect of distance on service use becomes stronger when combined with the lack of transportation and poor road conditions, which contribute to the indirect costs of visits[15)].

However, little is known about the magnitude of delay in Cambodia and effectiveness of the decentralization of DOTS in reducing the delay. Thus, the objective of this study was to compare delays in TB treatment and behavior of patients up to diagnosis between the pilot districts, where DOTS is decentralized through the HCs, and the control districts where DOTS is provided through hospitals.

## Methods

*Study sites and subjects*

A cross sectional study was conducted in six rural districts of six different provinces of Cambodia. Two pilot districts with decentralized DOTS (Thmorkol and Kampong Tralach districts), representing 327,696 people, and four control districts without decentralized DOTS (Kralanh, Stong, Cheung Prey and Saang districts), representing 524,063 people, were selected. The selection criteria of study sites were: 1) Each district has one district hospital with 50–70 beds and 10–15 HCs with a minimum package of services and activities of primary care, 2) TB is diagnosed using direct smear microscopic examination at the district laboratory, 3) In each district, the number of smear-positive patients was at least 15 cases per month, and a cure rate of at least 85% was achieved in the previous year.

In two pilot districts, all HCs functioning as TB service centers conduct a TB symptom screening among people presenting to out patients clinics in health care facilities, ensuring sputum collection and/or smear preparation as well as the delivery of daily ambulatory directly observed therapy (HC-based DOTS). In four control districts, HCs were not involved in the DOTS strategy. Hospitals were the only facilities that ensured sputum collection; smear preparation, direct smear microscopic examination and TB treatment. And TB treatment was provided mainly through two to three months hospitalization during the initial phase of treatment (hospital-based DOTS).

*Data collection*

Participants were all new smear-positive pulmonary TB (PTB+) patients aged 15 years or older who were registered in the study sites from May 1st to July 31st in 2002. Data were collected through structured questionnaire interviews from all the patients. Patients who rejected the interviews, or who were from outside the district coverage area were excluded.

The questionnaire included social and demographic variables and information on patients' health seeking behaviors during the period from the onset of TB symptoms to diagnosis. Information on the date of onset of first symptoms suggestive of TB and the date of visit to any health care provider before diagnosis were collected using a calendar based on local religious and political events. The pretest was done in a similar setting near the study area and was used for modification of the questionnaires.

Six health workers, one from each district, were selected as interviewers. We provided one day training to them on the objectives of the study and methods of data collection. The health workers conducted interviews with TB patients at the TB service centers. To check the reliability of the data, 16% of the patients were randomly selected and re-interviewed by the researchers. The results were not significant different in terms of patients' delay, health system delay, doctors' delay, total delay and the factors association with delays.

*Definitions of delays*

Five different types of delay to TB treatment were defined: 1) 'total delay' refers to the time from the onset of TB symptoms to treatment, 2) 'patient's, delay (first contact delay)' refers to the time from the onset of TB symptoms to the first visit to health care providers, 3) 'health system delay' refers to the time from the first visit to health care providers to treatment, 4) 'subsequent contact delay', which is the first part of health system delay, refers to the time from the first visit to health care providers to the first visit to TB service centers, 5) 'doctor's delay', which is a second part of the health system delay, refers to the time between the first visit to the TB service center and treatment.

*Data analysis*

To assess the differences between two groups of patients (those from the pilot districts and those from the control districts), time delays to treatment and travel costs were compared using the Mann Whitney U test. The reasons for the first consultation, the number of consultations, transportation types, and travel time were compared using the Chi-square test. Statistical Package for Social Sciences (SPSS) for Windows (version 11.00) was employed for data analysis.

## Results

During the study period, 374 TB patients were registered for treatment in the study sites. Of them, 322 PTB (+) were enrolled in the study (52 were excluded: 9 PTB+ but not eligible by reason of age or address, 14 re-treatments, six with smear negative TB and 23 extra pulmonary TB patients). Among the 322 patients, 112 in the pilot districts and 196 in the control districts were interviewed, and interviews were not available for 14 (4.3%) patients.

Patient characteristics are presented in Table 1. The patient age ranged from 15 to 83 years with a mean of 46 years (SD: ±15.1). Of the total, 50.3% were male. Forty percent of the patients were literate. There was no significant difference between the participants in the pilot districts and the control

**Table 1** Socio-demographic characteristics of the patients

| | Pilot districts | | Control districts | |
|---|---|---|---|---|
| | n=112 | % | n=196 | % |
| Age (years) | | | | |
| 15–39 | 40 | 35.7 | 66 | 33.7 |
| 40–65 | 59 | 52.7 | 110 | 56.1 |
| 65+ | 13 | 11.6 | 20 | 10.2 |
| (Mean±SD) | (46.1±14.7) | | (46.0±15.2) | |
| Range | (15–78) | | (15–83) | |
| Sex | | | | |
| Male | 51 | 45.5 | 104 | 53.1 |
| Female | 61 | 54.5 | 92 | 46.9 |
| Literacy | | | | |
| Literate | 47 | 42.0 | 73 | 37.2 |
| Illiterate | 65 | 58.0 | 123 | 62.8 |
| Occupation | | | | |
| None | 12 | 10.7 | 27 | 13.8 |
| Farmer | 86 | 76.8 | 150 | 76.5 |
| Others | 14 | 12.5 | 19 | 9.7 |
| Relationship to household head | | | | |
| Head of household | 52 | 46.4 | 82 | 41.8 |
| Spouse of household head | 35 | 31.3 | 58 | 29.6 |
| Others | 25 | 22.3 | 56 | 28.6 |
| Marital status | | | | |
| Married | 83 | 74.1 | 134 | 68.4 |
| Single | 9 | 8.0 | 25 | 12.8 |
| Other | 20 | 17.9 | 37 | 18.9 |
| Number of family members | | | | |
| 1–5 | 59 | 52.7 | 90 | 45.9 |
| 6–13 | 53 | 47.3 | 106 | 54.1 |
| (Mean±SD) | (5.5±2.3) | | (5.8±2.3) | |

**Table 2** Reason for the choice of health service facility for the first consultation

| | Pilot districts | | Control districts | |
|---|---|---|---|---|
| | n=112 | % | n=196 | % |
| Close to residence | 71 | 63.4 | 108 | 55.1 |
| Always use health facility first | 15 | 13.4 | 26 | 13.3 |
| I didn't know I had TB | 12 | 10.7 | 8 | 4.1 |
| I didn't know TB is treated at HC[1]/RH[2] free of charge | 0 | 0.0 | 5 | 2.6 |
| I thought private sector gave better treatment for TB | 14 | 12.5 | 49 | 25.0* |

*$p<0.01$ (Chi-square test)
[1]HC: Health center, [2]RH: Referral hospital

districts in terms of socio-demographic characteristics.

Reasons for the first contact for help are shown in Table 2. The most common reason for the choice of place of first contact was that it was the nearest place to home (179 patients, 58%) in both areas. However, patients in the control districts were more likely to believe in the private sector than those in the pilot districts ($p<0.01$).

Accessibility to TB service centers is shown in Table 3. 68% of the patients' homes were located within three kilometers of a TB service center in the pilot district, whereas 15% of the patients' homes were in the same distance among the patients in the control districts ($p<0.01$). Forty nine percent of the patients in the pilot districts could afford to visit a TB service center on foot within 30 minutes, whereas only six percent of the patients in the control district ($p<0.01$) could. The travel cost was significantly different between the patients in the pilot districts and those in the control districts ($p<0.01$).

TB symptoms and patients' seeking behaviors are presented

**Table 3** Distance, travel time from patient's home to TB service centers and cost of treatment

| | Pilot districts | | Control districts | |
|---|---|---|---|---|
| | n=112 | % | n=196 | % |
| Distance from patient's home to a TB service center | | | | |
| 0–3 km | 76 | 67.9 | 29 | 14.8* |
| 4–6 km | 12 | 10.7 | 86 | 43.9 |
| 6+ km | 24 | 21.4 | 81 | 41.3 |
| Travel time from patient's home to a TB service center | | | | |
| 0–30 minutes on foot | 55 | 49.1 | 11 | 5.6* |
| 0–30 minutes by other TTs[1] | 46 | 41.1 | 55 | 28.1 |
| 31–60 minutes by all TTs | 9 | 8.0 | 89 | 45.4 |
| 60+ minutes by all TTs | 2 | 1.8 | 41 | 20.9 |
| Cost of travel from patient's home to a TB service center | | | | |
| 0–500 Riel[2] | 91 | 81.3 | 68 | 34.7 |
| 500+ Riel | 21 | 18.8 | 128 | 65.3 |
| Median (IQR) | 0 (0–500 Riel) | | 2,000 (0–3,000 Riel)** | |

*p<0.01 (Chi-square test)
**p<0.01 (Mann Whitney U)
[1]TT=Type of Transportation
[2]Exchange rate 1 US$=3900 Cambodian Riel (31/07/2002)

**Table 4** TB symptoms and treatment seeking behavior

| | Pilot districts | | Control districts | |
|---|---|---|---|---|
| | n=112 | % | n=196 | % |
| First TB symptom recognized by patients | | | | |
| Cough | 111 | 99.1 | 192 | 98.0 |
| Bloody Sputum | 31 | 27.7 | 57 | 29.1 |
| Fever | 102 | 91.1 | 180 | 91.8 |
| Person who first told the patient that they might have TB | | | | |
| Nobody | 11 | 9.8 | 63 | 32.1 |
| Other TB patients | 36 | 32.1 | 62 | 31.6 |
| HC workers | 50 | 44.6 | 49 | 25.0* |
| Others | 15 | 13.4 | 22 | 11.2 |
| Place of first contact for help | | | | |
| Health center | 27 | 24.1 | 16 | 8.2* |
| Public hospital | 11 | 9.8 | 1 | 0.5* |
| Private clinics | 23 | 20.5 | 84 | 42.9* |
| Pharmacies/Drug sellers | 42 | 37.5 | 81 | 41.3 |
| Traditional healer/Krou Khmer | 8 | 7.1 | 14 | 7.1 |
| Other | 1 | 0.9 | 0 | 0.0 |
| Numbers of subsequent contacts for help before diagnosis | | | | |
| 1–2 times | 63 | 56.3 | 23 | 11.7* |
| 3–4 times | 46 | 41.1 | 128 | 65.3 |
| 4 times+ | 3 | 2.7 | 45 | 23.0 |
| (Mean±SD) | (2.4±0.9) | | (3.7±1.0) | |

*p<0.01 (Chi-square test)

in Table 4. The results indicated that the initial TB symptoms of most patients were cough (303 patients, 98.4%) and fever (282 patients, 91.6%) in both areas. In the pilot districts, most patients got advice from HC workers, compared to the patients in the control districts ($p<0.01$). The patients in the pilot districts were more likely to use the public sector than the patients in the control districts ($p<0.01$). There was a significant difference between the pilot districts and the control districts in terms of the number of consultations before TB diagnosis ($p<0.01$).

**Table 5** Comparison of delays to treatment among TB patients between districts with decentralized TB service (DOTS in health centers) and districts with conventional TB service through public hospitals

| | Pilot districts (n=112) | Control districts (n=196) |
|---|---|---|
| | median (IQR) | median (IQR) |
| Patients' delay (First contact delay) | 7 (5–10) | 7 (5–10) |
| Health system delay | | |
| Subsequent contact delay | 24 (5–93) | 185 (95–451)* |
| Doctors' delay | 10 (7–20) | 6 (3–12)* |
| Total delay | 58 (34–116) | 232 (119–486)* |

*$p<0.01$ (Mann Whitney U)

**Table 6** Factors associated with delay to reach TB service centers in patients with smear positive pulmonary TB

| | Total of first and subsequent contact delays | | |
|---|---|---|---|
| | n (308) | Median (days) | IQR |
| Sex | | | |
| Male | 155 | 125 | (50–322) |
| Female | 153 | 136 | (43–398) |
| Age | | | |
| 15–39 years | 106 | 111 | (35–311) |
| 40–65 years | 169 | 165 | (61–398) |
| 65 years+ | 33 | 121 | (47–355) |
| Family size | | | |
| 1–5 persons | 149 | 126 | (46–309) |
| 6–13 persons | 159 | 125 | (47–387) |
| Literacy | | | |
| Literate | 120 | 136 | (48–374) |
| Illiterate | 188 | 124 | (45–350) |
| Travel costs from patients' home to a TB service center (Riel) | | | |
| 0–500 | 159 | 78* | (23–201) |
| 500+ | 149 | 200 | (101–478) |
| Distances from patients' home to a TB service center (km) | | | |
| 0–3 | 105 | 61* | (20–177) |
| 4–6 | 98 | 153 | (84–386) |
| 6+ | 105 | 193 | (93–454) |

*$p<0.01$ (Mann Whitney U)

Table 5 shows the results of delay analysis. There was no difference between the pilot districts and the control districts in terms of the first contact delay (7 days vs. 7 days). However, the median of subsequent contact delay in the pilot districts was significantly shorter than that in the control districts (24 days vs. 185 days, $p<0.01$), while the median doctors' delay in the pilot districts was significantly longer than that in the control districts (10 days vs. 6 days, $p<0.01$). In sum, the median total delay to the start of treatment in the pilot districts was significantly shorter than that in the control districts (58 days vs. 232 days, $p<0.01$).

The factors associated with the delay to visit TB service centers of PTB (+) patients are presented in Table 6. The travel costs and distance from patients' home to a TB service center were the main factors influencing on the delay in seeking care to TB service center in both the pilot districts and the control districts ($p<0.01$). Gender was not a factor associated with this delay. No other variables had any significant association with the delay.

## Discussion

The study revealed that improved access to the DOTS program remarkably shortened the delay of TB treatment in Cambodia. The median total delay was two months in the pilot districts where the HC-based DOTS program was implemented, whereas it was more than seven months in the control districts where only hospitals provide TB diagnosis and treatment service. Though most of patients in both pilot and control districts began to take actions to seek relief earlier than expected (Table 5), there was a significant difference

between them (5 months) in terms of time to reach TB service centers. Poor infrastructure and poverty prevent patients living in rural areas from visiting a TB service center promptly, and that may cause further spread of TB in the community unnecessarily.

This finding justifies the newly implemented DOTS strategy of decentralized DOTS in Cambodia. In the pilot district, one TB service center became available for every 8,000–12,000 people who lived in the HC-coverage area after the new DOTS strategy was implemented[2)16)] Therefore patients could easily reach the TB service centers within reasonable travel costs and distance. In the control districts, by contrast, TB patients often visited the TB service centers in the hospitals several months after onset of the disease, because patients' costs were much higher due to the greater distances they had to travel[2)17)] The results of this study revealed that long distance could be a key determinant of delay to treatment, as shown in previous studies[18)~22)]. However, one unique factor of this study result was that the main part of the delay to treatment in Cambodia was not the patients' delay. As patients took action to seek relief earlier as soon as they recognized that they were ill, existence of appropriate health care facilities that can provide TB diagnosis and treatment within an accessible distance for the poor was a key to shortening the delay in rural areas.

Health center workers also played important roles in reducing the delay. In the pilot district, the health center workers were trained in TB control. Those basic health workers are the key persons providing primary health care services in the community. (These services included the provision of health education)[2)23)] Thus, the trained health workers involved in DOTS contribute to reducing the delay, especially the subsequent contact delay, by providing appropriate instructions to patients in the community.

The median of patients' delay of 7 days in both pilot and control areas was shorter than expected. Drug sellers, and private clinics run by health workers, which are both readily available in a village, are often utilized. However, the time of disease onset and the time of recognition of the illness by patients might be different, and that may cause the observed rather shorter patients' delay in Cambodia.

The doctors' delay in TB service centers was shorter in the control districts. The longer doctors' delay in the pilot districts may be due to the time required for referring the sputum specimens and/or smear slides to the district laboratory in the hospitals and receiving the result from those places, while TB service centers in control districts have doctors and microscopes. In the pilot districts, a large amount of sputum collection and smear preparation was done in HCs, and the smear slides were sent to the district laboratory once a week. However, a median doctor's delay of within ten days could be acceptable[16)]

Gender was not significantly associated with the delay to TB diagnosis in Cambodia as reported by some previous studies[8)7)24)]. This may suggest that the most important determining factors for patient action are availability and accessibility of TB service centers as was the case in Tanzania[8)]. However, this finding is contrary to what has been shown in various studies. The patients' delay was greater in women in Vietnam[9)], Ghana[10)], and Nepal[11)]. In each of these studies, the reason for the gender difference in delay was due to the fact that women were more likely to visit and to believe in traditional healers.

The findings of this study need to be interpreted in the light of certain limitations. First, there may be a recall bias with reference to the duration of symptoms and the timeliness and chronology of health providers consulted, because the patients provided retrospective responses. However, this bias is probably minimal because more than 95% of the patients were interviewed within a day of treatment registration. Second, this study investigated TB patients only in the selected rural population, but it can be generalized to many districts in Cambodia, because 84.3% of the population lives in rural areas[25)]. Third, though this study was carried out in districts where the case detection rate seemed to be high and where TB service by the private sector was very limited, interviewed patients were all cases that were passively detected by public health service. Therefore, it might be interesting to compare the result with prevalent cases in community detected by active case finding or TB prevalence survey.

This study showed that decentralized DOTS through the health center networks is highly effective in reducing the delay to TB treatment in Cambodia. The cure rate of 85% was maintained in both pilot and control districts; shorter delay to treatment should have significant impact on tuberculosis control. It might reduce the prevalence of infectious cases in the community. The National Tuberculosis Control Program should extend the new DOTS strategy through nationwide decentralization of TB services to health centers near the community.

## Conclusion

The delay to TB treatment was two months in the districts with decentralized TB service and seven and half months in the districts with conventional TB service through hospitals. Decentralized of DOTS through a health center network could reduce the delay significantly, especially the subsequent contact delay. NTP should expand DOTS to health centers near communities of poor rural patients.

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# カンボジアにおける結核サービスの地方展開は治療の遅れを有意に短縮させた

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**要旨**：〔目的〕カンボジアの地方でDOTSのプライマリーケアセンターへの展開が完了した2パイロット郡とDOTSが郡病院で実施されている4対照郡で，結核の治療の遅れの期間と患者行動を比較した。〔方法〕2002年5月1日から7月31日にパイロット郡と対照郡で発見登録された全新塗抹陽性患者に対し，定められた様式に従って聞き取り調査を実施。〔結果〕発症の自覚から治療にいたる期間の中央値は，パイロット郡58日，対照郡232日で有意な差があった（$p<0.01$）。結核診療施設での診断の遅れの中央値は，パイロット郡で10日，対照郡で6日だった（$p<0.01$）。患者は症状自覚後比較的早く受診行動をとる（中央値7日）が，その後結核サービスにたどり着くまでの期間が長い（パイロット郡24日，対照郡185日，$p<0.01$）。結核サービスセンターへの距離と交通費が結核治療の遅れを規定する有意な要素で，性・年齢・識字力などは遅れを規定する要素ではなかった。〔結論〕カンボジアにおけるDOTSのヘルスセンターレベルへの展開は，地方における結核治療の遅れを有意に短縮した。貧しい僻地住民が容易に到達できる所までDOTSを展開する必要がある。

**キーワーズ**：結核，DOTS，発見の遅れ，カンボジア，ディセントラリゼーション