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Tuberculosis outcomes among peri-urban children receiving doorstep tuberculosis care

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Abstract

Objective—To determine the optimal tuberculosis (TB) management strategy for children living in peri-urban, resource-limited settings.

Design—We compared TB treatment outcomes among children, aged 0–15 years, receiving doorstep care (n=82) to a historical group (n=97) receiving clinic-based care.

Results—In comparison, the doorstep care and clinic-based groups had similar age and sex profiles; treatment default rates were 3.7% (3/82) vs 38.1% (37/97), p<0.0001; treatment completion rates were 65.9% (54/82) vs 51.6% (50/97), p=0.01; and cure rates were 13.4% (11/82) vs 2.1% (2/97), p<0.0001 respectively.

Conclusion—Children living within peri-urban communities experience improved TB outcomes with doorstep care.

Introduction

Approximately 6% of the global tuberculosis (TB) burden occurred in children aged between 0 and 15 years in 2012[1]. While TB mortality rate among HIV infected children is largely unknown, the 74 000 TB deaths among HIV negative children accounted for 8% of global TB deaths[1]. In South Africa, childhood TB cases accounts for 15–20% (47 571 cases) of the total number of TB cases and is among the top five causes of death in children under 15[2]. In 2006 in South Africa, 29 801 TB cases were reported among children aged 0 to 7 years, accounting for 8% of all TB cases notified[3]. The TB impact on child health is one which impedes South Africa's efforts to achieve Millennium Development Goals (MDG) 4 and 6 which pertain to the health of children[4]

The optimal childhood TB management strategy is largely unknown. The World Health Organisation's Stop TB strategy which advocates for directly observed therapy (DOT)

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within decentralised TB care[1], makes no special considerations for children. Resource-constraints have meant clinic-based TB care remains the routine approach, even among children[5]. Despite the successes of DOT[5], a meta-analysis suggested that this strategy was not superior to self-administration[6]. There is scarce evaluation of the impact of alternate approaches to childhood TB care within this setting.

We compared TB treatment outcomes among children receiving doorstep TB care to a historical groups receiving clinic-based care within the same peri-urban community.

Method

We conducted a retrospective analysis of clinic records of 82 children aged between 0 and 15 years, enrolled onto a pilot CAPRISA doorstep TB care programme from 2008 to 2011. This was compared to a historical group of 92 children from the same peri-urban community receiving clinic-based TB care from 2005 to 2008. This peri-urban community included dwellers from low cost state housing and adjacent informal squatter settlements.

The doorstep TB care programme was a healthcare intervention that formed part of the CAPRISA community based treatment programme, aimed at enhancing TB treatment access and adherence. There were 516 adult and childhood ambulatory TB cases that were referred to the doorstep TB upon presentation at either one of the two local primary healthcare clinics for TB diagnosis or treatment follow-up. TB diagnosis was made based on sputum analysis and Chest X-Ray. Following counselling, parents or guardians provided consent for enrolment of children into care. Addresses were then verified. Trained community caregivers or nurses supervised two to three home visits per week and recorded basic clinical history, evaluated TB treatment adherence, completed the TB treatment card, offered TB specific health education, addressed issues related to poor adherence, dispensed TB medication and arranged follow-up visits. All patients and their guardians were counselled on the need for TB screening in the household and for HIV-testing, and where permission for testing was obtained, HIV testing and TB screening was conducted. TB therapy was monitored using a doorstep TB care card. Very sick patients were visited by a professional nurse upon request and were referred to another health facility if required along with those patients who were wishing to relocate. These patients were documented as transferred out. All patients visited the clinic at the end of the intensive and continuous phases of TB therapy for sputum and clinical evaluation.

There were 560 adult and childhood TB cases receiving clinic-based care. The clinic-based group received care from the local primary health care clinic as per typical practise. Patients were expected to visit the clinic once a month to collect their medications. Clinic cards contained only basic demographic and TB outcome data. A follow-up date was written on the patient’s clinic-card. Patients could visit the clinic if they felt unwell or had queries regarding their medication.

Treatment administered for both groups was the standard treatment regimen, i.e. Rifampicin, Isoniazid, Pyrazinamide and Ethambutol. Multi-drug resistant, extremely drug resistant and extra-pulmonary Tuberculosis cases were not included in this study. TB outcomes for both

groups were as per the 2014 South African TB Control Program Guidelines and 2013 WHO TB outcomes classification[7, 8].

Statistical analysis

Data are presented as proportions. One sample t-test and a one sample binomial test were used to compare TB outcome data between the groups. Statistical analyses were done by using SAS, version 9.2 (SAS Institute, Cary, North Carolina).

The study was approved by the University of KwaZulu-Natal Biomedical Research Ethics Committee (Ref: E248/05).

Results

Baseline Characteristics

Overall childhood tuberculosis accounted for 82/516 (15.9%) in the doorstep TB care and 97/560 (17.3%) in the clinic-based care programme. In the doorstep and clinic-based care programmes respectively, the mean age (inter-quartile range) was 3.9 (1–5) years (p=0.91) vs. 3.5 (1–5) years (p=0.91); most children were between the ages of 1 and 6 years 64.6% vs. 69.2% with a male predominance, 53.7% vs 55.7%.

TB Outcomes

In the doorstep TB and clinic-based TB care programmes, treatment success (cure and completion) (Table 2) rates were 79.3% (65/82) and 53.7% (52/97) (p<0.0001); TB treatment completion rates were 65.9% (54/82) and 51.6% (50/97) (p=0.01) and cure rates were 13.4% (11/82) and 2.1% (2/97), (p<0.0001), respectively. Children receiving doorstep TB care had a significantly lower treatment default rate (3.7% (3/82)) compared to those who received clinic-based TB care (38.1% (37/97)) (p<0.0001). Transfer out and relocation occurred more frequently in the doorstep vs. clinic-based care group; 5 (6.1%) vs. 3 (3.1%) and 9 (11%) vs. 4 (4.1%), respectively. Patients who transferred out or relocated did not have TB outcomes evaluated. There was one death among the patients receiving clinic-based care.

Age-stratified TB outcomes

The TB treatment completion outcome (Table 3) shows the greatest improvement among children aged <1 year under doorstep TB care (76.9% (10/13)) vs. clinic-based care (7.5% (1/13)). The largest reduction in the treatment default rate was among children aged 7 and 12 years; from 46.7% (7/15) in clinic-based care to 0% (0/11) in doorstep TB care. Provision of doorstep TB care failed to impact the 7–12 and 13–15 year olds who relocated or transferred out where both outcomes increased from 6.7% (1/15) in clinic-based care to 9.1% (1/11) in doorstep care.

HIV co-infection

Data pertaining to HIV status of the patients is only available for the doorstep TB care group. There were 36/82 (44%) patients who had known HIV status of which 15 were verified. V by the healthcare worker. There were 21/82 (26%) HIV uninfected (17 unverified) children. Of the 46 children (56%) not tested for HIV, guardians of 30 children

said that the child could be tested after TB treatment completion. These numbers are too small to comment on the association of HIV co-infection with TB outcomes.

Discussion

Improved treatment success rates among children receiving doorstep TB care compared to clinic-based care suggests that it is a preferred strategy for childhood TB management. The greatest impact on the TB treatment success rate was achieved in the under one year age group (Table 3). There is limited data for the comparison of TB outcomes, specifically TB treatment completion rate, and treatment default rate among children aged 1 year and younger and between 7 and 12 years. Available age stratified TB outcome data from a retrospective study of over 2000 children conducted in Ethiopia demonstrated similar TB treatment completion, default and transfer out rates among children < 4 years of age when compared to the rates among children < 6 years in our study[9]. While the Ethiopian study also demonstrated significantly higher mortality among children under-five ($p < 0.001$) and among those with HIV co-infection ($p < 0.001$)[9], we have insufficient data to make this comparison.

We attribute the extremely low TB cure rate in our population to the recognised challenge associated with detecting TB in very young children[1]. Although the treatment success rate among those receiving doorstep TB care was higher than among those receiving clinic-based care, they do not achieve the WHO and in country target of 85%[1, 7]. A study from India in which children 12 years and younger were enrolled onto the more resource intensive conventional Directly Observed Treatment Strategy (DOTS) programme, showed an 94.6% treatment success rate.[10] The low TB treatment success rate for children enrolled in clinic-based care as seen in this study is replicated in the findings of studies conducted in Botswana, Malawi and India[11, 12]. In our South African context, where the childhood TB burden accounts for approximately 13% of the South African TB burden[1], children are a necessary vulnerable group requiring attention. Current TB management efforts are largely clinic-based and will not yet enable us to reach the MDG 4 and 6 targets which deal pertaining to childhood and disease.

While the impact of HIV co- infection, malnutrition, immunosuppression and TB drug-resistance[13] on TB outcomes were not evaluated in this study, we highlight notable improvements in TB treatment outcomes, and a significant reduction in the treatment default rate among children accessing doorstep TB treatment care. More patients had a record of transferred out or relocated in the doorstep TB care programme as opposed to the clinic-based care, most likely due to reporting bias. This is also evident in higher rates of transfer out and relocation. Furthermore, TB outcomes in these patients were not evaluated in both study groups due to resource constraints. It is reasonable to suggest that migration patterns typical of peri-urban populations, as seen elsewhere in India and globally[5, 14], influence ascertainment of treatment outcomes.

Since the risk of progression to active TB is greatest among children under 2 years old[15], it was unsurprising that approximately 81% of TB cases in this study were 6 years or younger; consistent with other studies done elsewhere[9, 16] The 2012 South African Integrated

Schools' Health Policy, which utilizes schools as a first point of care[17], therefore misses the majority of childhood TB cases. The optimal mechanism for detection of these cases within the health programme would be via the Integrated Management of Childhood Illnesses programme and Expanded Programme of Immunization. In addition, initiatives to address retention gaps are necessary even with doorstep care programmes. Patient education on disclosure of pending relocation; improved communication between patients and Healthcare workers (HCW's), and between HCW's of different facilities, will enable seamless transfer of patients between facilities.

Limitations

There are important limitations in this study. The generalizability of our findings is limited as the study was restricted to selected clinics serving a geographically defined population. Due to inadequate documentation, we are unable to report on outcomes by site of TB and smear status or on efforts in household TB contact tracing. In addition, HIV testing rates in children was low due to challenges in obtaining consent from parents and guardians, limiting a true estimate of the impact of HIV co-infection on TB outcomes in this group. The inability to determine the cure and mortality rates among the clinic-based care group was likely due to poor TB tracing systems, and lack of mechanisms within the programme for detection of TB treatment default. While the number of TB treatment defaulters in doorstep-care programme was fewer, no further follow-up was possible in the treatment defaulters and in those transferred out, in both groups, due to poor patient communication of impending relocation, and restricted geographic coverage of the programme. Additional potential bias include ascertainment bias since data was collected over different periods of time in the two groups, and due to the retrospective nature of the analysis of the clinic-based care group, only demographic data for sex and age were available for comparison. Further research evaluating the impact of doorstep care on TB outcomes is warranted. Analysis that stratify by HIV status, nutrition level, clinical presentation and location of TB, and availability of mycobacteriological data and treatment features will provide further data on the utility and generalizability of such a strategy to resource limited settings where these co-existing features are common place.

Conclusion

Doorstep TB care improves TB cure and completion rates among children as compared to clinic-based care but treatment success rates still remain below WHO targets. System strengthening is needed to ensure retention of children in TB treatment programmes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Baseline characteristics comparing children receiving Doorstep tuberculosis (TB) care and Clinic-based care

Variable	Doorstep TB care (N=82)	Clinic-based TB care (N=97)	p-value
Male	44 (53.7)	54 (55.7)	0.80
Age (years)			
<1	13 (15.9)	13 (13.5)	0.60
1–6	53 (64.6)	67 (69.1)	0.45
7–12	11 (13.4)	15 (15.5)	0.74
13–15	5 (6.1)	2 (2.1)	0.059

Table 2

Childhood tuberculosis (TB) outcomes of the Doorstep TB care cohort and the Clinic-based care cohort

Tuberculosis Outcome	Doorstep TB care (N=82)	Clinic-based TB care (N=97)	p-value
Positive outcomes			
Cure	11 (13.4)	2 (2.1)	<0.0001
Completed treatment	54 (65.9)	50 (51.6)	0.01
Treatment Success (cure and completion)	65 (79.3)	52 (53.7)	<0.0001
Uncertain Outcomes			
Defaulted	3 (3.7)	37 (38.1)	<0.0001
Not Evaluated			
Transferred Out	5 (6.1)	3 (3.1)	0.22
Relocated	9 (11.0)	4 (4.1)	0.01
Death	0 (0)	1 (1.0)	-

Table 3

Age-stratified tuberculosis outcomes for Doorstep TB care and Clinic-based TB care

	Doorstep TB care n (%)				Clinic-based TB care n (%)			
Age category	**<1**	**1–6**	**7–12**	**13–15**	**<1**	**1–6**	**7–12**	**13–15**
Cure	1 (7.7)	4 (7.5)	4 (36.4)	2 (40)	0 (0)	0 (0)	2 (13.3)	0 (0)
Completed Treatment	10 (76.9)	37 (69.8)	5 (45.5)	2 (40)	1 (7.7)	44 (65.7)	4 (26.7)	1 (50)
Defaulted	1 (7.7)	2 (3.8)	0 (0)	0 (0)	10 (76.9)	19 (28.4)	7 (46.7)	1 (50)
Transferred Out	0 (0)	4 (7.5)	1 (9.1)	0 (0)	0 (0)	2 (3.0)	1 (6.7)	0 (0)
Relocated	1 (7.7)	6 (11.3)	1 (9.1)	1 (20.0)	1 (7.7)	2 (3.0)	1 (6.7)	0 (0)
Death	0 (0)	0 (0)	0 (0)	0 (0)	1 (7.7)	0 (0)	0(0)	0 (0)
Total	13 (100)	53 (100)	11 (100)	5 (100)	13 (100)	67 (100)	15 (100)	2 (100)