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## Improvements in tuberculosis preventive treatment in child household contacts following community interventions led by women "Iddirs" in Ethiopia

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062298
Article Type:	Original research
Date Submitted by the Author:	25-Feb-2022
Complete List of Authors:	Jerene, Degu; KNCV Tuberculosis Foundation, Assefa, Dawit; KNCV Tuberculosis Foundation, Ethiopia Country Office Tesfaye, Kalkidan; Love in Action Ethiopia Bayu, Samuel; KNCV Tuberculosis Foundation, Ethiopia Office Seid, Samuel; KNCV Tuberculosis Foundation, Ethiopia Country Office Aberra, Fikirte; Southern Nations Nationalities and Peoples' Region Health Bureau Bedru, Ahmed; KNCV Tuberculosis Foundation Khan, Amara; Stop TB Partnership Creswell, Jacob; Stop TB Partnership,
Keywords:	Tuberculosis < INFECTIOUS DISEASES, PUBLIC HEALTH, Community child health < PAEDIATRICS

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3 **1 Improvements in tuberculosis preventive treatment in child household contacts following**  
4 **2 community interventions led by women “Iddirs” in Ethiopia**  
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6 **3**

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8 4 Degu Jerene<sup>1\*</sup>, Dawit Assefa<sup>2</sup>, Kalkidan Tesfaye<sup>3</sup>, Samuel Bayu<sup>2</sup>, Samuel Seid<sup>2</sup>, Fikirte Aberra<sup>4</sup>,  
9 5 Ahmed Bedru<sup>2</sup>, Amera Khan<sup>5</sup>, Jacob Creswell<sup>5</sup>

10  
11 6 <sup>1\*</sup> Corresponding author, KNCV Tuberculosis Foundation

12  
13 7 <sup>2</sup> KNCV Tuberculosis Foundation, Addis Ababa, Ethiopia

14  
15 8 <sup>3</sup> Love in Action Ethiopia, Addis Ababa, Ethiopia

16  
17 9 <sup>4</sup> Southern Nations', Nationalities', and Peoples' Regional Health Bureau, Hawassa, Ethiopia

18  
19 10 <sup>5</sup> Stop TB Partnership, Geneva, Switzerland

20  
21 11 \* Corresponding author

22  
23 12 Dr Degu Jerene, KNCV Tuberculosis Foundation, Maanweg 174, 2516 AB Den Haag, Netherlands.

24  
25 13 email: [degu.dare@kncvtbc.org](mailto:degu.dare@kncvtbc.org) or [degujerene@gmail.com](mailto:degujerene@gmail.com)

26  
27 14 **Key words**

28  
29 15 TB preventive treatment; under-five children; Ethiopia; Iddirs; household contacts  
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31 16

32  
33 17 **Word count**

34  
35 18 4156  
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## 21 Abstract

22 **Objectives:** Our objective was to evaluate the impact of a service delivery model led by  
23 membership-based associations called *Iddirs* formed by women on tuberculosis preventive  
24 treatment (TPT) initiation and completion rates among children.

26 **Setting:** Three intervention and two comparator districts in Ethiopia.

28 **Participants:** Children under-fifteen years of age who had a history of close contact with adults  
29 with infectious forms of TB. We included all child contacts in whom active TB and  
30 contraindications to TPT regimens as being eligible for TPT.

32 **Interventions:** Between July 2020-June 2021, trained women Iddir members visited households  
33 of index TB patients, screened child household contacts for TB, provided education and  
34 information on the benefits of TPT, linked them to the nearby health center, and followed them  
35 at home for TPT adherence and side effects. Two comparator zones received the standard of care  
36 which comprised of facility-based provision of TPT to children. We analyzed quarterly TPT data  
37 for treatment initiation and completion and compared intervention and comparator zones before  
38 and after the intervention.

40 **Primary and secondary outcome measures:** There were two primary outcome measures:  
41 proportion of eligible children initiated TPT; and proportion completed treatment out of those  
42 eligible.

43 **Results**

44 TPT initiation rate among eligible under-15-year-old children (U15C) increased from 31.9% to  
45 74.5% in the intervention zones while it increased from 34.6% to 43.2%. TPT initiation rate for  
46 under-five year old children (U5C) increased from 13% (17 out of 131) to 93% (937 out of  
47 1010). Of the U5C initiated, 99% completed treatment; two discontinued due to side effects;  
48 three parents refused to continue; and one child was lost to follow-up.

50 **Conclusion:** Women-led *Iddirs* contributed to significant increase in TPT initiation and  
51 completion rates. The model of TPT delivery should be scaled-up.

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## 54 INTRODUCTION

55 Of the 1.7 billion people estimated to be infected with TB worldwide in 2019, about 80% reside  
56 in South-East Asian, Pacific, and African regions. <sup>1</sup> If the goal of ending TB by 2030 is to be met  
57 <sup>2</sup>, management of TB infection and preventing TB disease should be intensified along with  
58 strengthened efforts to diagnose and treat active disease. <sup>3</sup> Reviews of recent progress, however,  
59 shows a significant lag in achieving globally agreed upon targets. According to the progress  
60 report of the UN high-level meeting (UNHLM) targets, only 21% (6.3 of 30 million) of TB  
61 preventive treatment (TPT) targets were met after 40% of the time has elapsed. Moreover,  
62 achievements varied considerably by population sub-groups: <1% for household contacts older  
63 than 5 years, 20% for contacts under-five (U5C), and 88% for people living with HIV (PLHIV)  
64 making efforts to treat the first two groups of critical importance. <sup>4</sup>

65 In Ethiopia, a high TB burden country missing about a third of estimated 151,000 people who  
66 develop TB each year, <sup>5</sup> treatment of TB infection among children has also been a major area of  
67 concern. The pathway of care for TPT in children usually begins with contact investigation of a  
68 household member with diagnosed TB. Young children are identified and screened for active  
69 disease. If active disease is ruled out, then TPT can be offered. Programmatic data show variable  
70 TPT initiation rates ranging from 13%-64.3% <sup>6</sup>, and treatment completion rates have been either  
71 low or unknown, with some sites reporting as low as 12%. <sup>7</sup> Nevertheless, Ethiopia is among a  
72 few African countries which have made significant progress in increasing TPT. <sup>8</sup> <sup>6</sup> High  
73 treatment completion rates were reported in districts that received additional technical assistance  
74 to the existing health extension program (HEP). <sup>9</sup> These results were achieved through additional  
75 technical and financial support, but sustainably replicating these best practices requires further  
76 work. <sup>9</sup> <sup>10</sup>

77 Of several factors that contribute to the low uptake of TPT in the household contact groups, cost  
78 of travel to health facilities; perceived lack of need for TPT in children among parents; low level  
79 of knowledge among health care workers; stigma; other competing priorities of the family; and  
80 medication related challenges such as pill burden stand out as common barriers.<sup>11</sup> <sup>12</sup> Other factors  
81 include fear of side effects<sup>7</sup>, lack of supplies, and poor recording and reporting practices.<sup>13</sup>  
82 Common themes with the barriers include access and information which may be better addressed  
83 with community-based interventions.

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85 There are successful examples of community-based interventions that helped improve childhood  
86 TB services. In Nepal, for example, intensified community-based case finding strategies led to  
87 improvements in TB childhood TB case-finding. <sup>14</sup> Similarly, in Uganda, strategies that included  
88 decentralized delivery of TB services through community health workers childhood TB case  
89 detection and contributed to 85% TPT completion rates. <sup>15</sup> In a prospective study in Peru where  
90 community-based accompaniment team of trained community health workers and nurse  
91 technicians were involved in a comprehensive psycho-social supported that included home visits  
92 and direct treatment observation, 61 contacts including 35 aged 0-19 years received TPT

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3 93 prescriptions. Of those prescribed TPT 57 received treatment of whom 51 completed the  
4 94 treatment.<sup>16</sup>  
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8 96 While Ethiopia demonstrated impressive results in TPT uptake and TB case detection by  
9 97 engaging paid community health workers<sup>9 10 17</sup>, the contribution of volunteer women organized  
10 98 through the government system has been inconsistent<sup>18</sup>. An often-overlooked local support  
11 99 system is the role of indigenous associations such as *Iddirs* in TB control in Ethiopia. *Iddirs* are  
12 100 membership-based local associations of people who have voluntarily entered an agreement to  
13 101 help each other during times of adversities. According to Kloos and Mariam<sup>19</sup>, *Iddirs* are one of  
14 102 the oldest social capital institutions, designed to help reduce poverty by creating a strong  
15 103 network and cooperation among the community and as risk sharing and coping mechanism  
16 104 during economic crises. They are indigenous voluntary associations, mostly unique to Ethiopia,  
17 105 established primarily to provide support in burial matters. Household membership is ensured  
18 106 through payment of monthly fixed contributions. The association raises money whenever death  
19 107 occurs in a household, the amount depending on the specific bylaws.

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24 108 There is no data on the role of *Iddirs* in TB care, but their engagement in HIV care and other  
25 109 social services has been reported.<sup>19 20</sup> Similarly, engaging saving groups has been groups has  
26 110 been beneficial for infant feeding practices in Malawi.<sup>21</sup> Studies on the role of *Iddirs* and similar  
27 111 groups in TB care are scarce. We share results from an innovative project that collaborated with  
28 112 *Iddirs* in Ethiopia. Since empowering women is associated with favorable child health  
29 113 outcomes, we selected women only *Iddirs* as a strategy to empower women in decision making  
30 114 for their children's medical care.<sup>22 23</sup> Our objective was to assess the outcomes of engaging  
31 115 women only *Iddirs* in TPT uptake in under-five children in selected districts in Ethiopia.

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## 36 117 **METHODS**

### 38 118 **Study sites**

39 119 We conducted this study in two remote zones, Gamo and Goffa, in the Southern Nations',  
40 120 Nationalities' and Peoples' Region (SNNPR) of Ethiopia, and Addis Ketema sub-city in the  
41 121 capital Addis Ababa. Figure 1 shows map of Intervention and comparator Zones.  
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43  
44 122 The two zones were selected based on their low TPT coverage and lack of external partner  
45 123 support at the time of project initiation. Gamo and Goffa were under one zonal administration  
46 124 (Gamo Goffa zone) during the planning phase of this project, but they were split into two zones  
47 125 at the beginning of implementation. The two newly formed zones have a combined population of  
48 126 2,202,751 (Gamo 1,544,756 and Goffa 658,005). Addis Ketema is a densely populated slum sub-  
49 127 city with population of 343, 228, and had one of the lowest TPT initiation rates in Addis Ababa,  
50 128 Ethiopia's capital. Gedeo zone from SNNPR (population 1,138,814) and Yeka sub-city  
51 129 (population 415,735) from Addis Ababa served as comparator zones and were purposefully  
52 130 selected based on their population size, geographic location (distinct and far away from the  
53 131 intervention zones), and similarity in baseline TPT initiation rates.  
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### 132 **Study design**

133 We used a before-after study design involving three intervention areas and two comparator areas  
134 as part of a TB REACH project following standardized methodology designed to measure TPT  
135 uptake in under-five children in the selected project sites. As described below, the two  
136 comparator zones received the standard of care while the intervention zones received the *Iddir*  
137 intervention.

### 138 **Study period**

139 Interventions were implemented between July 2020-June 2021.

### 140 **The standard of care**

141 According to national guidelines, TPT services are provided at the health center or hospital level.  
142 Children are offered enrollment in TPT if they present at health facilities as a household contact  
143 of a person with TB and are found not to have active disease. Active search or contact  
144 investigation for eligible child contacts rarely practiced at community level despite its being  
145 recommended to be part of the package for HEWs. *Iddirs* do not participate in contact  
146 investigation, TPT service facilitation, or other TB services. A six-month course of isoniazid  
147 (INH) (6H) was the only nationally recommended IPT regimen for all eligible children during  
148 the designing phase of this project. Only U5C contacts and people living with HIV were eligible  
149 for TPT until the guideline changed in July 2020 to include children below 15 years of age. At  
150 the same time, the new national recommendations included two additional TPT regimens: a  
151 three-month daily dose of INH and Rifampicin (3HR) and weekly INH and Rifapentine (3HP).

### 152 **Interventions**

153 Figure 2 summarizes the key interventions which encompassed the following components and  
154 roles:

#### 155 **Selection and capacity building of Iddir members and focal persons**

156 We first mapped, selected, and conducted capacity building of women only Iddir members and  
157 focal persons from each selected district. Iddir leaders then nominated two focal persons from  
158 each Iddir to liaise with the project. During the selection of the Iddir focal persons and the  
159 additional Iddir members, the following criteria were used: previous engagement in volunteer  
160 services in the community, ability to read and write, possession of a mobile phone, and good  
161 communication skills. The selected *Iddir* focal persons and members received training on the  
162 basics of TB with a focus on under-five child contact management and TPT. The training  
163 curriculum was customized from the Integrated Refresher Training (IRT) material used for  
164 training HEWs. The IRT is a modular training material aimed at enhancing the knowledge and  
165 skills of HEWs in a wide range of disease prevention and health promotion topics where TB and  
166 HIV are included as one module. In addition to the basic training, they received training on  
167 COVID-19 preventive and personal protective equipment for use during home and health facility  
168 visits. The main trainer was an MSc level trained health officer from KNCV tuberculosis foundation  
169 together with two zonal project coordinators.

170 To ensure proper alignment of the project activities with the existing health system, we  
171 sensitized the district TB coordinators and TB focal persons about the project approaches and got



172 their buy-in for implementation. This was organized as part of a three-day event combined with a  
173 project kick-off meeting.

#### 174 **Active outreach for contact investigation and TPT**

175 Each trained Iddir focal person selected three additional volunteers, to form a village steering  
176 group. The volunteer women conducted home visits to the households with known index  
177 pulmonary TB patients based on a list they obtained from the health facility TB focal person.  
178 During home visits, volunteers did symptom-based screening using a checklist, or verified if  
179 contacts were already screened for TB, with special focus on under-five children. All under-five  
180 child contacts received a referral slip to the nearby health center for further evaluation and TPT  
181 initiation. Community mobilizers (one per zone) who were nurses with additional orientation on  
182 the project activities provided additional technical guidance and administrative support to the  
183 volunteer women. By the end of each week, the volunteer women reported to the community  
184 mobilizers on the status of new enrollment and treatment completion rates. Figure 2 describes the  
185 core activities of the volunteers and other key contributors.

186 Once a child started TPT, community volunteers continued the follow-up by daily direct home  
187 visits, if the home was accessible and near to her district. Otherwise, visits were conducted once  
188 or twice per week. Additionally, in areas where mobile network was available, community  
189 volunteers sent daily text reminders and phone calls to the mother/guardian to remind them about  
190 the daily dose intake. The volunteers used a checklist to monitor children's adherence level and  
191 to document any side effects. The project provided airtime and transport costs for the volunteer  
192 women. Mothers/guardians of children who completed at least 95% of the recommended doses  
193 received a certificate of completion.

#### 195 **Strengthen data collection, monitoring, and evaluation**

196 Community mobilizers collected weekly progress reports from *Iddir* focal persons, and then  
197 aggregated the data and submitted to zonal project coordinators. The zonal project coordinators,  
198 after checking for data quality, submitted the report to the central project coordinator for  
199 quarterly compilation and reporting. Zonal project coordinators also visited intervention  
200 supported health facilities on a quarterly basis to provide onsite support. A key component of this  
201 quarterly onsite support included hands-on demonstration and feedback on the use of the  
202 nationally approved contact investigation and TPT registers. The intervention organized  
203 quarterly review meetings where planning, achievements and challenges were discussed.

#### 204 ***Data sources and analysis***

205 We used two data sources for the analysis. The first data source was the District Health  
206 Information System (DHIS-2) that compiles routine data for the national health system. Here,  
207 age disaggregation was limited to just two categories (<15 year and >=15 year). Also, TPT  
208 completion data was not available. Since the DHIS-2 became fully operational only from July  
209 2019, we limited our comparison zonal comparative analysis to two time periods: July 2019-June  
210 2020 as pre-intervention and July 2020-June 2021 as post-intervention periods. Since the DHIS-  
211 2 data was available both from comparator and intervention zones, we used this data to  
212 demonstrate impact using the difference-in-difference (DiD) approach.<sup>24</sup>

213

214 The second data source was a Microsoft Excel based data collected by project teams from the  
215 intervention sites for U5C contacts. This data contained information extracted from facility  
216 registers since July 2018, then collected and updated prospectively monthly. This data was not  
217 available for the comparator zones. As a result, data analysis focused on trends in TPT  
218 improvement over three time periods: July 2018-June 2019 as pre-intervention; July 2019-June  
219 2020 as preparatory; and July 2020-2021 as post-intervention.

220 The key variables collected and analyzed included the standard cascade of contact investigation:

- 221 • **Eligible:** screened children in whom active TB was excluded and contraindications for  
222 TPT ruled out

- 223 • **Initiated:** eligible children who started TPT as per the national guidelines

224 We calculated total numbers and proportion of eligible children treated with TPT; and number  
225 and proportion of treated children who successfully completed treatment (for the U5C group  
226 only). Eligibility for TPT was based on the national guideline as described under the standard of  
227 care above.

228 We used Microsoft Excel to compile, analyze, and describe quarterly TPT initiation data before  
229 and after the intervention. We presented the results in tables and displayed visually in graphs.  
230 Since the DID analysis for the U15C data was based on aggregate data, no statistical significance  
231 was tested. Instead, pictorial comparison of the directionality of change in key variables was  
232 made and calculated differences in numbers were presented in a table. DID analysis was not  
233 done for the U5C because data was not available for the comparator zones.

### 234 *Ethics considerations*

235 Although ethics approval was not needed for the aggregate data analysis, the study was reviewed  
236 and approved by Ethics Committees of Addis Ababa (ID-2793/227) and SNNP Regional Health  
237 Bureaus (ID-RDG-4-3054) because we intended to analyze side effect profiles of the new drugs  
238 based on individual patient data. The health facility data was accessed with full permission of the  
239 heads of health facilities.

### 241 **Patient and public involvement**

242 Iddir members are an integral part of the public and therefore their participation in this study was  
243 with full endorsement of most of the public in the study villages. Since the patients treated under  
244 this project were young children, their parents and guardians played active role in the decision to  
245 provide the preventive treatment.

## 246 **RESULTS**

### 247 **Characteristics of Iddirs**

248 We identified 67 women *Iddirs* in the three project zones, 42 in Gamo, 15 in Goffa and 10 in  
249 Addis Ketema. Seven of the 10 Iddirs in Addis Ketema sub city were involved in childcare, five  
250 in wedding services, and three in HIV care support. However, only two of the 42 Iddirs in Gamo

251 and one of the 15 Iddirs in Goffa were in non-funeral activities at baseline. None of these *Iddirs*  
 252 was in TB care at baseline.

253

### 254 **Improvements in the number of eligible U15C children enrolled**

255 The number of U15C contacts screened in intervention zones increased from 351 at baseline to  
 256 1620 during the intervention. In the comparator zones, the increase was just by 53.6%, from 567  
 257 to 871. There was considerable difference between intervention and comparator zones in terms  
 258 of the number and proportion of eligible children put on TPT. In the intervention districts, the  
 259 number of eligible U15C enrolled increased from 320 at baseline to 1550 post-intervention  
 260 (nearly 5-fold increase). In the comparator zones, the increase in the number of eligible U15C  
 261 enrollment was just by 52%. While the overall improvement in additional eligible patients  
 262 enrolled was dramatic (964 overall difference), the improvement in the intervention sub-city in  
 263 Addis Ababa was lower than that of the comparator sub-city. Table 1 summarizes the differences  
 264 and percentage changes in improvement.

265

266 Table 1. The difference-in-difference analysis of number of eligible U15C before and after the  
 267 intervention

Region	Number of Eligible U15C		
	Intervention	Comparator	Difference in Difference (DID)
<b>Addis Ababa</b>			
Before	156	43	113
After	234	98	136
Difference	78	55	23
<b>SNNPR</b>			
Before	164	466	-302
After	1316	677	639
Difference	1152	211	941
<b>Total</b>			
Before	320	509	-189
After	1550	775	775
Difference	1230	266	964

268

### 269 **TPT initiation rates among eligible U15C contacts**

270 The rate of TPT initiation in the intervention zones increased from 31.9% to 74.5%. In the  
 271 comparator districts, TPT initiation rate increased from 34.6% to just 43.2%. There was regional  
 272 variation with the intervention sub-city in Addis Ababa having the highest per centage point

273 improvement in TPT initiation rate, from 21.1% to 77.3%. Table 2 shows the DID estimates for  
274 the intervention and comparator zones.

275 Table 2. The difference-in-difference analysis of TPT initiation rate before and after the  
276 intervention

<b>TPT initiation rate among eligible U15C</b>			
<b>Region</b>	<b>Intervention</b>	<b>Comparator</b>	<b>Difference in Difference (DID)</b>
<b>Addis Ababa</b>			
Before	21.1	13.9	7.2
After	77.3	59.2	18.1
Difference	56.2	45.3	10.9
<b>SNNPR</b>			
Before	35.9	36.5	-0.6
After	51.4	35.7	15.7
Difference	15.5	-0.8	16.3
<b>Total</b>			
Before	31.9	34.6	-2.7
After	74.5	43.2	31.3
Difference	42.6	8.6	34

277

278 As clearly shown in Figure 3, TPT initiation rates started to be visibly different between  
279 intervention and comparator districts starting from the second quarter of 2020 which coincided  
280 with the deployment of zonal project officers and the baseline assessment. In the third quarter of  
281 2020, the difference became even wider.

### 282 **Improvements in TPT initiation and treatment outcome rates in U5C**

283 The number of eligible children enrolled during the pre-intervention period was 131; slightly  
284 declined to 126 during the preparatory phase; and then increased dramatically to 1,010 during the  
285 post-intervention period. The TPT initiation rate improved steadily from 13% during the pre-  
286 intervention period, to 24% during the preparatory phase, and then to 93% during the post-  
287 intervention period. (Figure 4).

288 Of 937 U5C treated, 872 (93.1%) received 3RH, 45 (4.8%) 6H, and 20 (2.1%) 3HP. Treatment  
289 outcome status was available for all the 937 U5C, of whom 99% successfully completed  
290 treatment. Treatment was discontinued in two children who had side effects. Three parents  
291 refused to continue treatment because they were not convinced why their apparently healthy  
292 child needed treatment. Only one child was lost to follow-up.

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**DISCUSSION**

We provide the first report on the beneficial role that engaging *Iddirs*, locally established community support groups, can have in TB care in Ethiopia. We found that despite a general upwards trend in TPT enrolment, children in the intervention zone had uptake and acceptance rates that were several times higher than those of comparator zones. TPT initiation among eligible U5C more than quadrupled after the intervention, and 99% of these children were treated successfully. The results highlight that volunteer women mobilized through *Iddirs* can serve as additional support to the health system in improving TPT services in the community. This new model of care has a potential for further scale-up in Ethiopia for TB but also other health issues that may require a greater involvement of community care rather than medicalized approaches.

The observed improvement in TPT service uptake sparks an important question about the place of these self-organized entities in a country where the HEWs are believed to be the anchors of the community health system. Despite improvements the HEWs brought about, several challenges were identified including low productivity and efficiency; poor working and living conditions of HEWs; limited capacity of health posts; and socio-economic factors of cross-cutting nature.<sup>25</sup> While the HEWs will remain the pillar of Ethiopia's community-based health services, additional results obtained by engaging volunteer groups highlights potential synergies that can be achieved through such interventions. Earlier studies demonstrated that HEWs can be more effective when they receive adequate technical and financial support through well-organized mechanisms.<sup>9 10</sup> The evidence from our study adds a fresh perspective that indigenous groups such as *Iddirs* as time-tested social capitals that can serve as a more sustainable addition to the existing arsenal against TB.

Until recently, *Iddirs* were reluctant to be involved in development activities due to fear of state interference.<sup>19</sup> Financial constraints due to high rates of HIV associated death among young people forced *Iddirs* to consider alternative sources of income including letting their properties and engaging in development activities. Subsequently, they became more and more involved in issues beyond funeral support which was their focus initially. A study in Addis Ababa showed several beneficial roles *Iddirs* play including emotional support, experience sharing, creating opportunities for social interaction, and improving leadership roles.<sup>26</sup> In our study at least 30% of those selected in Addis Ababa were active in HIV related activities which suggests the continued role *Iddirs* play in the HIV response in major urban areas. Even more striking is the finding that 70% was reportedly involved in childcare in Addis Ababa which shows their evolving focus as the country's health priorities shift.

329

Despite clear and much greater improvements in TPT initiation rates between intervention and comparator zones, the 71.3% TPT initiation rate among children below 15 years of age is still suboptimal and could be due to several reasons. First, the primary target groups of this project were under-five children according to the prevailing national guidelines. The expanded age group was nationally approved only after the project was launched and hence it took some time

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3 335 until all sites came on board. In addition, the analysis was based on the routine health system  
4 336 data which was still in transition to incorporate the updated indicators which may have led to  
5 337 some data quality issues. Nevertheless, the 93% TPT initiation rate achieved among under-five  
6 338 child contacts in the intervention zones clearly supports the impact of the intervention for service  
7 339 uptake among the intended target beneficiaries. In 2018, nationally reported programmatic data  
8 340 showed TPT initiation rate of 51.6% in under-five children.<sup>6</sup>

11 341 In other African settings TPT uptake rates are dismally low. A recent report from South Africa,  
12 342 for example, shows that only 0.5% of household contacts received TPT.<sup>27</sup> A systematic review  
13 343 that included 24 studies on TPT initiation rate showed that TPT initiation rates among all under-  
14 344 five children screened ranged from 2.3% to 100%. However, nine of the 24 studies reported that  
15 345 less than a half of the screened children initiated TPT.<sup>12</sup> Further in this review, one of the two  
16 346 studies that reported a 100% TPT initiation rate was from Ethiopia in which the full cascade of  
17 347 care was not described, precluding us from making conclusions about the proportion initiated  
18 348 TPT among eligible children.<sup>7</sup> In fact, this study from Ethiopia with TPT completion rate of  
19 349 12% was the very study that prompted us to look for additional interventions to improve the poor  
20 350 performance of TPT in the country. Similarly, the Indian study which was reported to have a  
21 351 TPT initiation rate of 100% had missed 39% of the children at screening; they initially identified  
22 352 71 (81%) of the 87 child contacts, screened 53 of the 71, and then put all the 53 on TPT.<sup>28</sup>  
23 353 Therefore, the 93% TPT initiation rate among all eligible U5C contacts is on the high end even  
24 354 compared with globally reported rates. Moreover, since the focus of our intervention was U5C,  
25 355 the higher rate of initiation among the U5C compared with the rate among the U15C clearly  
26 356 shows the impact of the interventions.

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34 358 The TPT success rate of 99% in this study is perhaps the highest ever reported unless proven  
35 359 otherwise through systematic reviews. In a previous TB REACH project that utilized a  
36 360 community-based approach through HEWs, 91.7% of child contacts completed a six-month  
37 361 course of TPT.<sup>9</sup> In another project that employed comprehensive health facility-based support,  
38 362 treatment completion rate of 6H among child contacts was 80.3%.<sup>29</sup> The shorter treatment  
39 363 regimen used in our study can explain only part of the difference as even in a European setting  
40 364 where shorter treatment regimens were used, treatment completion rate among foreign-born  
41 365 patients was 92%.<sup>30</sup> A recent systematic review and meta-analysis of TPT initiation and  
42 366 completion rates among migrants in low TB incidence countries showed that only 52% of those  
43 367 who initiated completed treatment.<sup>31</sup>

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48  
49 369 The difference in performance rates between the urban (Addis Ababa) and rural (SNNPR)  
50 370 intervention sites is worth discussing. The lesser increase in the number of eligible patients  
51 371 enrolled in Addis Ababa could be related to the higher impact of COVID-19 due to stricter  
52 372 restriction of activities were implemented especially during the first wave of the pandemic.<sup>32</sup>  
53 373 Also, the Iddirs in Addis Ababa were already busy with other competing social activities as  
54 374 shown in our baseline assessment. However, once eligible children are enrolled, their chances of

375 initiating TPT were higher in Addis Ababa which clearly shows the impact of the Iddir  
376 intervention.

377  
378 Our results should be interpreted cautiously because of some limitations. We cannot demonstrate  
379 causality of the *Iddir* intervention as it was not a randomized trial design. Before-after study  
380 designs have inherent limitations such as failure to control other confounding factors such as  
381 other general health system support in the area.<sup>33</sup> Since the intervention had several interrelated  
382 components such as mentoring and supervision by zonal project officers, involvement of  
383 community mobilizers and the additional support received from health workers in the catchment  
384 health facilities, it is not possible to make effect attribution to involvement of *Iddirs* alone.  
385 However, since the temporal relationship between the intervention and the outcomes show  
386 visible impact of the combination of interventions, it is highly probable that the *Iddir*  
387 intervention made a clear difference as visual evidence is a valid way of making inferences in  
388 DID analysis.<sup>34</sup>

## 389 CONCLUSION

390 This is the first comprehensive report of the beneficial role of *Iddirs* in TB program  
391 implementation in Ethiopia. Engaging women *Iddir* members contributed to demonstrable  
392 increase in TPT initiation rates and high treatment success rates among under-five children in  
393 two rural zones and in a slum sub-city in Ethiopia. These results were achieved in the face of an  
394 unprecedented COVID-19 pandemic and subsequent measures that hampered health service  
395 uptake in the country. The results suggest the untapped potential of social networks such as  
396 *Iddirs* in supporting the health system to improve TB service uptake in high TB burden settings.

397 A more rigorous evaluation and further refinement of the intervention is needed to scale up the  
398 approach. Qualitative studies should also be planned to better understand the various intervention  
399 subcomponents which contributed to achieving higher TPT initiation and completion rates post-  
400 intervention. The role of other indigenous associations both in Ethiopia and in other high TB  
401 burden settings should be studied. Further work is needed to better understand how this model of  
402 intervention can be sustained without external financial and technical support.

## 403 CONTRIBUTORSHIP STATEMENT

404 DJ designed the study, acquired resources, supervised implementation, analyzed the data, wrote  
405 the first and subsequent drafts and approved the final version. DA supervised data collection and  
406 implementation, contributed to analysis, reviewed the first and subsequent drafts, and approved  
407 the final version. KT, SB, and SS collected data, trained health workers and community  
408 volunteers, supervised community and health facility workers, reviewed the draft manuscript,  
409 and approved the final version. FA and AB oversaw implementation, supervised data collection,  
410 reviewed the first and subsequent drafts and approved the final version. AK and JC contributed  
411 to data analysis, reviewed the first and subsequent drafts and approved the final version.

412

## 413 COMPETING INTERESTS

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3 414 We declare we have no competing interest.  
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5 415

6 416 **FUNDING**  
7

8 417 This project was funded by the STOP TB Partnership under TB REACH Wave 7. The grant  
9 418 number was STBP/TBREACH/GSA/W7-8044.

11 419 **DATA SHARING STATEMENT**  
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13 420 Aggregate data will be available for sharing immediately after publication.  
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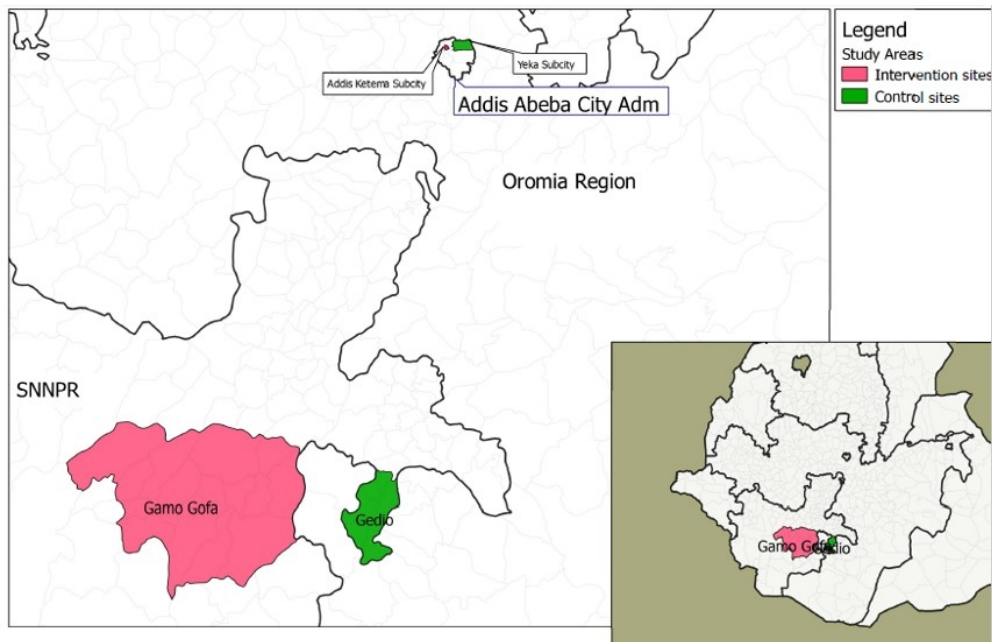
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3 512 **FIGURE LEGEND**  
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5 513 Figure 1: Map of study sites  
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7 514 Figure 2: Schematic representation of the core interventions and key players  
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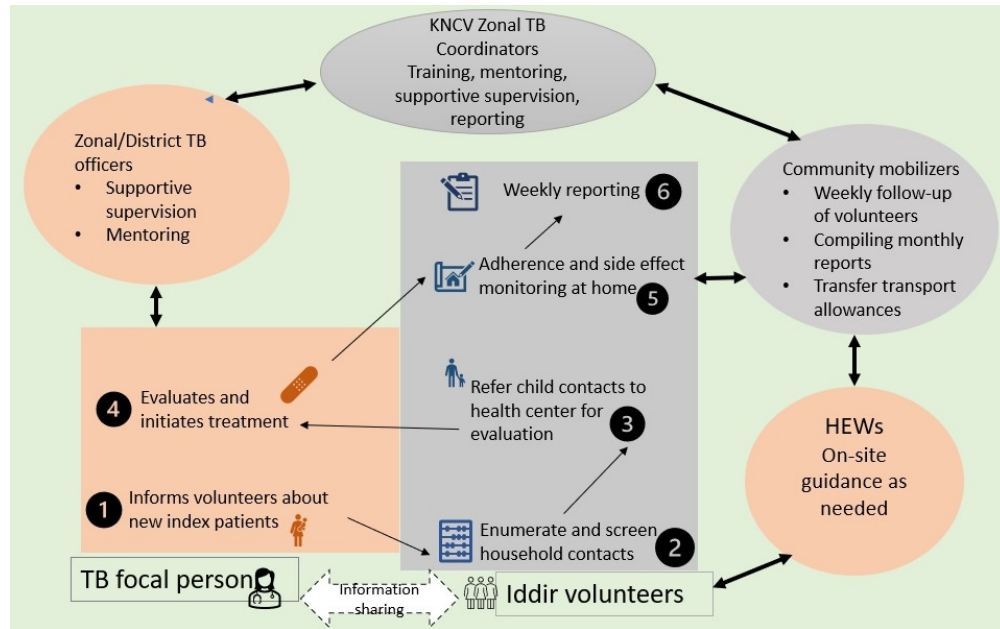
9 515 Figure 3: Trends in the number of U15C put on TPT  
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11 516 Figure 4: Trends in TPT initiation rate in U5C  
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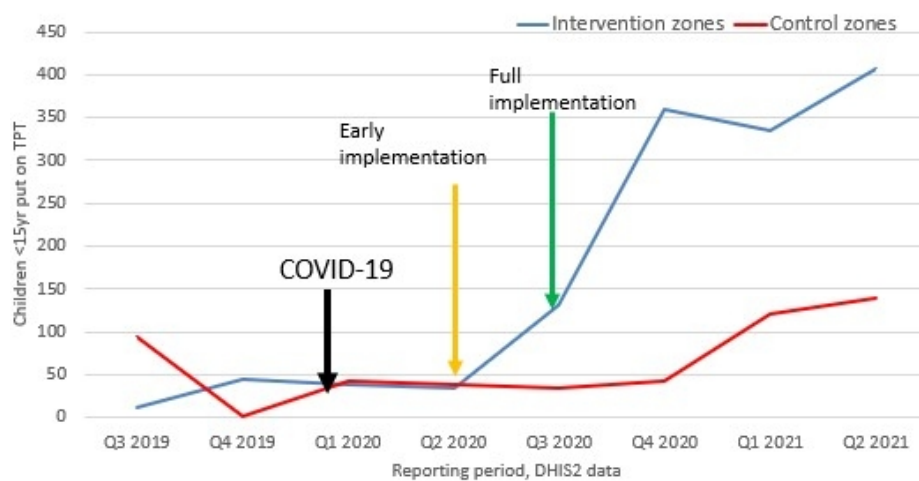
Map of Study Sites

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27 Diagrammatic representation of the core interventions and key players

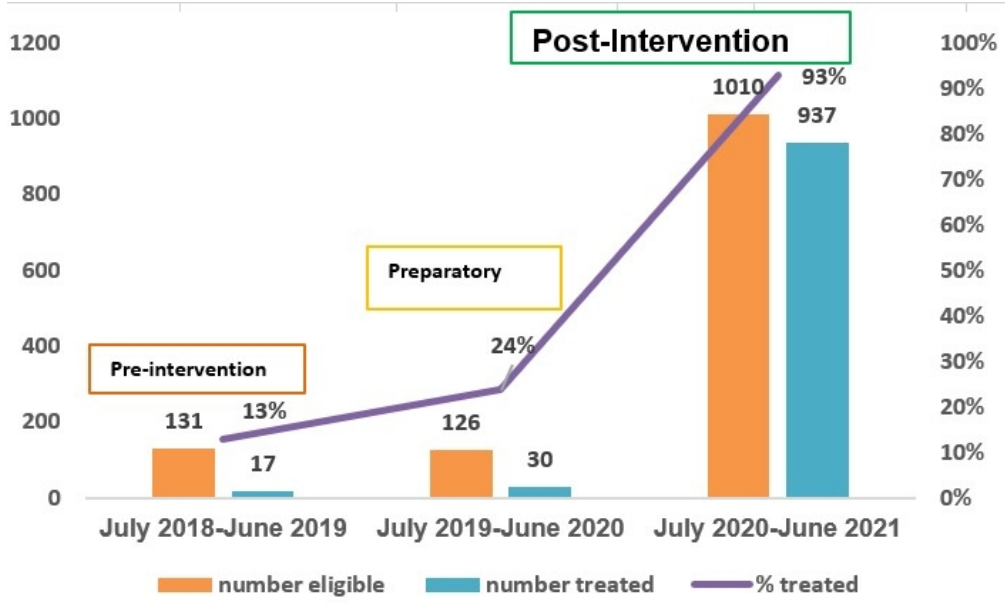
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Trends in the number of eligible U15C put on TPT

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Trends in TPT initiation rate in U5C

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# BMJ Open

## Effectiveness of women-led community interventions in improving tuberculosis preventive treatment in children: results from a comparative, before-after study in Ethiopia

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062298.R1
Article Type:	Original research
Date Submitted by the Author:	31-Mar-2022
Complete List of Authors:	Jerene, Degu; KNCV Tuberculosis Foundation, Assefa, Dawit; KNCV Tuberculosis Foundation, Ethiopia Country Office Tesfaye, Kalkidan; Love in Action Ethiopia Bayu, Samuel; KNCV Tuberculosis Foundation, Ethiopia Office Seid, Samuel; KNCV Tuberculosis Foundation, Ethiopia Country Office Aberra, Fikirte; Southern Nations Nationalities and Peoples' Region Health Bureau Bedru, Ahmed; KNCV Tuberculosis Foundation Khan, Amara; Stop TB Partnership Creswell, Jacob; Stop TB Partnership,
<b>Primary Subject Heading</b>:	Global health
Secondary Subject Heading:	Infectious diseases, Global health
Keywords:	Tuberculosis < INFECTIOUS DISEASES, PUBLIC HEALTH, Community child health < PAEDIATRICS

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3 **1 Effectiveness of women-led community interventions in improving tuberculosis preventive**  
4 **2 treatment in children: results from a comparative, before-after study in Ethiopia**

6 3 Degu Jerene<sup>1\*</sup>, Dawit Assefa<sup>2</sup>, Kalkidan Tesfaye<sup>3</sup>, Samuel Bayu<sup>2</sup>, Samuel Seid<sup>2</sup>, Fikirte Aberra<sup>4</sup>,  
7 4 Ahmed Bedru<sup>2</sup>, Amera Khan<sup>5</sup>, Jacob Creswell<sup>5</sup>

9 5 <sup>1\*</sup> Corresponding author, KNCV Tuberculosis Foundation

11 6 <sup>2</sup> KNCV Tuberculosis Foundation, Addis Ababa, Ethiopia

13 7 <sup>3</sup> Love in Action Ethiopia, Addis Ababa, Ethiopia

15 8 <sup>4</sup> Southern Nations', Nationalities', and Peoples' Regional Health Bureau, Hawassa, Ethiopia

17 9 <sup>5</sup> Stop TB Partnership, Geneva, Switzerland

18 10 \* Corresponding author

20 11 Dr Degu Jerene, KNCV Tuberculosis Foundation, Maanweg 174, 2516 AB Den Haag, Netherlands.  
21 12 email: [degu.dare@kncvtbc.org](mailto:degu.dare@kncvtbc.org) or [degujerene@gmail.com](mailto:degujerene@gmail.com)

23 13 **Key words**

25 14 TB preventive treatment; under-five children; Ethiopia; Iddirs; household contacts

27 15

29 16 **Word count**

31 17 4156

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19

20 Abstract

21 **Objectives:** Our objective was to evaluate the impact of a service delivery model led by  
22 membership-based associations called *Iddirs* formed by women on tuberculosis preventive  
23 treatment (TPT) initiation and completion rates among children.

24  
25 Design: Comparative, before-and-after study design

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27 **Setting:** Three intervention and two control districts in Ethiopia.

28  
29 **Participants:** Children under-fifteen years of age who had a history of close contact with adults  
30 with infectious forms of TB. Child contacts in whom active TB and contraindications to TPT  
31 regimens excluded were considered eligible for TPT.

32  
33 **Interventions:** Between July 2020-June 2021, trained women Iddir members visited households  
34 of index TB patients, screened child household contacts for TB, provided education and  
35 information on the benefits of TPT, linked them to the nearby health center, and followed them  
36 at home for TPT adherence and side effects. Two control zones received the standard of care  
37 which comprised of facility-based provision of TPT to children. We analyzed quarterly TPT data  
38 for treatment initiation and completion and compared intervention and control zones before and  
39 after the intervention.

40  
41 **Primary and secondary outcome measures:** There were two primary outcome measures:  
42 proportion of eligible children initiated TPT; and proportion completed treatment out of those  
43 eligible.

#### 44 **Results**

45 TPT initiation rate among eligible under-15-year-old children (U15C) increased from 31.9% to  
46 74.5% in the intervention zones while it increased from 34.6% to 43.2% in the control zones.  
47 TPT initiation rate for under-five year old children (U5C) increased from 13% (17 out of 131) to  
48 93% (937 out of 1010). Of the U5C initiated, 99% completed treatment; two discontinued due to  
49 side effects; three parents refused to continue; and one child was lost to follow-up.

50  
51 **Conclusion:** Women-led *Iddirs* contributed to significant increase in TPT initiation and  
52 completion rates. The model of TPT delivery should be scaled-up.

53

54

## 55 INTRODUCTION

56 Of the 1.7 billion people estimated to be infected with TB worldwide in 2019, about 80% reside  
57 in South-East Asian, Pacific, and African regions. <sup>1</sup> If the goal of ending TB by 2030 is to be met  
58 <sup>2</sup>, management of TB infection and preventing TB disease should be intensified along with  
59 strengthened efforts to diagnose and treat active disease. <sup>3</sup> Reviews of recent progress, however,  
60 shows a significant lag in achieving globally agreed upon targets. According to the progress  
61 report of the UN high-level meeting (UNHLM) targets, only 21% (6.3 of 30 million) of TB  
62 preventive treatment (TPT) targets were met after 40% of the time has elapsed. Moreover,  
63 achievements varied considerably by population sub-groups: <1% for household contacts older  
64 than 5 years, 20% for contacts under-five (U5C), and 88% for people living with HIV (PLHIV)  
65 making efforts to treat the first two groups of critical importance. <sup>4</sup>

66 In Ethiopia, a high TB burden country missing about a third of estimated 151,000 people who  
67 develop TB each year, <sup>5</sup> treatment of TB infection among children has also been a major area of  
68 concern. The pathway of care for TPT in children usually begins with contact investigation of a  
69 household member with diagnosed TB. Young children are identified and screened for active  
70 disease. If active disease is ruled out, then TPT can be offered. Programmatic data show variable  
71 TPT initiation rates ranging from 13%-64.3% <sup>6</sup>, and treatment completion rates have been either  
72 low or unknown, with some sites reporting as low as 12%. <sup>7</sup> Nevertheless, Ethiopia is among a  
73 few African countries which have made significant progress in increasing TPT. <sup>8</sup> <sup>6</sup> High  
74 treatment completion rates were reported in districts that received additional technical assistance  
75 to the existing health extension program (HEP). <sup>9</sup> These results were achieved through additional  
76 technical and financial support, but sustainably replicating these best practices requires further  
77 work. <sup>9</sup> <sup>10</sup>

78 Of several factors that contribute to the low uptake of TPT in the household contact groups, cost  
79 of travel to health facilities; perceived lack of need for TPT in children among parents; low level  
80 of knowledge among health care workers; stigma; other competing priorities of the family; and  
81 medication related challenges such as pill burden stand out as common barriers.<sup>11</sup> <sup>12</sup> Other factors  
82 include fear of side effects<sup>7</sup>, lack of supplies, and poor recording and reporting practices.<sup>13</sup>  
83 Common themes with the barriers include access and information which may be better addressed  
84 with community-based interventions.

85

86 There are successful examples of community-based interventions that helped improve childhood  
87 TB services. In Nepal, for example, intensified community-based case finding strategies led to  
88 improvements in childhood TB case-finding. <sup>14</sup> Similarly, in Uganda, strategies that included  
89 decentralized delivery of TB services through community health workers contributed to 85%  
90 TPT completion rates. <sup>15</sup> In a prospective study in Peru where community-based accompaniment  
91 team of trained community health workers and nurse technicians were involved in a  
92 comprehensive psycho-social supported that included home visits and direct treatment

93 observation, 61 contacts including 35 aged 0-19 years received TPT prescriptions. Of those  
94 prescribed TPT 57 received treatment of whom 51 completed the treatment.<sup>16</sup>

95

96 While Ethiopia demonstrated impressive results in TPT uptake and TB case detection by  
97 engaging paid community health workers<sup>9 10 17</sup>, the contribution of volunteer women organized  
98 through the government system has been inconsistent<sup>18</sup>. An often-overlooked local support  
99 system is the role of indigenous associations such as *Iddirs* in TB control in Ethiopia. *Iddirs* are  
100 membership-based local associations of people who have voluntarily entered an agreement to  
101 help each other during times of adversities. According to Kloos and Mariam<sup>19</sup>, *Iddirs* are one of  
102 the oldest social capital institutions, designed to help reduce poverty by creating a strong  
103 network and cooperation among the community and as risk sharing and coping mechanism  
104 during economic crises. They are indigenous voluntary associations, mostly unique to Ethiopia,  
105 established primarily to provide support in burial matters. Household membership is ensured  
106 through payment of monthly fixed contributions. The association raises money whenever death  
107 occurs in a household, the amount depending on the specific bylaws.

108 There is no data on the role of *Iddirs* in TB care, but their engagement in HIV care and other  
109 social services has been reported.<sup>19 20</sup> Similarly, engaging saving groups has been beneficial for  
110 infant feeding practices in Malawi.<sup>21</sup> Studies on the role of *Iddirs* and similar groups in TB care  
111 are scarce. We share results from an innovative project that collaborated with *Iddirs* in Ethiopia.  
112 Since empowering women is associated with favorable child health outcomes, we selected  
113 women-only *Iddirs* as a strategy to empower women in decision making for their children's  
114 medical care.<sup>22 23</sup> Our objective was to assess the outcomes of engaging women-only *Iddirs* in  
115 TPT uptake in under-five children in selected districts in Ethiopia.

116

## 117 **METHODS**

### 118 **Study sites**

119 We conducted this study in two remote zones, Gamo and Goffa, in the Southern Nations',  
120 Nationalities' and Peoples' Region (SNNPR) of Ethiopia, and Addis Ketema sub-city in the  
121 capital Addis Ababa. Figure 1 shows a map of Intervention and control Zones.

122 The two zones were selected based on their low TPT coverage and lack of external partner  
123 support at the time of project initiation. Gamo and Goffa were under one zonal administration  
124 (Gamo Goffa zone) during the planning phase of this project, but they were split into two zones  
125 at the beginning of implementation. The two newly formed zones have a combined population of  
126 2,202,751 (Gamo 1,544,756 and Goffa 658,005). Addis Ketema is a densely populated slum sub-  
127 city with population of 343, 228, and had one of the lowest TPT initiation rates in Addis Ababa,  
128 Ethiopia's capital. Gedeo zone from SNNPR (population 1,138,814) and Yeka sub-city  
129 (population 415,735) from Addis Ababa served as control zones and were purposefully selected  
130 based on their population size, geographic location (distinct and far away from the intervention  
131 zones), and similarity in baseline TPT initiation rates.

### 132 **Study design**

133 We used a before-after study design involving three intervention areas and two control areas as  
134 part of a TB REACH project following standardized methodology designed to measure TPT  
135 uptake in under-five children in the selected project sites. As described below, the two control  
136 zones received the standard of care while the intervention zones received the *Iddir* intervention.

### 137 **Study period**

138 Interventions were implemented between July 2020-June 2021.

### 139 **The standard of care**

140 According to national guidelines, TPT services are provided at the health center or hospital level.  
141 Children are offered enrollment in TPT if they present at health facilities as a household contact  
142 of a person with TB and are found not to have active disease. Active search or contact  
143 investigation for eligible child contacts is rarely practiced at community level despite this being  
144 recommended to be part of the package for HEWs. *Iddirs* do not participate in contact  
145 investigation, TPT service facilitation, or other TB services. A six-month course of isoniazid  
146 (INH) (6H) was the only nationally recommended IPT regimen for all eligible children during  
147 the designing phase of this project. Only U5C contacts and people living with HIV were eligible  
148 for TPT until the guideline changed in July 2020 to include children below 15 years of age. At  
149 the same time, the new national recommendations included two additional TPT regimens: a  
150 three-month daily dose of INH and Rifampicin (3HR) and weekly INH and Rifapentine (3HP).

### 151 **Interventions**

152 Figure 2 summarizes the key interventions which encompassed the following components and  
153 roles:

#### 154 **Selection and capacity building of Iddir members and focal persons**

155 We first mapped, selected, and conducted capacity building of women only Iddir members and  
156 focal persons from each selected district. Iddir leaders then nominated two focal persons from  
157 each Iddir to liaise with the project. During the selection of the Iddir focal persons and the  
158 additional Iddir members, the following criteria were used: previous engagement in volunteer  
159 services in the community, ability to read and write, possession of a mobile phone, and good  
160 communication skills. The selected *Iddir* focal persons and members received training on the  
161 basics of TB with a focus on under-five child contact management and TPT. The training  
162 curriculum was customized from the Integrated Refresher Training (IRT) material used for  
163 training HEWs. The IRT is a modular training material aimed at enhancing the knowledge and  
164 skills of HEWs in a wide range of disease prevention and health promotion topics where TB and  
165 HIV are included as one module. In addition to the basic training, they received training on  
166 COVID-19 preventive and personal protective equipment for use during home and health facility  
167 visits. The main trainer was an MSc level trained health officer from KNCV tuberculosis foundation  
168 together with two zonal project coordinators.

169 To ensure proper alignment of the project activities with the existing health system, we  
170 sensitized the district TB coordinators and TB focal persons about the project approaches and got

171 their buy-in for implementation. This was organized as part of a three-day event combined with a  
172 project kick-off meeting.

### 173 **Active outreach for contact investigation and TPT**

174 Each trained Iddir focal person selected three additional volunteers, to form a village steering  
175 group. The volunteer women conducted home visits to the households with known index  
176 pulmonary TB patients based on a list they obtained from the health facility TB focal person.  
177 During home visits, volunteers did symptom-based screening using a checklist, or verified if  
178 contacts were already screened for TB, with special focus on under-five children. All under-five  
179 child contacts received a referral slip to the nearby health center for further evaluation and TPT  
180 initiation. Community mobilizers (one per zone) who were nurses with additional orientation on  
181 the project activities provided additional technical guidance and administrative support to the  
182 volunteer women. By the end of each week, the volunteer women reported to the community  
183 mobilizers on the status of new enrollment and treatment completion rates. Figure 2 describes the  
184 core activities of the volunteers and other key contributors.

185 Once a child started TPT, community volunteers continued the follow-up by daily direct home  
186 visits, if the home was accessible and near to her district. Otherwise, visits were conducted once  
187 or twice per week. Additionally, in areas where mobile network was available, community  
188 volunteers sent daily text reminders and phone calls to the mother/guardian to remind them about  
189 the daily dose intake. The volunteers used a checklist to monitor children's adherence level and  
190 to document any side effects. The project provided airtime and transport costs for the volunteer  
191 women. Mothers/guardians of children who completed at least 95% of the recommended doses  
192 received a certificate of completion.

### 194 **Strengthen data collection, monitoring, and evaluation**

195 Community mobilizers collected weekly progress reports from *Iddir* focal persons, and then  
196 aggregated the data and submitted to zonal project coordinators. The zonal project coordinators,  
197 after checking for data quality, submitted the report to the central project coordinator for  
198 quarterly compilation and reporting. Zonal project coordinators also visited intervention  
199 supported health facilities on a quarterly basis to provide onsite support. A key component of this  
200 quarterly onsite support included hands-on demonstration and feedback on the use of the  
201 nationally approved contact investigation and TPT registers. The intervention organized  
202 quarterly review meetings where planning, achievements and challenges were discussed.

### 203 ***Data sources and analysis***

204 We used two data sources for the analysis. The first data source was the District Health  
205 Information System (DHIS-2) that compiles routine data for the national health system. Here,  
206 age disaggregation was limited to just two categories (<15 year and >=15 year). Also, TPT  
207 completion data was not available. Since the DHIS-2 became fully operational only from July  
208 2019, we limited our comparison zonal comparative analysis to two time periods: July 2019-June  
209 2020 as pre-intervention and July 2020-June 2021 as post-intervention periods. The variables in  
210 the DHIS-2 database included number of U15C screened, eligible and initiated on TPT. We  
211 obtained the data through the Ministry of Health Ethiopia, DHIS-2 platform. Since the DHIS-2

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3 212 data was available both from control and intervention zones, we used this data to demonstrate  
4 213 impact using the difference-in-difference ( DiD) approach.<sup>24</sup>  
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8 215 The second data source was a Microsoft Excel based data collected by project teams from the  
9 216 intervention sites for U5C contacts. This data contained information extracted from facility  
10 217 registers since July 2018, then collected and updated prospectively monthly. The prospective  
11 218 data collection was done by Iddir women who maintained a logbook of every child identified and  
12 219 linked to the nearby health facility. At the end of every work week, they visited the health  
13 220 facility and checked the status of every child they referred. With support from the health facility  
14 221 TB focal person, they extracted the information from the health facility TPT register using a  
15 222 paper-based data abstraction form. They collected information about the number of children  
16 223 screened, eligible and initiated TPT, and reported to the community mobilizers on a weekly basis  
17 224 who in turn compiled the data in a monthly reporting format and submitted to a central  
18 225 coordinator. This data was not available for the control zones. As a result, data analysis from this  
19 226 source focused on trends in TPT improvement over three time periods: July 2018-June 2019 as  
20 227 pre-intervention; July 2019-June 2020 as preparatory; and July 2020-2021 as post-intervention.

21 228 The key variables collected and analyzed included the standard cascade of contact investigation:

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27 229 • **Eligible:** screened children in whom active TB was excluded and contraindications for  
28 230 TPT ruled out  
29 231 • **Initiated:** eligible children who started TPT

30 232 We calculated total numbers and proportion of eligible children initiated TPT; and number and  
31 233 proportion of initiated children who successfully completed treatment (for the U5C group only).  
32 234 Eligibility for TPT was based on the national guideline as described under the standard of care  
33 235 above.  
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36 236 We used Microsoft Excel to compile, analyze, and describe quarterly TPT initiation data before  
37 237 and after the intervention. We presented the results in tables and displayed visually in graphs. In  
38 238 our DiD analysis, we used pictorial comparison of the directionality of change in key variables  
39 239 and calculated differences in numbers and percentages.  
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#### 42 240 ***Ethics considerations***

43 241 Although ethics approval was not needed for the aggregate data analysis, the study was reviewed  
44 242 and approved by Ethics Committees of Addis Ababa (ID-2793/227) and SNNP Regional Health  
45 243 Bureaus (ID-RDG-4-3054) because we intended to analyze side effect profiles of the new drugs  
46 244 based on individual patient data. The health facility data was accessed with full permission of the  
47 245 heads of health facilities.  
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#### 50 246 51 247 **Patient and public involvement**

52 248 We included Iddir members who are an integral part of the public and therefore their  
53 249 participation in this study was with full endorsement of the public in the study villages. Since the  
54 250 patients treated under this project were children, their parents and guardians played active role in  
55 251 the decision to provide the preventive treatment. Moreover, we plan to disseminate the final  
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252 results of the study during our future engagement with the community where we support other  
253 TB implementation projects at the moment.

254

## 255 RESULTS

### 256 Characteristics of Iddirs

257 We identified 67 women-only *Iddirs* in the three project zones, 42 in Gamo, 15 in Goffa and 10  
258 in Addis Ketema. Seven of the 10 *Iddirs* in Addis Ketema sub city were involved in childcare,  
259 five in wedding services, and three in HIV care support. However, only two of the 42 *Iddirs* in  
260 Gamo and one of the 15 *Iddirs* in Goffa were involved in non-funeral activities at baseline. None  
261 of these *Iddirs* was involved in TB care at baseline.

262

### 263 Improvements in the number of eligible U15C children enrolled and initiated

264 The number of U15C contacts screened in intervention zones increased from 351 at baseline to  
265 1620 during the intervention which was a 361% increase. In the control zones, the increase was  
266 just by 53.6%, from 567 to 871. Similarly, the number of eligible U15C enrolled in the  
267 intervention zones increased from 320 at baseline to 1550 post-intervention (nearly 5-fold  
268 increase). In the control zones, the increase in the number of eligible U15C enrollment was just  
269 by 52%. While the overall improvement in additional eligible patients enrolled was dramatic  
270 (964 overall difference), the improvement in the intervention sub-city in Addis Ababa was lower  
271 than that of the control sub-city. Table 1 summarizes the differences and percentage changes in  
272 improvement.

273 Table 1. The difference-in-difference analysis of eligible U15C enrolled and treated before and  
274 after the intervention

Region	Intervention			Control		
	Eligible enrolled	Eligible initiated	% Initiated	Eligible enrolled	Eligible initiated	% Initiated
<b>Addis Ababa</b>						
Before	156	33	21.1	43	6	13.9
After	234	181	77.3	98	58	59.2
Difference (%)	78 (+50%)	148 (+448%)	56.2 (+266%)	55 (+128%)	52 (+866%)	45.3 (+326%)
<b>SNNPR</b>						
Before	164	59	35.9	466	170	36.5
After	1316	796	60.4	677	277	40.9
Difference (%)	1152 (+702%)	737 (+1249%)	24.5 (+68.2%)	211 (+45%)	107 (+63%)	3.5 (+9.6%)
<b>Total</b>						
Before	320	92	28.7	509	176	34.6
After	1550	977	63.05	775	335	43.2
Difference (%)	1230 (+384%)	885 (+963%)	42.6 (+148%)	266 (+52%)	159 (+90.3%)	8.6 (+24.9%)

275 Legend: In this table, "before" refers to the period July 2019-June 2020 while after refers to the period July 2020-June 2021.

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3 277 The rate of TPT initiation in the intervention zones increased from 28.7% to 63.5%. In the  
4 278 control districts, TPT initiation rate increased from 34.6% to just 43.2%. There was regional  
5 279 variation with the control sub-city in Addis Ababa having the highest per centage point  
6 280 improvement in TPT initiation rate (Table 1).

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9 281 As clearly shown in Figure 3, TPT initiation rates started to be visibly different between  
10 282 intervention and control districts starting from the second quarter of 2020 which coincided with  
11 283 the deployment of zonal project officers and the baseline assessment. In the third quarter of  
12 284 2020, the difference became even wider.

### 14 285 **Improvements in TPT initiation and treatment outcome rates in U5C**

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16 286 The number of eligible children enrolled during the pre-intervention period was 131; slightly  
17 287 declined to 126 during the preparatory phase; and then increased dramatically to 1,010 during the  
18 288 post-intervention period. The proportion of U5C among all eligible children enrolled in the  
19 289 intervention zones increased from 39% (126/320) to 65% (1010/1550). The TPT initiation rate  
20 290 improved steadily from 13% during the pre-intervention period, to 24% during the preparatory  
21 291 phase, and then to 93% during the post-intervention period. (Figure 4).

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24 292 Of 937 U5C treated, 872 (93.1%) received 3RH, 45 (4.8%) 6H, and 20 (2.1%) 3HP. Treatment  
25 293 outcome status was available for all the 937 U5C, of whom 99% successfully completed  
26 294 treatment. Treatment was discontinued in two children who had side effects. Three parents  
27 295 refused to continue treatment because they were not convinced why their apparently healthy  
28 296 child needed treatment. Only one child was lost to follow-up.  
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**DISCUSSION**

We provide the first report on the beneficial role that engaging *Iddirs*, locally established community support groups, can have in TB care in Ethiopia. We found that despite a general upwards trend in TPT enrolment in both groups, children in the intervention zone had uptake and acceptance rates that were several times higher than those of control zones. TPT initiation among eligible U5C more than quadrupled after the intervention, and 99% of these children were treated successfully. The results highlight that volunteer women mobilized through *Iddirs* can serve as additional support to the health system in improving TPT services in the community. This new model of care has a potential for further scale-up in Ethiopia for TB but also other health issues that may require a greater involvement of community care rather than medicalized approaches.

The observed improvement in TPT service uptake sparks an important question about the place of *Iddirs* in a country where the HEWs are believed to be the anchors of the community health system. Despite improvements the HEWs brought about, several challenges were identified including low productivity and efficiency; poor working and living conditions of HEWs; limited capacity of health posts; and socio-economic factors of cross-cutting nature.<sup>25</sup> While the HEWs will remain the pillar of Ethiopia's community-based health services, additional results obtained by engaging volunteer groups highlights potential synergies that can be achieved through such interventions. Earlier studies demonstrated that HEWs can be more effective when they receive adequate technical and financial support through well-organized mechanisms.<sup>9 10</sup> The evidence from our study adds a fresh perspective that indigenous groups such as *Iddirs* as time-tested social capitals can serve as a more sustainable addition to the existing arsenal against TB.

Until recently, *Iddirs* were reluctant to be involved in development activities due to fear of state interference.<sup>19</sup> Financial constraints due to high rates of HIV associated death among young people forced *Iddirs* to consider alternative sources of income including letting their properties and engaging in development activities. Subsequently, they became more and more involved in issues beyond funeral support which was their focus initially. A study in Addis Ababa showed several beneficial roles *Iddirs* play including emotional support, experience sharing, creating opportunities for social interaction, and improving leadership roles.<sup>26</sup> In our study at least 30% of those selected in Addis Ababa were active in HIV related activities which suggests the continued role *Iddirs* play in the HIV response in major urban areas. Even more striking is the finding that 70% of the *iddirs* were reportedly involved in childcare in Addis Ababa which shows their evolving focus as the country's health priorities shift.

332

Despite clear and much greater improvements in TPT initiation rates between intervention and control zones, the 71.3% TPT initiation rate among children below 15 years of age is still suboptimal and could be due to several reasons. First, the primary target groups of this project were under-five children according to the prevailing national guidelines. The expanded age group was nationally approved only after the project was launched and hence it took some time until all sites came on board. In addition, the analysis was based on the routine health system

339 data which was still in transition to incorporate the updated indicators which may have led to  
340 some data quality issues. Nevertheless, the 93% TPT initiation rate achieved among under-five  
341 child contacts in the intervention zones clearly supports the impact of the intervention for service  
342 uptake among the intended target beneficiaries. In 2018, nationally reported programmatic data  
343 showed TPT initiation rate of 51.6% in under-five children.<sup>6</sup>

344 In other African settings TPT uptake rates are dismally low. A recent report from South Africa,  
345 for example, shows that only 0.5% of household contacts received TPT.<sup>27</sup> A systematic review  
346 that included 24 studies on TPT initiation rate showed that TPT initiation rates among all under-  
347 five children screened ranged from 2.3% to 100%. However, nine of the 24 studies reported that  
348 less than a half of the screened children initiated TPT.<sup>12</sup> Further in this review, one of the two  
349 studies that reported a 100% TPT initiation rate was from Ethiopia in which the full cascade of  
350 care was not described, precluding us from making conclusions about the proportion initiated  
351 TPT among eligible children.<sup>7</sup> In fact, this study from Ethiopia with TPT completion rate of  
352 12% was the very study that prompted us to look for additional interventions to improve the poor  
353 performance of TPT in the country. Similarly, the Indian study which was reported to have a  
354 TPT initiation rate of 100% had missed 39% of the children at screening; they initially identified  
355 71 (81%) of the 87 child contacts, screened 53 of the 71, and then put all the 53 on TPT.<sup>28</sup>  
356 Therefore, the 93% TPT initiation rate among all eligible U5C contacts in our study is on the  
357 high end even compared with globally reported rates. Moreover, since the focus of our  
358 intervention was U5C, the higher rate of initiation among the U5C compared with the rate among  
359 the U15C clearly shows the impact of the interventions.

360

361 The TPT success rate of 99% in this study is perhaps the highest ever reported unless proven  
362 otherwise through systematic reviews. In a previous TB REACH project that utilized a  
363 community-based approach through HEWs, 91.7% of child contacts completed a six-month  
364 course of TPT.<sup>9</sup> In another project that employed comprehensive health facility-based support,  
365 treatment completion rate of 6H among child contacts was 80.3%.<sup>29</sup> The shorter treatment  
366 regimen used in our study can explain only part of the difference as even in a European setting  
367 where shorter treatment regimens were used, treatment completion rate among foreign-born  
368 patients was 92%.<sup>30</sup> A recent systematic review and meta-analysis of TPT initiation and  
369 completion rates among migrants in low TB incidence countries showed that only 52% of those  
370 who initiated completed treatment.<sup>31</sup>

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372 The difference in performance rates between the urban (Addis Ababa) and rural (SNNPR)  
373 intervention sites is worth discussing. The lesser increase in the number of eligible patients  
374 enrolled in Addis Ababa could be related to the higher impact of COVID-19 due to stricter  
375 restriction of activities implemented especially during the first wave of the pandemic.<sup>32</sup> Also, the  
376 *Iddirs* in Addis Ababa were already busy with other competing social activities as shown in our  
377 baseline assessment.

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3 379 Our results should be interpreted cautiously because of some limitations. We cannot demonstrate  
4 380 causality of the *Iddir* intervention as it was not a randomized trial design. Before-after study  
5 381 designs have inherent limitations such as failure to control for other confounding factors such as  
6 382 general health system support in the area.<sup>33</sup> Since the intervention had several interrelated  
7 383 components such as mentoring and supervision by zonal project officers, involvement of  
8 384 community mobilizers and the additional support received from health workers in the catchment  
9 385 health facilities, it is not possible to make effect attribution to involvement of *Iddirs* alone.  
10 386 Improved recording and reporting of U5C in the intervention zones may have led to apparent  
11 387 improvement in TPT enrollment. However, improvement in recording and reporting practices  
12 388 that followed the national recommendation to expand the age limit for TPT initiation may have  
13 389 led to sustaining TPT initiation and completion rates in control zones, counterbalancing the  
14 390 possible information bias introduced by the intervention. One can also argue a potential positive  
15 391 impact of change in national guidelines, but our results clearly show relative increase in the  
16 392 proportion of U5C enrolled further confirming the impact of the intervention. As the temporal  
17 393 relationship between the intervention and the outcomes show visible impact of the combination  
18 394 of interventions, it is highly probable that the *Iddir* intervention made a clear difference as visual  
19 395 evidence is a valid way of making inferences in DiD analysis.<sup>34</sup>

## 25 396 **CONCLUSION**

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27 397 This is the first comprehensive report of the beneficial role of *Iddirs* in TB program  
28 398 implementation in Ethiopia. Engaging women *Iddir* members contributed to demonstrable  
29 399 increase in TPT initiation rates and high treatment success rates among under-five children in  
30 400 two rural zones and in a slum sub-city in Ethiopia. These results were achieved in the face of an  
31 401 unprecedented COVID-19 pandemic and subsequent measures that hampered health service  
32 402 uptake in the country. The results suggest the untapped potential of social networks such as  
33 403 *Iddirs* in supporting the health system to improve TB service uptake in high TB burden settings.

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36 404 A more rigorous evaluation and further refinement of the intervention is needed to scale up the  
37 405 approach. Qualitative studies should also be planned to better understand the various intervention  
38 406 subcomponents which contributed to achieving higher TPT initiation and completion rates post-  
39 407 intervention. The role of other indigenous associations both in Ethiopia and in other high TB  
40 408 burden settings should be studied. Further work is needed to better understand how this model of  
41 409 intervention can be sustained without external financial and technical support.

## 44 410 **CONTRIBUTORSHIP STATEMENT**

45  
46 411 DJ designed the study, acquired resources, supervised implementation, analyzed the data, wrote  
47 412 the first and subsequent drafts and approved the final version. DA supervised data collection and  
48 413 implementation, contributed to analysis, reviewed the first and subsequent drafts, and approved  
49 414 the final version. KT, SB, and SS collected data, trained health workers and community  
50 415 volunteers, supervised community and health facility workers, reviewed the draft manuscript,  
51 416 and approved the final version. FA and AB oversaw implementation, supervised data collection,  
52 417 reviewed the first and subsequent drafts and approved the final version. AK and JC contributed  
53 418 to data analysis, reviewed the first and subsequent drafts and approved the final version.

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3 419 The contents of the article are the responsibility of the authors alone and do not necessarily  
4 420 reflect the views of donors or employers of the authors.  
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8 422 **COMPETING INTERESTS**

9 423 We declare we have no competing interest.  
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13 425 **FUNDING**

14 426 This project was funded by the STOP TB Partnership under TB REACH Wave 7. The grant  
15 427 number was STBP/TBREACH/GSA/W7-8044.  
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18 428 **DATA SHARING STATEMENT**

19 429 Aggregate data will be available for sharing immediately after publication.  
20  
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3 521 **FIGURE LEGEND**  
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5 522 Figure 1: Map of study sites  
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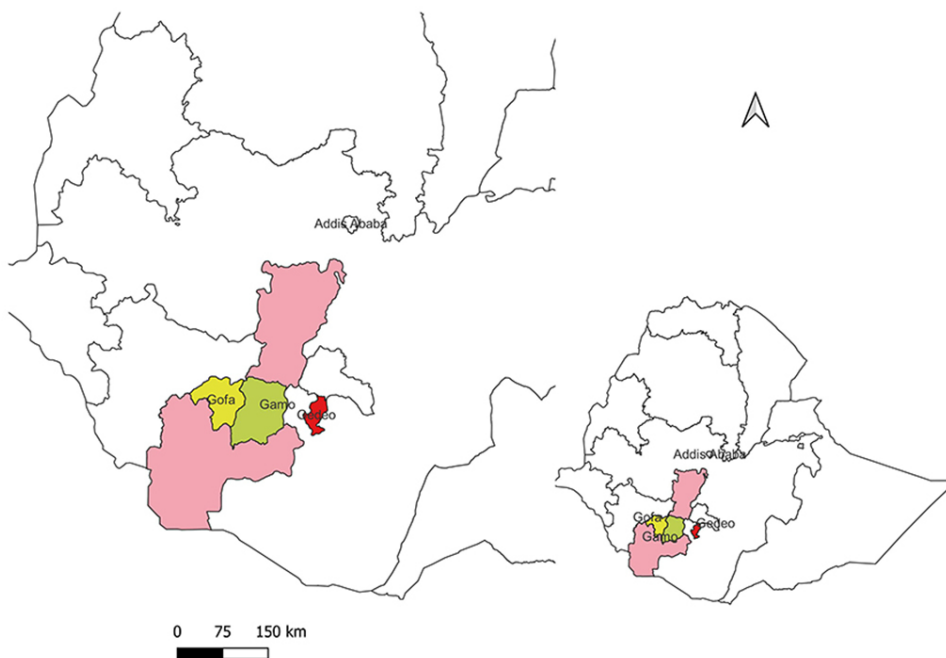
7 523 Figure 2: Schematic representation of the core interventions and key players  
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9 524 Figure 3: Trends in the number of U15C put on TPT  
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11 525 Figure 4: Trends in TPT initiation rate in U5C  
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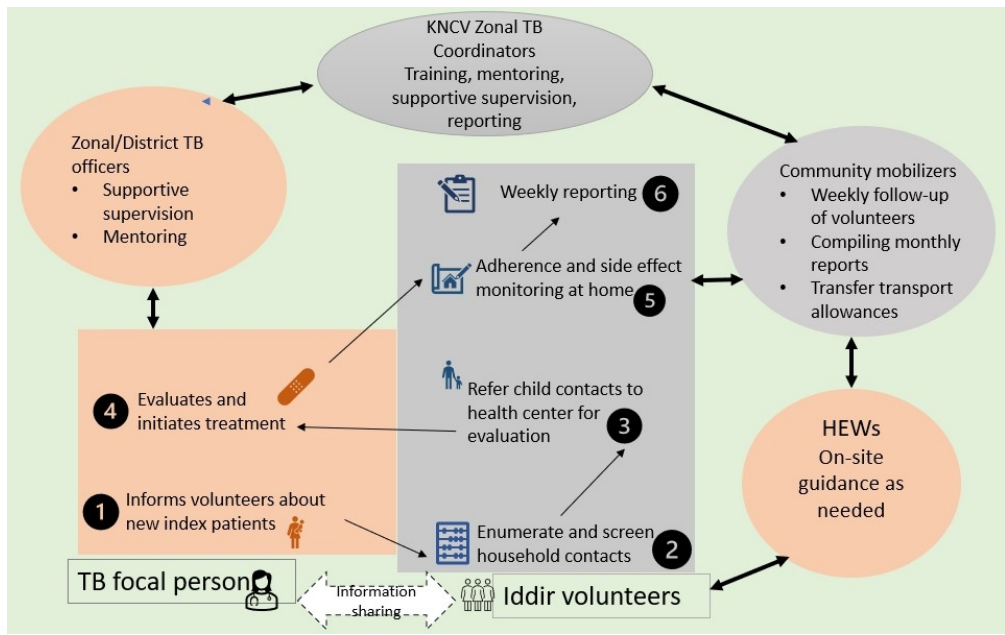
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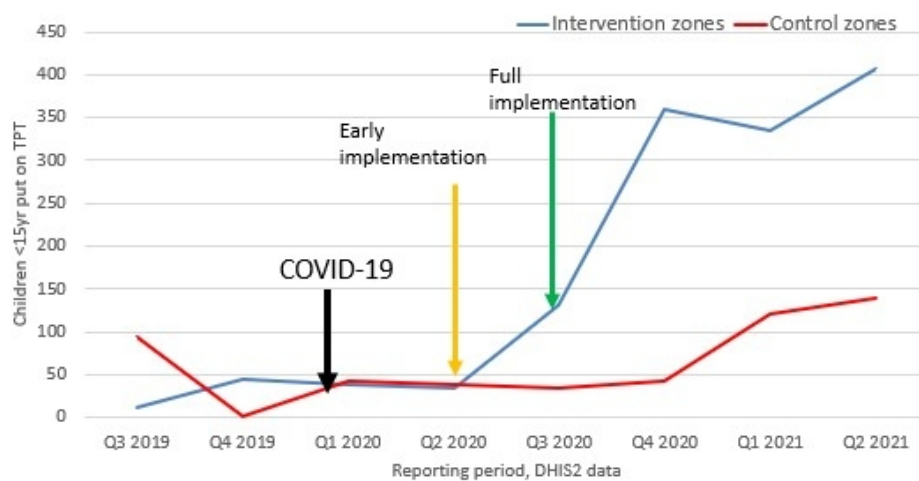
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Diagrammatic representation of the core interventions and key players

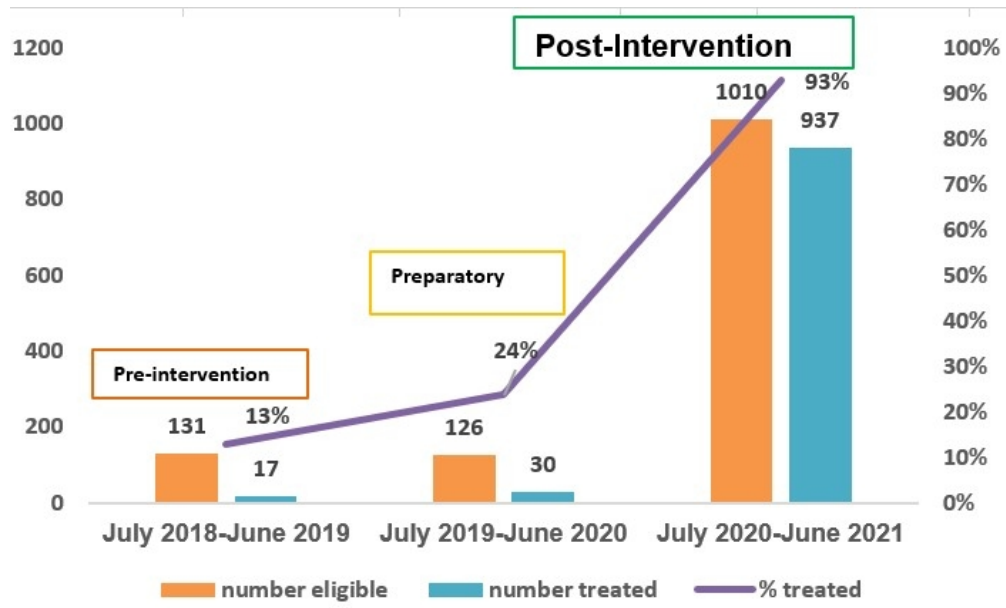
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Trends in the number of eligible U15C put on TPT

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Trends in TPT initiation rate in U5C

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## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	

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<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	6
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	7
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Effectiveness of women-led community interventions in improving tuberculosis preventive treatment in children: results from a comparative, before-after study in Ethiopia

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062298.R2
Article Type:	Original research
Date Submitted by the Author:	14-Jun-2022
Complete List of Authors:	Jerene, Degu; KNCV Tuberculosis Foundation, Assefa, Dawit; KNCV Tuberculosis Foundation, Ethiopia Country Office Tesfaye, Kalkidan; Love in Action Ethiopia Bayu, Samuel; KNCV Tuberculosis Foundation, Ethiopia Office Seid, Samuel; KNCV Tuberculosis Foundation, Ethiopia Country Office Aberra, Fikirte; Southern Nations Nationalities and Peoples' Region Health Bureau Bedru, Ahmed; KNCV Tuberculosis Foundation Khan, Amara; Stop TB Partnership Creswell, Jacob; Stop TB Partnership,
<b>Primary Subject Heading</b>:	Global health
Secondary Subject Heading:	Infectious diseases, Global health
Keywords:	Tuberculosis < INFECTIOUS DISEASES, PUBLIC HEALTH, Community child health < PAEDIATRICS

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3 **1 Effectiveness of women-led community interventions in improving tuberculosis preventive**  
4 **2 treatment in children: results from a comparative, before-after study in Ethiopia**

6 3 Degu Jerene<sup>1\*</sup>, Dawit Assefa<sup>2</sup>, Kalkidan Tesfaye<sup>3</sup>, Samuel Bayu<sup>2</sup>, Samuel Seid<sup>2</sup>, Fikirte Aberra<sup>4</sup>,  
7 4 Ahmed Bedru<sup>2</sup>, Amera Khan<sup>5</sup>, Jacob Creswell<sup>5</sup>

9 5 <sup>1\*</sup> Corresponding author, KNCV Tuberculosis Foundation

11 6 <sup>2</sup> KNCV Tuberculosis Foundation, Addis Ababa, Ethiopia

13 7 <sup>3</sup> Love in Action Ethiopia, Addis Ababa, Ethiopia

15 8 <sup>4</sup> Southern Nations', Nationalities', and Peoples' Regional Health Bureau, Hawassa, Ethiopia

17 9 <sup>5</sup> Stop TB Partnership, Geneva, Switzerland

18 10 \* Corresponding author

20 11 Dr Degu Jerene, KNCV Tuberculosis Foundation, Maanweg 174, 2516 AB Den Haag, Netherlands.  
21 12 email: [degu.dare@kncvtbc.org](mailto:degu.dare@kncvtbc.org) or [degujerene@gmail.com](mailto:degujerene@gmail.com)

23 13 **Key words**

25 14 TB preventive treatment; under-five children; Ethiopia; *Iddirs*; household contacts

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29 16 **Word count**

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20 Abstract

21 **Objectives:** Our objective was to evaluate the impact of a service delivery model led by  
22 membership-based associations called *Iddirs* formed by women on tuberculosis preventive  
23 treatment (TPT) initiation and completion rates among children.

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25 **Design:** Comparative, before-and-after study design

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27 **Setting:** Three intervention and two control districts in Ethiopia

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29 **Participants:** Children who had a history of close contact with adults with infectious forms of  
30 TB. Child contacts in whom active TB and contraindications to TPT regimens were excluded  
31 were considered eligible for TPT.

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33 **Interventions:** Between July 2020-June 2021, trained women *Iddir* members visited households  
34 of index TB patients, screened child household contacts for TB, provided education and  
35 information on the benefits of TPT, linked them to the nearby health center, and followed them  
36 at home for TPT adherence and side effects. Two control zones received the standard of care  
37 which comprised of facility-based provision of TPT to children. We analyzed quarterly TPT data  
38 for treatment initiation and completion and compared intervention and control zones before and  
39 after the interventions and tested for statistical significance using Poisson regression.

40  
41 **Primary and secondary outcome measures:** There were two primary outcome measures:  
42 proportion of eligible children initiated TPT; and proportion completed treatment out of those  
43 eligible.

#### 44 **Results**

45 TPT initiation rate among eligible under-15-year-old children(U15C) increased from 28.7% to  
46 63.05% in the intervention zones while it increased from 34.6% to 43.2% in the control zones,  
47 and the difference was statistically significant ( $p<0.001$ ). TPT initiation rate for under-five year  
48 old children (U5C) increased from 13% (17 out of 131) to 93% (937 out of 1010). Of the U5C  
49 initiated, 99% completed treatment; two discontinued due to side effects; three parents refused to  
50 continue; and one child was lost to follow-up.

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52 **Conclusion:** Women-led *Iddirs* contributed to significant increase in TPT initiation and  
53 completion rates. The model of TPT delivery should be scaled-up.

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55 **Strengths and limitations of this study**

- 56 • We used a double-difference analysis approach substantiated with statistical tests to ascertain  
57 the impact of the interventions.  
58 • Data on the full cascade of care including treatment outcome data was available for all under-  
59 five children included in this study.  
60 • We provide the first report on the beneficial role that engaging *Iddirs*, locally established  
61 community support groups, can have in TB care in Ethiopia.  
62 • Before-after study designs have inherent limitations such as failure to control for other  
63 confounding factors.  
64 • The intervention had several interrelated components making it impossible to attribute  
65 impact to the involvement of *Iddirs* alone.  
66

67

## 68 INTRODUCTION

69 Of the 1.7 billion people estimated to be infected with TB worldwide in 2019, about 80% reside  
70 in South-East Asian, Pacific, and African regions. <sup>1</sup> If the goal of ending TB by 2030 is to be met  
71 <sup>2</sup>, management of TB infection and preventing TB disease should be intensified along with  
72 strengthened efforts to diagnose and treat active disease. <sup>3</sup> Reviews of recent progress, however,  
73 shows a significant lag in achieving globally agreed upon targets. According to the progress  
74 report of the UN high-level meeting (UNHLM) targets, only 21% (6.3 of 30 million) of TB  
75 preventive treatment (TPT) targets were met after 40% of the time has elapsed. Moreover,  
76 achievements varied considerably by population sub-groups: <1% for household contacts older  
77 than 5 years, 20% for contacts under-five (U5C), and 88% for people living with HIV (PLHIV)  
78 making efforts to treat the first two groups of critical importance. <sup>4</sup>

79 In Ethiopia, a high TB burden country missing about a third of estimated 151,000 people who  
80 develop TB each year, <sup>5</sup> treatment of TB infection among children has also been a major area of  
81 concern. The pathway of care for TPT in children usually begins with contact investigation of a  
82 household member with diagnosed TB. Young children are identified and screened for active  
83 disease. If active disease is ruled out, then TPT can be offered. Programmatic data show variable  
84 TPT initiation rates ranging from 13%-64.3% <sup>6</sup>, and treatment completion rates have been either  
85 low or unknown, with some sites reporting as low as 12%. <sup>7</sup> Nevertheless, Ethiopia is among a  
86 few African countries which have made significant progress in increasing TPT. <sup>8</sup> <sup>6</sup> High  
87 treatment completion rates were reported in districts that received additional technical assistance  
88 to the existing health extension program (HEP). <sup>9</sup> These results were achieved through additional  
89 technical and financial support, but sustainably replicating these best practices requires further  
90 work. <sup>9</sup> <sup>10</sup>

91 Of several factors that contribute to the low uptake of TPT in the household contact groups, cost  
92 of travel to health facilities; perceived lack of need for TPT in children among parents; low level  
93 of knowledge among health care workers; stigma; other competing priorities of the family; and  
94 medication related challenges such as pill burden stand out as common barriers. <sup>11</sup> <sup>12</sup> Other factors  
95 include fear of side effects<sup>7</sup>, lack of supplies, and poor recording and reporting practices. <sup>13</sup>  
96 Common themes with the barriers include access and information which may be better addressed  
97 with community-based interventions.

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99 There are successful examples of community-based interventions that helped improve childhood  
100 TB services. In Nepal, for example, intensified community-based case finding strategies led to  
101 improvements in childhood TB case-finding. <sup>14</sup> Similarly, in Uganda, strategies that included  
102 decentralized delivery of TB services through community health workers contributed to 85%  
103 TPT completion rates. <sup>15</sup> In a prospective study in Peru where community-based accompaniment  
104 team of trained community health workers and nurse technicians were involved in a  
105 comprehensive psycho-social supported that included home visits and direct treatment

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3 106 observation, 61 contacts including 35 aged 0-19 years received TPT prescriptions. Of those  
4 107 prescribed TPT 57 received treatment of whom 51 completed the treatment.<sup>16</sup>

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8 109 While Ethiopia demonstrated impressive results in TPT uptake and TB case detection by  
9 110 engaging paid community health workers<sup>9 10 17</sup>, the contribution of volunteer women organized  
10 111 through the government system has been inconsistent<sup>18</sup>. An often-overlooked local support  
11 112 system is the role of indigenous associations such as *Iddirs* in TB control in Ethiopia. *Iddirs* are  
12 113 membership-based local associations of people who have voluntarily entered an agreement to  
13 114 help each other during times of adversities. According to Kloos and Mariam<sup>19</sup>, *Iddirs* are one of  
14 115 the oldest social capital institutions, designed to help reduce poverty by creating a strong  
15 116 network and cooperation among the community and as risk sharing and coping mechanism  
16 117 during economic crises. They are indigenous voluntary associations, mostly unique to Ethiopia,  
17 118 established primarily to provide support in burial matters. Household membership is ensured  
18 119 through payment of monthly fixed contributions. The association raises money whenever death  
19 120 occurs in a household, the amount depending on the specific bylaws.

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23 121 There is no data on the role of *Iddirs* in TB care, but their engagement in HIV care and other  
24 122 social services has been reported.<sup>19 20</sup> Similarly, engaging saving groups has been beneficial for  
25 123 infant feeding practices in Malawi.<sup>21</sup> Studies on the role of *Iddirs* and similar groups in TB care  
26 124 are scarce. We share results from an innovative project that collaborated with *Iddirs* in Ethiopia.  
27 125 Since empowering women is associated with favorable child health outcomes, we selected  
28 126 women-only *Iddirs* as a strategy to empower women in decision making for their children's  
29 127 medical care.<sup>22 23</sup> Our objective was to assess the outcomes of engaging women-only *Iddirs* in  
30 128 TPT uptake in under-five children in selected districts in Ethiopia.

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## 35 36 130 **METHODS**

### 37 38 131 **Study sites**

39 132 We conducted this study in two remote zones, Gamo and Goffa, in the Southern Nations',  
40 133 Nationalities' and Peoples' Region (SNNPR) of Ethiopia, and Addis Ketema sub-city in the  
41 134 capital Addis Ababa. Figure 1 shows a map of Intervention and control Zones.

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44 135 The two zones were selected based on their low TPT coverage and lack of external partner  
45 136 support at the time of project initiation. Gamo and Goffa were under one zonal administration  
46 137 (Gamo Goffa zone) during the planning phase of this project, but they were split into two zones  
47 138 at the beginning of implementation. The two newly formed zones have a combined population of  
48 139 2,202,751 (Gamo 1,544,756 and Goffa 658,005). Addis Ketema is a densely populated slum sub-  
49 140 city with population of 343, 228, and had one of the lowest TPT initiation rates in Addis Ababa,  
50 141 Ethiopia's capital. Gedeo zone from SNNPR (population 1,138,814) and Yeka sub-city  
51 142 (population 415,735) from Addis Ababa served as control zones and were purposefully selected  
52 143 based on their population size, geographic location (distinct and far away from the intervention  
53 144 zones), and similarity in baseline TPT initiation rates.

### 145 **Study design**

146 We used a before-after study design involving three intervention areas and two control areas as  
147 part of a TB REACH project following standardized methodology designed to measure TPT  
148 uptake in under-five children in the selected project sites. As described below, the two control  
149 zones received the standard of care while the intervention zones received the *Iddir* intervention.

### 150 **Study period**

151 Interventions were implemented between July 2020-June 2021.

### 152 **The standard of care**

153 According to national guidelines, TPT services are provided at the health center or hospital level.  
154 Children are offered enrollment in TPT if they present at health facilities as a household contact  
155 of a person with TB and are found not to have active disease. Active search or contact  
156 investigation for eligible child contacts is rarely practiced at community level despite this being  
157 recommended to be part of the package for HEWs. *Iddirs* do not participate in contact  
158 investigation, TPT service facilitation, or other TB services. A six-month course of isoniazid  
159 (INH) (6H) was the only nationally recommended IPT regimen for all eligible children during  
160 the designing phase of this project. Only U5C contacts and people living with HIV were eligible  
161 for TPT until the guideline changed in July 2019 to include children below 15 years of age. At  
162 the same time, the new national recommendations included two additional TPT regimens: a  
163 three-month daily dose of INH and Rifampicin (3HR) and weekly INH and Rifapentine (3HP).

### 164 **Interventions**

165 Figure 2 summarizes the key interventions which encompassed the following components and  
166 roles:

#### 167 **Selection and capacity building of *Iddir* members and focal persons**

168 We first mapped, selected, and conducted capacity building of women only *Iddir* members and  
169 focal persons from each selected district. *Iddir* leaders then nominated two focal persons from  
170 each *Iddir* to liaise with the project. During the selection of the *Iddir* focal persons and the  
171 additional *Iddir* members, the following criteria were used: previous engagement in volunteer  
172 services in the community, ability to read and write, possession of a mobile phone, and good  
173 communication skills. The selected *Iddir* focal persons and members received training on the  
174 basics of TB with a focus on under-five child contact management and TPT. The training  
175 curriculum was customized from the Integrated Refresher Training (IRT) material used for  
176 training HEWs. The IRT is a modular training material aimed at enhancing the knowledge and  
177 skills of HEWs in a wide range of disease prevention and health promotion topics where TB and  
178 HIV are included as one module. In addition to the basic training, they received training on  
179 COVID-19 preventive and personal protective equipment for use during home and health facility  
180 visits. The main trainer was an MSc level trained health officer from KNCV tuberculosis foundation  
181 together with two zonal project coordinators.

182 To ensure proper alignment of the project activities with the existing health system, we  
183 sensitized the district TB coordinators and TB focal persons about the project approaches and got

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3 184 their buy-in for implementation. This was organized as part of a three-day event combined with a  
4 185 project kick-off meeting.

### 6 186 **Active outreach for contact investigation and TPT**

7 187 Each trained *Iddir* focal person selected three additional volunteers, to form a village steering  
8 188 group. The volunteer women conducted home visits to the households with known index  
9 189 pulmonary TB patients based on a list they obtained from the health facility TB focal person.  
10 190 During home visits, volunteers did symptom-based screening using a checklist, or verified if  
11 191 contacts were already screened for TB, with special focus on under-five children. All under-five  
12 192 child contacts received a referral slip to the nearby health center for further evaluation and TPT  
13 193 initiation. The volunteers then cross-checked clinic registers for linkage and initiation of all  
14 194 referred eligible children. The volunteers and clinic TB focal persons made frequent face to face  
15 195 and phone contacts to ensure no eligible child is left unattended. The district and zonal TB  
16 196 officers emphasized linkage and TPT initiation during their quarterly mentoring and supervision  
17 197 meetings. Community mobilizers (one per zone) who were nurses with additional orientation on  
18 198 the project activities provided additional technical guidance and administrative support to the  
19 199 volunteer women. By the end of each week, the volunteer women reported to the community  
20 200 mobilizers on the status of new enrollment and treatment completion rates. Figure 2 describes the  
21 201 core activities of the volunteers and other key contributors.

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27 202 Once a child started TPT, community volunteers continued the follow-up by daily direct home  
28 203 visits, if the home was accessible and near to her district. Otherwise, visits were conducted once  
29 204 or twice per week. Additionally, in areas where mobile network was available, community  
30 205 volunteers sent daily text reminders and phone calls to the mother/guardian to remind them about  
31 206 the daily dose intake. The volunteers used a checklist to monitor children's adherence level and  
32 207 to document any side effects. The project provided airtime and transport costs for the volunteer  
33 208 women. Mothers/guardians of children who completed at least 95% of the recommended doses  
34 209 received a certificate of completion.

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### 38 211 **Strengthen data collection, monitoring, and evaluation**

39 212 Community mobilizers collected weekly progress reports from *Iddir* focal persons, and then  
40 213 aggregated the data and submitted to zonal project coordinators. The zonal project coordinators,  
41 214 after checking for data quality, submitted the report to the central project coordinator for  
42 215 quarterly compilation and reporting. Zonal project coordinators also visited intervention  
43 216 supported health facilities on a quarterly basis to provide onsite support. A key component of this  
44 217 quarterly onsite support included hands-on demonstration and feedback on the use of the  
45 218 nationally approved contact investigation and TPT registers. The intervention organized  
46 219 quarterly review meetings where planning, achievements and challenges were discussed.

### 49 220 **Data sources and analysis**

50 221 We used two data sources for the analysis. The first data source was the District Health  
51 222 Information System (DHIS-2) that compiles routine data for the national health system. Here,  
52 223 age disaggregation was limited to just two categories (<15 year and >=15 year). Also, TPT  
53 224 completion data was not available. Since the DHIS-2 became fully operational only from July  
54 225 2019, we limited our zonal comparative analysis to two time periods: July 2019-June 2020 as



226 pre-intervention and July 2020-June 2021 as post-intervention periods. The variables in the  
227 DHIS-2 database included number of U15C screened, eligible and initiated on TPT. We obtained  
228 the data through the Ministry of Health Ethiopia, DHIS-2 platform. Since the DHIS-2 data was  
229 available both from control and intervention zones, we used this data to demonstrate impact  
230 using the difference-in-difference (DiD) approach.<sup>24</sup>

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232 The second data source was a Microsoft Excel based data collected by project teams from the  
233 intervention sites for U5C contacts. This data contained information extracted from facility  
234 registers since July 2018, then collected and updated prospectively on a monthly basis. The  
235 prospective data collection was done by *Iddir* women who maintained a logbook of every child  
236 identified and linked to the nearby health facility. At the end of every work week, they visited  
237 the health facility and checked the status of every child they referred. With support from the  
238 health facility TB focal person, they extracted the information from the health facility TPT  
239 register using a paper-based data abstraction form. They collected information about the number  
240 of children screened, eligible and initiated TPT, and reported to the community mobilizers on a  
241 weekly basis who in turn compiled the data in a monthly reporting format and submitted to a  
242 central coordinator. This data was not available for the control zones. As a result, data analysis  
243 from this source focused on trends in TPT improvement over three time periods: July 2018-June  
244 2019 as pre-intervention; July 2019-June 2020 as preparatory; and July 2020-2021 as post-  
245 intervention.

246 The key variables collected and analyzed included the standard cascade of contact investigation:

- 247 • **Eligible:** screened children in whom active TB was excluded and contraindications for  
248 TPT ruled out
- 249 • **Initiated:** eligible children who started TPT
- 250 • **Completed:** successful completion was defined as 80% of the recommended doses taken  
251 within 120% of planned TPT duration, or 90% of recommended doses used within 133%  
252 of planned TPT duration according to the national guideline. The number of  
253 recommended doses were 12 for 3HP; 84 for 3HR; and 168 for 6H. Completion status  
254 was ascertained by the community volunteers based on their weekly treatment follow-up  
255 records cross-checked with the clinic TPT register.

256 We calculated total numbers and proportion of eligible children initiated TPT; and number and  
257 proportion of initiated children who successfully completed treatment (for the U5C group only).  
258 Eligibility for TPT was based on the national guideline as described under the standard of care  
259 above.

260 We used Microsoft Excel to compile, analyze, and describe quarterly TPT initiation data before  
261 and after the intervention. We presented the results in tables and displayed visually in graphs. In  
262 our DiD analysis, we used pictorial comparison of the directionality of change in key variables  
263 and calculated differences in numbers and percentages. To test for statistical significance, we  
264 performed Poisson regression analysis in SPSS version 25 using count data for eligible and  
265 initiated children as dependent variables, and *Iddir* interventions and pre-post periods as

266 predictors.<sup>25</sup> Statistical significance was set at  $p < 0.05$  and the results were presented as  
267 exponential beta values with 95% confidence interval (95%CI).

### 268 ***Ethics considerations***

269 Although ethics approval was not needed for the aggregate data analysis, the study was reviewed  
270 and approved by Ethics Committees of Addis Ababa (ID-2793/227) and SNNP Regional Health  
271 Bureaus (ID-RDG-4-3054) because we intended to analyze side effect profiles of the new drugs  
272 based on individual patient data. The health facility data was accessed with full permission of the  
273 heads of health facilities.

### 275 **Patient and public involvement**

276 Patients and other members of the public were not involved in the conception and design of the  
277 study. We will disseminate the summary of final study results translated into the local language  
278 to the local community through the district TB- officers.

## 280 **RESULTS**

### 281 **Characteristics of *Iddirs***

282 We identified 67 women-only *Iddirs* in the three project zones, 42 in Gamo, 15 in Goffa and 10  
283 in Addis Ketema. Seven of the 10 *Iddirs* in Addis Ketema sub city were involved in childcare,  
284 five in wedding services, and three in HIV care support. However, only two of the 42 *Iddirs* in  
285 Gamo and one of the 15 *Iddirs* in Goffa were involved in non-funeral activities at baseline. None  
286 of these *Iddirs* was involved in TB care at baseline.

### 288 **Trends in the number of index TB patients notified**

289 The number of all forms of TB notified declined both in the intervention and control zones.  
290 There was an 11.8% decline in the intervention zones, from 2021 at baseline to 1783 post-  
291 intervention. The decline in the control zones was less dramatic (2.3%)—from 2589 at baseline  
292 to 2529 post-intervention.

### 293 **Improvements in the number of eligible U15C children enrolled and initiated**

294 The number of U15C contacts screened in intervention zones increased from 351 at baseline to  
295 1620 during the intervention which was a 361% increase. In the control zones, the increase was  
296 just by 53.6%, from 567 to 871. Similarly, the number of eligible U15C enrolled in the  
297 intervention zones increased from 320 at baseline to 1550 post-intervention (nearly 5-fold  
298 increase). In the control zones, the increase in the number of eligible U15C enrollment was just  
299 by 52%. While the overall improvement in additional eligible patients enrolled was dramatic  
300 (964 overall difference), the improvement in the intervention sub-city in Addis Ababa was lower  
301 than that of the control sub-city. Table 1 summarizes the differences and percentage changes in  
302 improvement.

303 Table 1. The difference-in-difference analysis of eligible U15C enrolled and treated before and  
 304 after the intervention

Region	Intervention			Control		
	Eligible	Initiated	% Initiated	Eligible	Initiated	% Initiated
<b>Addis Ababa</b>						
Before	156	33	21.1	43	6	13.9
After	234	181	77.3	98	58	59.2
Difference (%)	78 (+50%)	148 (+448%)	56.2 (+266%)	55 (+128%)	52 (+866%)	45.3 (+326%)
<b>SNNPR</b>						
Before	164	59	35.9	466	170	36.5
After	1316	796	60.4	677	277	40.9
Difference (%)	1152 (+702%)	737 (+1249%)	24.5 (+68.2%)	211 (+45%)	107 (+63%)	3.5 (+9.6%)
<b>Total</b>						
Before	320	92	28.7	509	176	34.6
After	1550	977	63.05	775	335	43.2
Difference (%)	1230 (+384%)	885 (+963%)	42.6 (+148%)	266 (+52%)	159 (+90.3%)	8.6 (+24.9%)

305 Legend: In this table, “before” refers to the period July 2019-June 2020 while after refers to the period July 2020-June 2021.

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307 The overall rate of TPT initiation in the intervention zones increased from 28.7% to 63.5%.  
 308 Despite increments in the number of eligible children aged 5-14 years from 194 to 540 in the  
 309 intervention zones, the TPT initiation rate for this age group declined from 31.9% (62/194) at  
 310 baseline to 7.4% (40/540) post-intervention. In the control districts, the overall TPT initiation  
 311 rate increased from 34.6% to just 43.2%. There was regional variation with the control sub-city  
 312 in Addis Ababa having the highest per centage point improvement in TPT initiation rate (Table  
 313 1).

314 As clearly shown in Figure 3, TPT initiation rates started to be visibly different between  
 315 intervention and control districts starting from the second quarter of 2020 which coincided with  
 316 the deployment of zonal project officers and the baseline assessment. In the third quarter of  
 317 2020, the difference became even wider.

318 Results from the Poisson regression analyses are presented in Table 2 and show significantly  
 319 higher number of eligible and initiated children, and the rate of initiation was more than 10 times  
 320 higher in the intervention zones after the intervention [Exp ( $\beta$ ), (95% CI) =10.62 (8.58, 13.15);  
 321  $p < 0.001$ ].

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Table 2. Poisson regression analysis showing the impact of *Iddir* interventions on the number of eligible children and those initiated on TPT.

Factors	Eligible	Initiated
	Exp ( $\beta$ ) [ 95% CI]	Exp ( $\beta$ ) [ 95% CI]
<b>Control zones</b>		
Time period (after versus before)	1.52 [1.36, 1.70]	1.90 [1.59, 2.28]
Region (SNNPR versus Addis Ababa)	8.11 [6.81, 9.66]	6.99 [5.37, 9.08]
<b>Intervention zones</b>		
Time period (after versus before)	4.84 [4.29, 5.46]	10.62 [8.58, 13.15]
Region (SNNPR versus Addis Ababa)	3.79 [3.39, 4.24]	3.99 [3.44, 4.64]
<b>Combined zones</b>		
<i>Iddir</i> intervention (yes versus no)	1.46 [1.36, 1.56]	2.09 [1.88, 2.32]
Time period (after versus before)	2.80 [2.59, 3.04]	4.89 [4.29, 5.58]
Region (SNNPR versus Addis Ababa)	4.94 [4.50, 5.42]	4.68 [4.11, 5.33]

P<0.001 for all factors

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The number of eligible U5C children enrolled during the pre-intervention period was 131; slightly declined to 126 during the preparatory phase; and then increased dramatically to 1,010 during the post-intervention period. The proportion of U5C among all eligible children enrolled in the intervention zones increased from 39% (126/320) to 65% (1010/1550). Similarly, taking July 2019-June 2020 as a common baseline for intervention zones, U5C constituted only 33% of those initiated TPT at baseline (30 out of 92), but increased to 96% (937 out of 977) post-intervention. The TPT initiation rate for U5C improved steadily from 13% during the pre-intervention period, to 24% during the preparatory phase, and then to 93% during the post-intervention period. (Figure 4).

Of 937 U5C initiated, 872 (93.1%) received 3RH, 45 (4.8%) 6H, and 20 (2.1%) 3HP. Treatment outcome status was available for all the 937 U5C, of whom 99% successfully completed treatment. Treatment was discontinued in two children who had side effects. Three parents refused to continue treatment because they were not convinced why their apparently healthy child needed treatment. Only one child was lost to follow-up.

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**DISCUSSION**

We provide the first report on the beneficial role that engaging *Iddirs*, locally established community support groups, can have in TB care in Ethiopia. We found that despite a general upwards trend in TPT enrolment in both groups, children in the intervention zone had uptake and acceptance rates that were several times higher than those of control zones. TPT initiation among eligible U5C more than quadrupled after the intervention, and 99% of these children were treated successfully. The results highlight that volunteer women mobilized through *Iddirs* can serve as additional support to the health system in improving TPT services in the community. This new model of care has a potential for further scale-up in Ethiopia for TB but also other health issues that may require a greater involvement of community care rather than medicalized approaches.

The observed improvement in TPT service uptake sparks an important question about the place of *Iddirs* in a country where the HEWs are believed to be the anchors of the community health system. Despite improvements the HEWs brought about, several challenges were identified including low productivity and efficiency; poor working and living conditions of HEWs; limited capacity of health posts; and socio-economic factors of cross-cutting nature.<sup>26</sup> While the HEWs will remain the pillar of Ethiopia's community-based health services, additional results obtained by engaging volunteer groups highlights potential synergies that can be achieved through such interventions. Earlier studies demonstrated that HEWs can be more effective when they receive adequate technical and financial support through well-organized mechanisms.<sup>9 10</sup> The evidence from our study adds a fresh perspective that indigenous groups such as *Iddirs* as time-tested social capitals can serve as a more sustainable addition to the existing arsenal against TB.

Until recently, *Iddirs* were reluctant to be involved in development activities due to fear of state interference.<sup>19</sup> Financial constraints due to high rates of HIV associated death among young people forced *Iddirs* to consider alternative sources of income including letting their properties and engaging in development activities. Subsequently, they became more and more involved in issues beyond funeral support which was their focus initially. A study in Addis Ababa showed several beneficial roles *Iddirs* play including emotional support, experience sharing, creating opportunities for social interaction, and improving leadership roles.<sup>27</sup> In our study at least 30% of those selected in Addis Ababa were active in HIV related activities which suggests the continued role *Iddirs* play in the HIV response in major urban areas. Even more striking is the finding that 70% of the *iddirs* were reportedly involved in childcare in Addis Ababa which shows their evolving focus as the country's health priorities shift.

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Despite clear and much greater improvements in TPT initiation rates between intervention and control zones, the 63.05% TPT initiation rate among children below 15 years of age is still suboptimal and could be due to several reasons. First, the primary target groups of this project were under-five children according to the prevailing national guidelines. The expanded age group was nationally approved only after the project was launched and hence it took some time until all sites came on board. In addition, the analysis was based on the routine health system

389 data which was still in transition to incorporate the updated indicators which may have led to  
390 some data quality issues. Nevertheless, the 93% TPT initiation rate achieved among under-five  
391 child contacts in the intervention zones clearly supports the impact of the intervention for service  
392 uptake among the intended target beneficiaries. In 2018, nationally reported programmatic data  
393 showed TPT initiation rate of 51.6% in under-five children.<sup>6</sup>

394 In other African settings TPT uptake rates are dismally low. A recent report from South Africa,  
395 for example, shows that only 0.5% of household contacts received TPT.<sup>28</sup> A systematic review  
396 that included 24 studies on TPT initiation rate showed that TPT initiation rates among all under-  
397 five children screened ranged from 2.3% to 100%. However, nine of the 24 studies reported that  
398 less than a half of the screened children initiated TPT.<sup>12</sup> Further in this review, one of the two  
399 studies that reported a 100% TPT initiation rate was from Ethiopia in which the full cascade of  
400 care was not described, precluding us from making conclusions about the proportion initiated  
401 TPT among eligible children.<sup>7</sup> In fact, this study from Ethiopia with TPT completion rate of  
402 12% was the very study that prompted us to look for additional interventions to improve the poor  
403 performance of TPT in the country. Similarly, the Indian study which was reported to have a  
404 TPT initiation rate of 100% had missed 39% of the children at screening; they initially identified  
405 71 (81%) of the 87 child contacts, screened 53 of the 71, and then put all the 53 on TPT.<sup>29</sup>  
406 Therefore, the 93% TPT initiation rate among all eligible U5C contacts in our study is on the  
407 high end even compared with globally reported rates. Moreover, since the focus of our  
408 intervention was U5C, the higher rate of initiation among the U5C compared with the rate among  
409 the U15C clearly shows the impact of the interventions.

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411 The TPT success rate of 99% in this study is perhaps the highest ever reported unless proven  
412 otherwise through systematic reviews. In a previous TB REACH project that utilized a  
413 community-based approach through HEWs, 91.7% of child contacts completed a six-month  
414 course of TPT.<sup>9</sup> In another project that employed comprehensive health facility-based support,  
415 treatment completion rate of 6H among child contacts was 80.3%.<sup>30</sup> The shorter treatment  
416 regimen used in our study can explain only part of the difference as even in a European setting  
417 where shorter treatment regimens were used, treatment completion rate among foreign-born  
418 patients was 92%.<sup>31</sup> A recent systematic review and meta-analysis of TPT initiation and  
419 completion rates among migrants in low TB incidence countries showed that only 52% of those  
420 who initiated completed treatment.<sup>32</sup>

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422 The difference in performance rates between the urban (Addis Ababa) and rural (SNNPR)  
423 intervention sites is worth discussing. The lesser increase in the number of eligible patients  
424 enrolled in Addis Ababa could be related to the higher impact of COVID-19 due to stricter  
425 restriction of activities implemented especially during the first wave of the pandemic.<sup>33</sup> Also, the  
426 *Iddirs* in Addis Ababa were already busy with other competing social activities as shown in our  
427 baseline assessment.

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3 429 Our results should be interpreted cautiously because of some limitations. We cannot demonstrate  
4 430 causality of the *Iddir* intervention as it was not a randomized trial design. Before-after study  
5 431 designs have inherent limitations such as failure to control for other confounding factors such as  
6 432 general health system support in the area.<sup>34</sup> Since the intervention had several interrelated  
7 433 components such as mentoring and supervision by zonal project officers, involvement of  
8 434 community mobilizers and the additional support received from health workers in the catchment  
9 435 health facilities, it is not possible to make effect attribution to involvement of *Iddirs* alone.  
10 436 Improved recording and reporting of U5C in the intervention zones may have led to apparent  
11 437 improvement in TPT enrollment. However, improvement in recording and reporting practices  
12 438 that followed the national recommendation to expand the age limit for TPT initiation may have  
13 439 led to sustaining TPT initiation and completion rates in control zones, counterbalancing the  
14 440 possible information bias introduced by the intervention. One can also argue a potential positive  
15 441 impact of change in national guidelines, but our results clearly show relative increase in the  
16 442 proportion of U5C enrolled further confirming the impact of the intervention. As the temporal  
17 443 relationship between the intervention and the outcomes show visible impact of the combination  
18 444 of interventions, it is highly probable that the *Iddir* intervention made a clear difference as visual  
19 445 evidence is a valid way of making inferences in DiD analysis.<sup>35</sup>

## 24 446 **CONCLUSION**

25 447 This is the first comprehensive report of the beneficial role of *Iddirs* in TB program  
26 448 implementation in Ethiopia. Engaging women *Iddir* members contributed to demonstrable  
27 449 increase in TPT initiation rates and high treatment success rates among under-five children in  
28 450 two rural zones and in a slum sub-city in Ethiopia. These results were achieved in the face of an  
29 451 unprecedented COVID-19 pandemic and subsequent measures that hampered health service  
30 452 uptake in the country. The results suggest the untapped potential of social networks such as  
31 453 *Iddirs* in supporting the health system to improve TB service uptake in high TB burden settings.

32 454 A more rigorous evaluation and further refinement of the intervention is needed to scale up the  
33 455 approach. Qualitative studies should also be planned to better understand the various intervention  
34 456 subcomponents which contributed to achieving higher TPT initiation and completion rates post-  
35 457 intervention. The role of other indigenous associations both in Ethiopia and in other high TB  
36 458 burden settings should be studied. Further work is needed to better understand how this model of  
37 459 intervention can be sustained without external financial and technical support.

## 40 460 **CONTRIBUTORSHIP STATEMENT**

41 461 DJ designed the study, acquired resources, supervised implementation, analyzed the data, wrote  
42 462 the first and subsequent drafts and approved the final version. DA supervised data collection and  
43 463 implementation, contributed to analysis, reviewed the first and subsequent drafts, and approved  
44 464 the final version. KT, SB, and SS collected data, trained health workers and community  
45 465 volunteers, supervised community and health facility workers, reviewed the draft manuscript,  
46 466 and approved the final version. FA and AB oversaw implementation, supervised data collection,  
47 467 reviewed the first and subsequent drafts and approved the final version. AK and JC contributed  
48 468 to data analysis, reviewed the first and subsequent drafts and approved the final version.

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3 469 The contents of the article are the responsibility of the authors alone and do not necessarily  
4 470 reflect the views of donors or employers of the authors.  
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8 472 **COMPETING INTERESTS**

9 473 We declare we have no competing interest.  
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12 475 **FUNDING**

13  
14 476 This project was funded by the STOP TB Partnership under TB REACH Wave 7. The grant  
15 477 number was STBP/TBREACH/GSA/W7-8044.  
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18 478 **DATA SHARING STATEMENT**

19 479 Aggregate data will be available for sharing immediately after publication.  
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21 480



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3 574 **FIGURE LEGEND**  
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5 575 Figure 1: Map of study sites  
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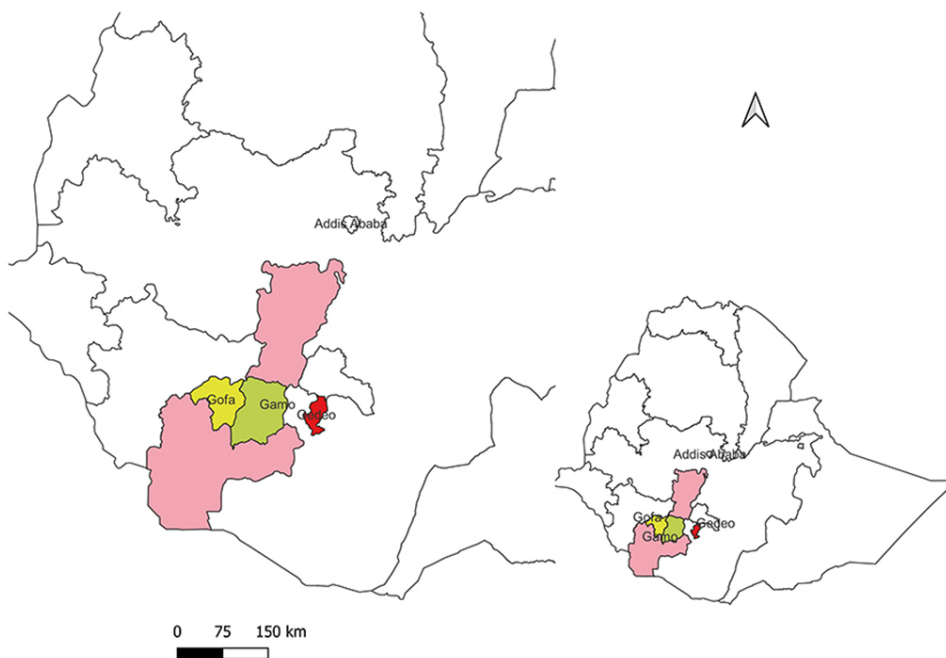
7 576 Figure 2: Schematic representation of the core interventions and key players  
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9 577 Figure 3: Trends in the number of U15C put on TPT  
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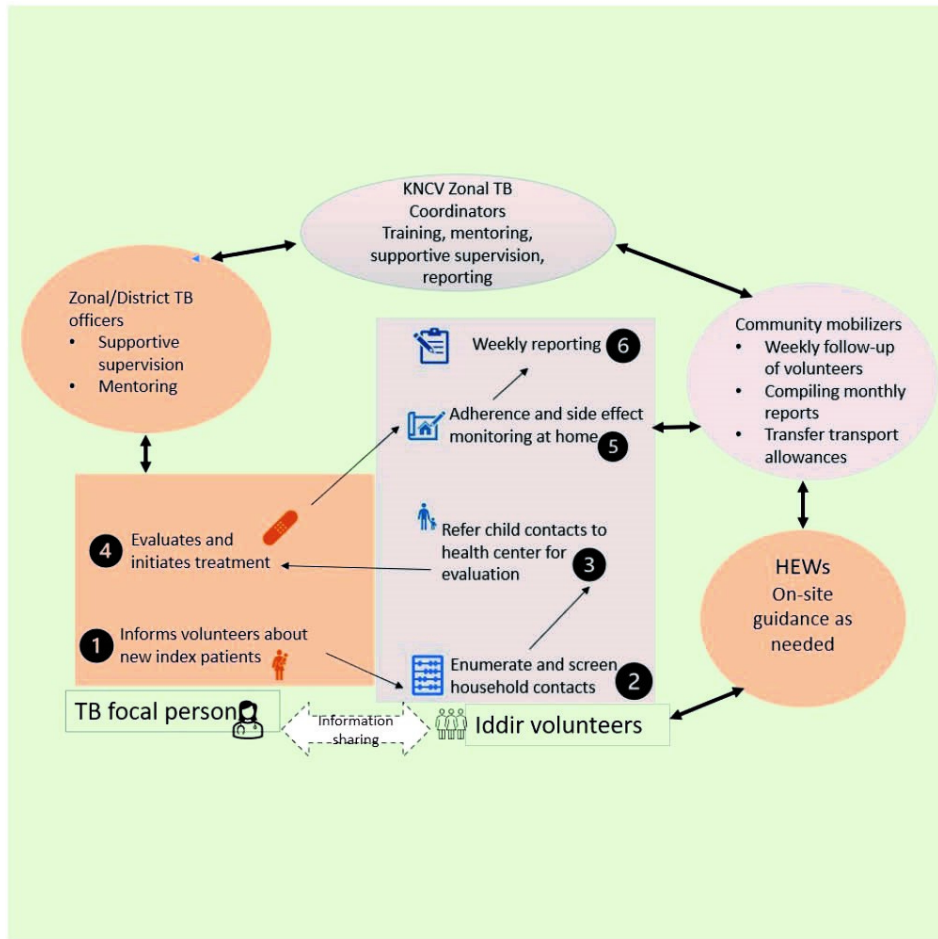
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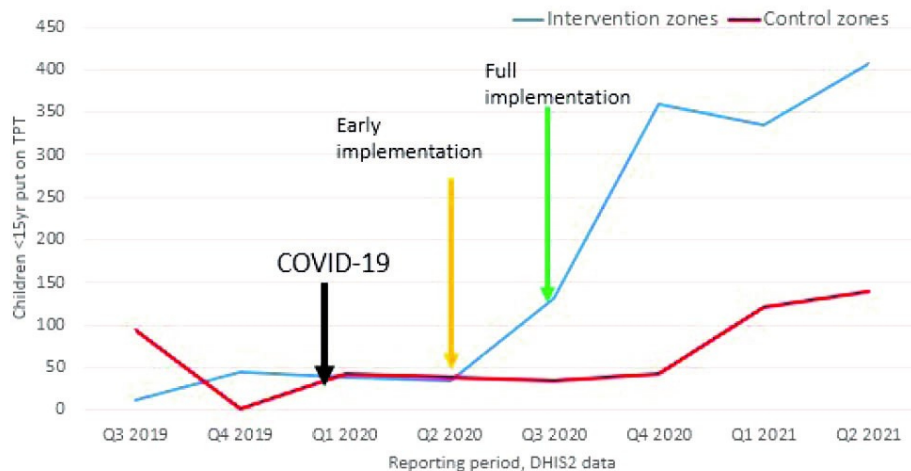
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Schematic representation of the core interventions and key players

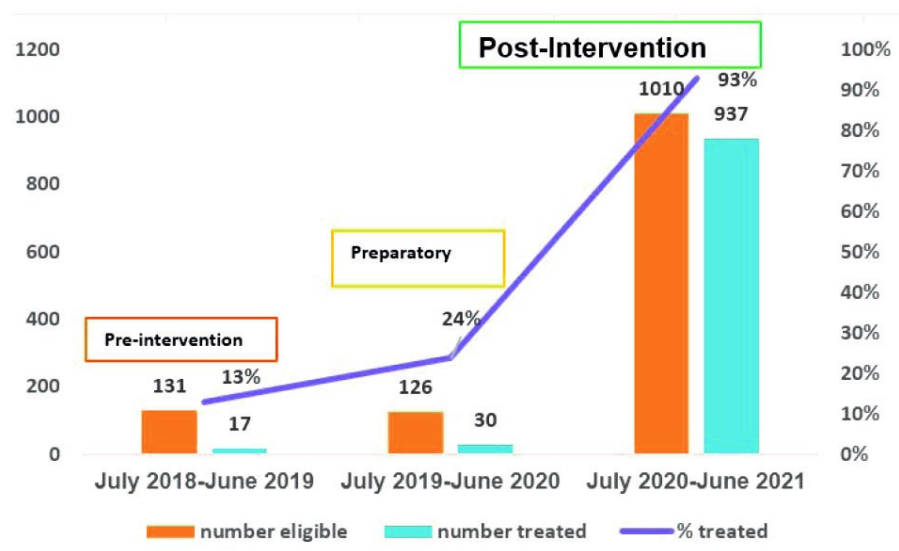
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Trends in the number of U15C put on TPT

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Trends in TPT initiation rate in U5C

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## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	8
	(c) Explain how missing data were addressed	n/a	
	(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	n/a	
	(e) Describe any sensitivity analyses		

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-9
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	n/a
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	n/a
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	n/a
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
		(b) Report category boundaries when continuous variables were categorized	n/a
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a

**Discussion**

Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10 & 12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12

**Other information**

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15
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\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Effectiveness of women-led community interventions in improving tuberculosis preventive treatment in children: results from a comparative, before-after study in Ethiopia

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062298.R3
Article Type:	Original research
Date Submitted by the Author:	05-Jul-2022
Complete List of Authors:	Jerene, Degu; KNCV Tuberculosis Foundation, Assefa, Dawit; KNCV Tuberculosis Foundation, Ethiopia Country Office Tesfaye, Kalkidan; Love in Action Ethiopia Bayu, Samuel; KNCV Tuberculosis Foundation, Ethiopia Office Seid, Samuel; KNCV Tuberculosis Foundation, Ethiopia Country Office Aberra, Fikirte; Southern Nations Nationalities and Peoples' Region Health Bureau Bedru, Ahmed; KNCV Tuberculosis Foundation Khan, Amara; Stop TB Partnership Creswell, Jacob; Stop TB Partnership,
<b>Primary Subject Heading</b>:	Global health
Secondary Subject Heading:	Infectious diseases, Global health
Keywords:	Tuberculosis < INFECTIOUS DISEASES, PUBLIC HEALTH, Community child health < PAEDIATRICS

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1 **Effectiveness of women-led community interventions in improving tuberculosis preventive**  
2 **treatment in children: results from a comparative, before-after study in Ethiopia**

3 Degu Jerene<sup>1\*</sup>, Dawit Assefa<sup>2</sup>, Kalkidan Tesfaye<sup>3</sup>, Samuel Bayu<sup>2</sup>, Samuel Seid<sup>2</sup>, Fikirte Aberra<sup>4</sup>,  
4 Ahmed Bedru<sup>2</sup>, Amera Khan<sup>5</sup>, Jacob Creswell<sup>5</sup>

5 <sup>1\*</sup> Corresponding author, KNCV Tuberculosis Foundation

6 <sup>2</sup> KNCV Tuberculosis Foundation, Addis Ababa, Ethiopia

7 <sup>3</sup> Love in Action Ethiopia, Addis Ababa, Ethiopia

8 <sup>4</sup> Southern Nations', Nationalities', and Peoples' Regional Health Bureau, Hawassa, Ethiopia

9 <sup>5</sup> Stop TB Partnership, Geneva, Switzerland

10 \* Corresponding author

11 Dr Degu Jerene, KNCV Tuberculosis Foundation, Maanweg 174, 2516 AB Den Haag, Netherlands.  
12 email: [degu.dare@kncvtbc.org](mailto:degu.dare@kncvtbc.org) or [degujerene@gmail.com](mailto:degujerene@gmail.com)

13 **Key words**

14 TB preventive treatment; under-five children; Ethiopia; *Iddirs*; household contacts

16 **Word count**

17 4156

19

20 Abstract

21 **Objectives:** Our objective was to evaluate the impact of a service delivery model led by  
22 membership-based associations called *Iddirs* formed by women on tuberculosis preventive  
23 treatment (TPT) initiation and completion rates among children.

24  
25 **Design:** Comparative, before-and-after study design

26  
27 **Setting:** Three intervention and two control districts in Ethiopia

28  
29 **Participants:** Children who had a history of close contact with adults with infectious forms of  
30 TB. Child contacts in whom active TB and contraindications to TPT regimens were excluded  
31 were considered eligible for TPT.

32  
33 **Interventions:** Between July 2020-June 2021, trained women *Iddir* members visited households  
34 of index TB patients, screened child household contacts for TB, provided education and  
35 information on the benefits of TPT, linked them to the nearby health center, and followed them  
36 at home for TPT adherence and side effects. Two control zones received the standard of care  
37 which comprised of facility-based provision of TPT to children. We analyzed quarterly TPT data  
38 for treatment initiation and completion and compared intervention and control zones before and  
39 after the interventions and tested for statistical significance using Poisson regression.

40  
41 **Primary and secondary outcome measures:** There were two primary outcome measures:  
42 proportion of eligible children initiated TPT; and proportion completed treatment out of those  
43 eligible.

#### 44 **Results**

45 TPT initiation rate among eligible under-15-year-old children(U15C) increased from 28.7% to  
46 63.05% in the intervention zones while it increased from 34.6% to 43.2% in the control zones,  
47 and the difference was statistically significant ( $p<0.001$ ). TPT initiation rate for under-five year  
48 old children (U5C) increased from 13% (17 out of 131) to 93% (937 out of 1010). Of the U5C  
49 initiated, 99% completed treatment; two discontinued due to side effects; three parents refused to  
50 continue; and one child was lost to follow-up.

51  
52 **Conclusion:** Women-led *Iddirs* contributed to significant increase in TPT initiation and  
53 completion rates. The model of TPT delivery should be scaled-up.

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3 55 **Strengths and limitations of this study**

- 4 56 • We used a double-difference analysis approach substantiated with statistical tests to ascertain  
5 57 the impact of the interventions.  
6  
7 58 • Data on the full cascade of care including treatment outcome data was available for all under-  
8 59 five children included in this study.  
9  
10 60 • We provide the first report on the beneficial role that engaging *Iddirs*, locally established  
11 61 community support groups, can have in TB care in Ethiopia.  
12 62 • Before-after study designs have inherent limitations such as failure to control for other  
13 63 confounding factors.  
14 64 • The intervention had several interrelated components making it impossible to attribute  
15 65 impact to the involvement of *Iddirs* alone.  
16 66

67

## 68 INTRODUCTION

69 Of the 1.7 billion people estimated to be infected with TB worldwide in 2019, about 80% reside  
70 in South-East Asian, Pacific, and African regions. <sup>1</sup> If the goal of ending TB by 2030 is to be met  
71 <sup>2</sup>, management of TB infection and preventing TB disease should be intensified along with  
72 strengthened efforts to diagnose and treat active disease. <sup>3</sup> Reviews of recent progress, however,  
73 show a significant lag in achieving globally agreed upon targets. According to the progress  
74 report of the UN high-level meeting (UNHLM) targets, only 21% (6.3 of 30 million) of TB  
75 preventive treatment (TPT) targets were met after 40% of the time has elapsed. Moreover,  
76 achievements varied considerably by population sub-groups: <1% for household contacts older  
77 than 5 years, 20% for contacts under-five (U5C), and 88% for people living with HIV (PLHIV)  
78 making efforts to treat the first two groups of critical importance. <sup>4</sup>

79 In Ethiopia, a high TB burden country missing about a third of estimated 151,000 people who  
80 develop TB each year, <sup>5</sup> treatment of TB infection among children has also been a major area of  
81 concern. The pathway of care for TPT in children usually begins with contact investigation of a  
82 household member with diagnosed TB. Young children are identified and screened for active  
83 disease. If active disease is ruled out, then TPT can be offered. Programmatic data show variable  
84 TPT initiation rates ranging from 13%-64.3% <sup>6</sup>, and treatment completion rates have been either  
85 low or unknown, with some sites reporting as low as 12%. <sup>7</sup> Nevertheless, Ethiopia is among a  
86 few African countries which have made significant progress in increasing TPT. <sup>8</sup> <sup>6</sup> High  
87 treatment completion rates were reported in districts that received additional technical assistance  
88 to the existing health extension program (HEP). <sup>9</sup> These results were achieved through additional  
89 technical and financial support, but sustainably replicating these best practices requires further  
90 work. <sup>9</sup> <sup>10</sup>

91 Of several factors that contribute to the low uptake of TPT in the household contact groups, cost  
92 of travel to health facilities; perceived lack of need for TPT in children among parents; low level  
93 of knowledge among health care workers; stigma; other competing priorities of the family; and  
94 medication related challenges such as pill burden stand out as common barriers.<sup>11</sup> <sup>12</sup> Other factors  
95 include fear of side effects<sup>7</sup>, lack of supplies, and poor recording and reporting practices.<sup>13</sup>  
96 Common themes with the barriers include access and information which may be better addressed  
97 with community-based interventions.

98 There are successful examples of community-based interventions that helped improve childhood  
99 TB services. In Nepal, for example, intensified community-based case finding strategies led to  
100 improvements in childhood TB case-finding. <sup>14</sup> Similarly, in Uganda, strategies that included  
101 decentralized delivery of TB services through community health workers contributed to 85%  
102 TPT completion rates. <sup>15</sup> In a prospective study in Peru where community-based accompaniment  
103 team of trained community health workers and nurse technicians were involved in a  
104 comprehensive psycho-social support that included home visits and direct treatment observation,  
105 61 contacts including 35 aged 0-19 years received TPT prescriptions. Of those prescribed TPT  
106 57 received treatment of whom 51 completed the treatment. <sup>16</sup>

107

108 While Ethiopia demonstrated impressive results in TPT uptake and TB case detection by  
109 engaging paid community health workers<sup>9 10 17</sup>, the contribution of volunteer women organized  
110 through the government system has been inconsistent<sup>18</sup>. An often-overlooked local support  
111 system is the role of indigenous associations such as *Iddirs* in TB control in Ethiopia. *Iddirs* are  
112 membership-based local associations of people who have voluntarily entered an agreement to  
113 help each other during times of adversities. According to Kloos and Mariam<sup>19</sup>, *Iddirs* are one of  
114 the oldest social capital institutions, designed to help reduce poverty by creating a strong  
115 network and cooperation among the community and as risk sharing and coping mechanism  
116 during economic crises. They are indigenous voluntary associations, mostly unique to Ethiopia,  
117 established primarily to provide support in burial matters. Household membership is ensured  
118 through payment of monthly fixed contributions. The association raises money whenever death  
119 occurs in a household, the amount depending on the specific bylaws.

120 There is no data on the role of *Iddirs* in TB care, but their engagement in HIV care and other  
121 social services has been reported.<sup>19 20</sup> Similarly, engaging saving groups has been beneficial for  
122 infant feeding practices in Malawi.<sup>21</sup> Studies on the role of *Iddirs* and similar groups in TB care  
123 are scarce. We share results from an innovative project that collaborated with *Iddirs* in Ethiopia.  
124 Since empowering women is associated with favorable child health outcomes, we selected  
125 women-only *Iddirs* as a strategy to empower women in decision making for their children's  
126 medical care.<sup>22 23</sup> Our objective was to assess the outcomes of engaging women-only *Iddirs* in  
127 TPT uptake in under-five children in selected districts in Ethiopia.

128

## 129 **METHODS**

### 130 **Study sites**

131 We conducted this study in two remote zones, Gamo and Goffa, in the Southern Nations',  
132 Nationalities' and Peoples' Region (SNNPR) of Ethiopia, and Addis Ketema sub-city in the  
133 capital Addis Ababa. Figure 1 shows a map of Intervention and control Zones.

134 The two zones were selected based on their low TPT coverage and lack of external partner  
135 support at the time of project initiation. Gamo and Goffa were under one zonal administration  
136 (Gamo Goffa zone) during the planning phase of this project, but they were split into two zones  
137 at the beginning of implementation. The two newly formed zones have a combined population of  
138 2,202,751 (Gamo 1,544,756 and Goffa 658,005). Addis Ketema is a densely populated slum sub-  
139 city with population of 343, 228, and had one of the lowest TPT initiation rates in Addis Ababa,  
140 Ethiopia's capital. Gedeo zone from SNNPR (population 1,138,814) and Yeka sub-city  
141 (population 415,735) from Addis Ababa served as control zones and were purposefully selected  
142 based on their population size, geographic location (distinct and far away from the intervention  
143 zones), and similarity in baseline TPT initiation rates.

### 144 **Study design**



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3 145 We used a before-after study design involving three intervention areas and two control areas as  
4 146 part of a TB REACH project following standardized methodology designed to measure TPT  
5 147 uptake in under-five children in the selected project sites. As described below, the two control  
6 148 zones received the standard of care while the intervention zones received the *Iddir* intervention.

### 9 149 **Study period**

10 150 Interventions were implemented between July 2020-June 2021.

### 12 151 **The standard of care**

13 152 According to the national guidelines, TPT services are provided at the health center or hospital  
14 153 level. Children are offered enrollment in TPT if they present at health facilities as a household  
15 154 contact of a person with TB and are found not to have active disease. Active search or contact  
16 155 investigation for eligible child contacts is rarely practiced at community level despite this being  
17 156 recommended to be part of the package for health extension workers (HEWs). *Iddirs* do not  
18 157 participate in contact investigation, TPT service facilitation, or other TB services. A six-month  
19 158 course of isoniazid (INH) (6H) was the only nationally recommended IPT regimen for all  
20 159 eligible children during the designing phase of this project. Only U5C contacts and people living  
21 160 with HIV were eligible for TPT until the guideline changed in July 2019 to include children  
22 161 below 15 years of age. At the same time, the new national recommendations included two  
23 162 additional TPT regimens: a three-month daily dose of INH and Rifampicin (3HR) and weekly  
24 163 INH and Rifapentine (3HP).

### 29 164 **Interventions**

30 165 Figure 2 summarizes the key interventions which encompassed the following components and  
31 166 roles:

#### 34 167 **Selection and capacity building of *Iddir* members and focal persons**

35 168 We first mapped, selected, and conducted capacity building of women-only *Iddir* members and  
36 169 focal persons from each selected district. *Iddir* leaders then nominated two focal persons from  
37 170 each *Iddir* to liaise with the project. During the selection of the *Iddir* focal persons and the  
38 171 additional *Iddir* members, the following criteria were used: previous engagement in volunteer  
39 172 services in the community, ability to read and write, possession of a mobile phone, and good  
40 173 communication skills. The selected *Iddir* focal persons and members received training on the  
41 174 basics of TB with a focus on under-five child contact management and TPT. The training  
42 175 curriculum was customized from the Integrated Refresher Training (IRT) material used for  
43 176 training HEWs. The IRT is a modular training material aimed at enhancing the knowledge and  
44 177 skills of HEWs in a wide range of disease prevention and health promotion topics where TB and  
45 178 HIV are included as one module. In addition to the basic training, they received training on  
46 179 COVID-19 preventive and personal protective equipment for use during home and health facility  
47 180 visits. The main trainer was an MSc level trained health officer from KNCV tuberculosis foundation  
48 181 together with two zonal project coordinators.

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53 182 To ensure proper alignment of the project activities with the existing health system, we  
54 183 sensitized the district TB coordinators and TB focal persons about the project approaches and got

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3 184 their buy-in for implementation. This was organized as part of a three-day event combined with a  
4 185 project kick-off meeting.

### 6 186 **Active outreach for contact investigation and TPT**

7 187 Each trained *Iddir* focal person selected three additional volunteers, to form a village steering  
8 188 group. The volunteer women conducted home visits to the households with known index  
9 189 pulmonary TB patients based on a list they obtained from the health facility TB focal person.  
10 190 During home visits, volunteers did symptom-based screening using a checklist, or verified if  
11 191 contacts were already screened for TB, with special focus on under-five children. All under-five  
12 192 child contacts received a referral slip to the nearby health center for further evaluation and TPT  
13 193 initiation. The volunteers then cross-checked clinic registers for linkage and initiation of all  
14 194 referred eligible children. The volunteers and clinic TB focal persons made frequent face to face  
15 195 and phone contacts to ensure no eligible child is left unattended. The district and zonal TB  
16 196 officers emphasized linkage and TPT initiation during their quarterly mentoring and supervision  
17 197 meetings. Community mobilizers (one per zone) who were nurses with additional orientation on  
18 198 the project activities provided additional technical guidance and administrative support to the  
19 199 volunteer women. By the end of each week, the volunteer women reported to the community  
20 200 mobilizers on the status of new enrollment and treatment completion rates. Figure 2 describes the  
21 201 core activities of the volunteers and other key contributors.

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27 202 Once a child started TPT, community volunteers continued the follow-up by daily direct home  
28 203 visits, if the home was accessible and close to her home. Otherwise, visits were conducted once  
29 204 or twice per week. Additionally, in areas where mobile network was available, community  
30 205 volunteers sent daily text reminders and phone calls to the mothers/guardians to remind them  
31 206 about the daily dose intake. The volunteers used a checklist to monitor children's adherence level  
32 207 and to document any side effects. The project provided airtime and transport costs for the  
33 208 volunteer women. Mothers/guardians of children who completed at least 95% of the  
34 209 recommended doses received a certificate of completion.

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### 38 211 **Strengthen data collection, monitoring, and evaluation**

39 212 Community mobilizers collected weekly progress reports from *Iddir* focal persons, and then  
40 213 aggregated the data and submitted to zonal project coordinators. The zonal project coordinators,  
41 214 after checking for data quality, submitted the report to the central project coordinator for  
42 215 quarterly compilation and reporting. Zonal project coordinators also visited intervention  
43 216 supported health facilities on a quarterly basis to provide onsite support. A key component of this  
44 217 quarterly onsite support included hands-on demonstration and feedback on the use of the  
45 218 nationally approved contact investigation and TPT registers. The intervention organized  
46 219 quarterly review meetings where planning, achievements and challenges were discussed.

### 49 220 **Data sources and analysis**

50 221 We used two data sources for the analysis. The first data source was the District Health  
51 222 Information System (DHIS-2) that compiles routine data for the national health system. Here,  
52 223 age disaggregation was limited to just two categories (<15 year and >=15 year). Also, TPT  
53 224 completion data was not available. Since the DHIS-2 became fully operational only from July  
54 225 2019, we limited our zonal comparative analysis to two time periods: July 2019-June 2020 as  
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226 pre-intervention and July 2020-June 2021 as post-intervention periods. The variables in the  
227 DHIS-2 database included number of U15C screened, eligible and initiated on TPT. We obtained  
228 the data through the Ministry of Health of Ethiopia, DHIS-2 platform. Since the DHIS-2 data  
229 was available both from control and intervention zones, we used this data to demonstrate impact  
230 using the difference-in-difference (DiD) approach.<sup>24</sup>

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232 The second data source was a Microsoft Excel based data collected by project teams from the  
233 intervention sites for U5C contacts. This data contained information extracted from facility  
234 registers since July 2018, then collected and updated prospectively on a monthly basis. The  
235 prospective data collection was done by *Iddir* women who maintained a logbook of every child  
236 identified and linked to the nearby health facility. At the end of every work week, they visited  
237 the health facility and checked the status of every child they referred. With support from the  
238 health facility TB focal person, they extracted the information from the health facility TPT  
239 register using a paper-based data abstraction form. They collected information about the number  
240 of children screened, eligible and initiated TPT, and reported to the community mobilizers on a  
241 weekly basis who in turn compiled the data in a monthly reporting format and submitted to a  
242 central coordinator. This data was not available for the control zones. As a result, data analysis  
243 from this source focused on trends in TPT improvement over three time periods: July 2018-June  
244 2019 as pre-intervention; July 2019-June 2020 as preparatory; and July 2020-2021 as post-  
245 intervention.

246 The key variables collected and analyzed included the standard cascade of contact investigation:

- 247 • **Eligible:** screened children in whom active TB was excluded and contraindications for  
248 TPT ruled out
- 249 • **Initiated:** eligible children who started TPT
- 250 • **Completed:** successful completion was defined as 80% of the recommended doses taken  
251 within 120% of planned TPT duration, or 90% of recommended doses used within 133%  
252 of planned TPT duration according to the national guideline. The number of  
253 recommended doses were 12 for 3HP; 84 for 3HR; and 168 for 6H. Completion status  
254 was ascertained by the community volunteers based on their weekly treatment follow-up  
255 records cross-checked with the clinic TPT register.

256 We calculated total numbers and proportion of eligible children initiated TPT; and number and  
257 proportion of initiated children who successfully completed treatment (for the U5C group only).  
258 Eligibility for TPT was based on the national guideline as described under the standard of care  
259 above.

260 We used Microsoft Excel to compile, analyze, and describe quarterly TPT initiation data before  
261 and after the intervention. We presented the results in tables and displayed visually in graphs. In  
262 our DiD analysis, we used pictorial comparison of the directionality of change in key variables  
263 and calculated differences in numbers and percentages. To test for statistical significance, we  
264 performed Poisson regression analysis in SPSS version 25 using count data for eligible and  
265 initiated children as dependent variables, and *Iddir* interventions, region, and pre-post periods as

266 predictors.<sup>25</sup> Statistical significance was set at  $p < 0.05$  and the results were presented as  
267 exponential beta values with 95% confidence interval (95%CI).

### 268 ***Ethics considerations***

269 Although ethics approval was not needed for the aggregate data analysis, the study was reviewed  
270 and approved by Ethics Committees of Addis Ababa (ID-2793/227) and SNNP Regional Health  
271 Bureaus (ID-RDG-4-3054) because we intended to analyze side effect profiles of the new drugs  
272 based on individual patient data. The health facility data was accessed with full permission of the  
273 heads of health facilities.

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### 275 **Patient and public involvement**

276 Patients and other members of the public were not involved in the conception and design of the  
277 study. We will disseminate the summary of final study results translated into the local language  
278 to the local community through the district TB- officers.

279

## 280 **RESULTS**

### 281 **Characteristics of *Iddirs***

282 We identified 67 women-only *Iddirs* in the three project zones, 42 in Gamo, 15 in Goffa and 10  
283 in Addis Ketema. Seven of the 10 *Iddirs* in Addis Ketema sub city were involved in childcare,  
284 five in wedding services, and three in HIV care support. However, only two of the 42 *Iddirs* in  
285 Gamo and one of the 15 *Iddirs* in Goffa were involved in non-funeral activities at baseline. None  
286 of these *Iddirs* was involved in TB care at baseline.

### 287 **Trends in the number of index TB patients notified**

288 The number of all forms of TB notified declined both in the intervention and control zones.  
289 There was an 11.8% decline in the intervention zones, from 2021 at baseline to 1783 post-  
290 intervention. The decline in the control zones was less dramatic (2.3%)—from 2589 at baseline  
291 to 2529 post-intervention.

### 292 **Improvements in the number of eligible U15C children enrolled and initiated**

293 The number of U15C contacts screened in intervention zones increased from 351 at baseline to  
294 1620 during the intervention which was a 361% increase. In the control zones, the increase was  
295 just by 53.6%, from 567 to 871. Similarly, the number of eligible U15C enrolled in the  
296 intervention zones increased from 320 at baseline to 1550 post-intervention (nearly 5-fold  
297 increase). In the control zones, the increase in the number of eligible U15C enrollment was just  
298 by 52%. While the overall improvement in additional eligible patients enrolled was dramatic  
299 (964 overall difference), the improvement in the intervention sub-city in Addis Ababa was lower  
300 than that of the control sub-city. Table 1 summarizes the differences and percentage changes in  
301 improvement.

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305 Table 1. The difference-in-difference analysis of eligible U15C enrolled and treated before and  
 306 after the intervention

Region	Intervention			Control		
	Eligible	Initiated	% Initiated	Eligible	Initiated	% Initiated
<b>Addis Ababa</b>						
Before	156	33	21.1	43	6	13.9
After	234	181	77.3	98	58	59.2
Difference (%)	78 (+50%)	148 (+448%)	56.2 (+266%)	55 (+128%)	52 (+866%)	45.3 (+326%)
<b>SNNPR</b>						
Before	164	59	35.9	466	170	36.5
After	1316	796	60.4	677	277	40.9
Difference (%)	1152 (+702%)	737 (+1249%)	24.5 (+68.2%)	211 (+45%)	107 (+63%)	3.5 (+9.6%)
<b>Total</b>						
Before	320	92	28.7	509	176	34.6
After	1550	977	63.05	775	335	43.2
Difference (%)	1230 (+384%)	885 (+963%)	42.6 (+148%)	266 (+52%)	159 (+90.3%)	8.6 (+24.9%)

307 Legend: In this table, "before" refers to the period July 2019-June 2020 while after refers to the period July 2020-June 2021.

308 The overall rate of TPT initiation in the intervention zones increased from 28.7% to 63.5%.  
 309 Despite increments in the number of eligible children aged 5-14 years from 194 to 540 in the  
 310 intervention zones, the TPT initiation rate for this age group declined from 31.9% (62/194) at  
 311 baseline to 7.4% (40/540) post-intervention. In the control districts, the overall TPT initiation  
 312 rate increased from 34.6% to just 43.2%. There was regional variation with the control sub-city  
 313 in Addis Ababa having the highest per centage point improvement in TPT initiation rate (Table  
 314 1).

315 As clearly shown in Figure 3, TPT initiation rates started to be visibly different between  
 316 intervention and control districts starting from the second quarter of 2020 which coincided with  
 317 the deployment of zonal project officers and the baseline assessment. In the third quarter of  
 318 2020, the difference became even wider.

319 Results from the Poisson regression analyses are presented in Table 2 and show significantly  
 320 higher number of eligible and initiated children, and the number initiated was more than 10 times  
 321 higher in the intervention zones after the intervention [Exp ( $\beta$ ), (95% CI) =10.62 (8.58, 13.15);  
 322  $p < 0.001$ ].

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330 Table 2. Adjusted Poisson regression analyses showing the impact of *Iddir* interventions on the  
 331 number of eligible children and those initiated on TPT.

Factors	Eligible	Initiated
	Exp ( $\beta$ ) [ 95% CI]	Exp ( $\beta$ ) [ 95% CI]
Time period (after versus before)	1.52 [1.36, 1.70]	1.90 [1.59, 2.28]
Region (SNNPR versus Addis Ababa)	8.11 [6.81, 9.66]	6.99 [5.37, 9.08]
<b>Intervention zones</b>		
Time period (after versus before)	4.84 [4.29, 5.46]	10.62 [8.58, 13.15]
Region (SNNPR versus Addis Ababa)	3.79 [3.39, 4.24]	3.99 [3.44, 4.64]
<b>Combined zones</b>		
<i>Iddir</i> intervention (yes versus no)	1.46 [1.36, 1.56]	2.09 [1.88, 2.32]
Time period (after versus before)	2.80 [2.59, 3.04]	4.89 [4.29, 5.58]
Region (SNNPR versus Addis Ababa)	4.94 [4.50, 5.42]	4.68 [4.11, 5.33]

332 P<0.001 for all factors

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334 The number of eligible U5C children enrolled during the pre-intervention period was 131;  
 335 slightly declined to 126 during the preparatory phase; and then increased dramatically to 1,010  
 336 during the post-intervention period. The proportion of U5C among all eligible children enrolled  
 337 in the intervention zones increased from 39% (126/320) to 65% (1010/1550). Similarly, taking  
 338 July 2019-June 2020 as a common baseline for intervention zones, U5C constituted only 33% of  
 339 those initiated TPT at baseline (30 out of 92), but increased to 96% (937 out of 977) post-  
 340 intervention. The TPT initiation rate for U5C improved steadily from 13% during the pre-  
 341 intervention period, to 24% during the preparatory phase, and then to 93% during the post-  
 342 intervention period. (Figure 4).

343 Of 937 U5C initiated, 872 (93.1%) received 3RH, 45 (4.8%) 6H, and 20 (2.1%) 3HP. Treatment  
 344 outcome status was available for all the 937 U5C, of whom 99% successfully completed  
 345 treatment. Treatment was discontinued in two children who had side effects. Three parents  
 346 refused to continue treatment because they were not convinced why their apparently healthy  
 347 child needed treatment. Only one child was lost to follow-up.

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351 **DISCUSSION**

352 We provide the first report on the beneficial role that engaging *Iddirs*, locally established  
353 community support groups, can have in TB care in Ethiopia. We found that despite a general  
354 upwards trend in TPT enrolment in both groups, children in the intervention zone had uptake and  
355 acceptance rates that were several times higher than those of control zones. TPT initiation among  
356 eligible U5C more than quadrupled after the intervention, and 99% of these children were treated  
357 successfully. The results highlight that volunteer women mobilized through *Iddirs* can serve as  
358 additional support to the health system in improving TPT services in the community. This new  
359 model of care has a potential for further scale-up in Ethiopia for TB but also other health issues  
360 that may require a greater involvement of community care rather than medicalized approaches.

361 The observed improvement in TPT service uptake sparks an important question about the place  
362 of *Iddirs* in a country where the HEWs are believed to be the anchors of the community health  
363 system. Despite improvements the HEWs brought about, several challenges were identified  
364 including low productivity and efficiency; poor working and living conditions of HEWs; limited  
365 capacity of health posts; and socio-economic factors of cross-cutting nature.<sup>26</sup> While the HEWs  
366 will remain the pillar of Ethiopia's community-based health services, additional results obtained  
367 by engaging volunteer groups highlights potential synergies that can be achieved through such  
368 interventions. Earlier studies demonstrated that HEWs can be more effective when they receive  
369 adequate technical and financial support through well-organized mechanisms.<sup>9 10</sup> The evidence  
370 from our study adds a fresh perspective that indigenous groups such as *Iddirs* as time-tested  
371 social capitals can serve as a more sustainable addition to the existing arsenal against TB.

372 Until recently, *Iddirs* were reluctant to be involved in development activities due to fear of state  
373 interference.<sup>19</sup> Financial constraints due to high rates of HIV associated death among young  
374 people forced *Iddirs* to consider alternative sources of income including letting their properties  
375 and engaging in development activities. Subsequently, they became more and more involved in  
376 issues beyond funeral support which was their focus initially. A study in Addis Ababa showed  
377 several beneficial roles *Iddirs* play including emotional support, experience sharing, creating  
378 opportunities for social interaction, and improving leadership roles.<sup>27</sup> In our study at least 30%  
379 of those selected in Addis Ababa were active in HIV related activities which suggests the  
380 continued role *Iddirs* play in the HIV response in major urban areas. Even more striking is the  
381 finding that 70% of the *Iddirs* were reportedly involved in childcare in Addis Ababa which  
382 shows their evolving focus as the country's health priorities shift.

383 Despite clear and much greater improvements in TPT initiation rates between intervention and  
384 control zones, the 63.05% TPT initiation rate among children below 15 years of age is still  
385 suboptimal and could be due to several reasons. First, the primary target groups of this project  
386 were under-five children according to the prevailing national guidelines. In addition, the analysis  
387 was based on the routine health system data which was still in transition to incorporate the  
388 updated indicators which may have led to some data quality issues. Nevertheless, the 93% TPT  
389 initiation rate achieved among under-five child contacts in the intervention zones clearly

390 supports the impact of the intervention for service uptake among the intended target  
391 beneficiaries. In 2018, nationally reported programmatic data showed TPT initiation rate of  
392 51.6% in under-five children.<sup>6</sup>

393 In other African settings TPT uptake rates are dismally low. A recent report from South Africa,  
394 for example, shows that only 0.5% of household contacts received TPT.<sup>28</sup> A systematic review  
395 that included 24 studies on TPT initiation rate showed that TPT initiation rates among all under-  
396 five children screened ranged from 2.3% to 100%. However, nine of the 24 studies reported that  
397 less than a half of the screened children initiated TPT.<sup>12</sup> Further in this review, one of the two  
398 studies that reported a 100% TPT initiation rate was from Ethiopia in which the full cascade of  
399 care was not described, precluding us from making conclusions about the proportion initiated  
400 TPT among eligible children.<sup>7</sup> In fact, this study from Ethiopia with TPT completion rate of  
401 12% was the very study that prompted us to look for additional interventions to improve the poor  
402 performance of TPT in the country. Similarly, the Indian study which was reported to have a  
403 TPT initiation rate of 100% had missed 39% of the children at screening; they initially identified  
404 71 (81%) of the 87 child contacts, screened 53 of the 71, and then put all the 53 on TPT.<sup>29</sup>  
405 Therefore, the 93% TPT initiation rate among all eligible U5C contacts in our study is on the  
406 high end even compared with globally reported rates. Moreover, since the focus of our  
407 intervention was U5C, the higher rate of initiation among the U5C compared with the rate among  
408 the U15C clearly shows the impact of the interventions.

409 The TPT success rate of 99% in this study is perhaps the highest ever reported unless proven  
410 otherwise through systematic reviews. In a previous TB REACH project that utilized a  
411 community-based approach through HEWs, 91.7% of child contacts completed a six-month  
412 course of TPT.<sup>9</sup> In another project that employed comprehensive health facility-based support,  
413 treatment completion rate of 6H among child contacts was 80.3%.<sup>30</sup> The shorter treatment  
414 regimen used in our study can explain only part of the difference as even in a European setting  
415 where shorter treatment regimens were used, treatment completion rate among foreign-born  
416 patients was 92%.<sup>31</sup> A recent systematic review and meta-analysis of TPT initiation and  
417 completion rates among migrants in low TB incidence countries showed that only 52% of those  
418 who initiated completed treatment.<sup>32</sup>

419 The difference in performance rates between the urban (Addis Ababa) and rural (SNNPR)  
420 intervention sites is worth discussing. The lesser increase in the number of eligible patients  
421 enrolled in Addis Ababa could be related to the higher impact of COVID-19 due to stricter  
422 restriction of activities implemented especially during the first wave of the pandemic.<sup>33</sup> Also, the  
423 *Iddirs* in Addis Ababa were already busy with other competing social activities as shown in our  
424 baseline assessment.

425 Our results should be interpreted cautiously because of some limitations. We cannot demonstrate  
426 causality of the *Iddir* intervention as it was not a randomized trial design. Before-after study  
427 designs have inherent limitations such as failure to control for other confounding factors such as  
428 general health system support in the area.<sup>34</sup> Since the intervention had several interrelated  
429 components such as mentoring and supervision by zonal project officers, involvement of  
430 community mobilizers and the additional support received from health workers in the catchment



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3 431 health facilities, it is not possible to make effect attribution to involvement of *Iddirs* alone.  
4 432 Improved recording and reporting of U5C in the intervention zones may have led to apparent  
5 433 improvement in TPT enrollment. However, improvement in recording and reporting practices  
6 434 that followed the national recommendation to expand the age limit for TPT initiation may have  
7 435 led to sustaining TPT initiation and completion rates in control zones, counterbalancing the  
8 436 possible information bias introduced by the intervention. One can also argue about a potential  
9 437 positive impact of change in national guidelines, but our results clearly show relative increase in  
10 438 the proportion of U5C enrolled further confirming the impact of the intervention. It is also highly  
11 439 probable that the *Iddir* intervention made a clear difference as visual evidence shown in the  
12 440 graphs is a valid way of making inferences in DiD analysis,<sup>35</sup> which was further confirmed by  
13 441 the statistical tests.

## 17 442 **CONCLUSION**

19 443 This is the first comprehensive report of the beneficial role of *Iddirs* in TB program  
20 444 implementation in Ethiopia. Engaging women *Iddir* members contributed to demonstrable  
21 445 increase in TPT initiation rates and high treatment success rates among under-five children in  
22 446 two rural zones and in a slum sub-city in Ethiopia. These results were achieved in the face of an  
23 447 unprecedented COVID-19 pandemic and subsequent measures that hampered health service  
24 448 uptake in the country. The results suggest the untapped potential of social networks such as  
25 449 *Iddirs* in supporting the health system to improve TB service uptake in high TB burden settings.

28 450 A more rigorous evaluation and further refinement of the intervention is needed to scale up the  
29 451 approach. Qualitative studies should also be planned to better understand the various intervention  
30 452 subcomponents which contributed to achieving higher TPT initiation and completion rates post-  
31 453 intervention. The role of other indigenous associations both in Ethiopia and in other high TB  
32 454 burden settings should be studied. Further work is needed to better understand how this model of  
33 455 intervention can be sustained without external financial and technical support.

## 37 456 **CONTRIBUTORSHIP STATEMENT**

39 457 DJ designed the study, acquired resources, supervised implementation, analyzed the data, wrote  
40 458 the first and subsequent drafts and approved the final version. DA supervised data collection and  
41 459 implementation, contributed to analysis, reviewed the first and subsequent drafts, and approved  
42 460 the final version. KT, SB, and SS collected data, trained health workers and community  
43 461 volunteers, supervised community and health facility workers, reviewed the draft manuscript,  
44 462 and approved the final version. FA and AB oversaw implementation, supervised data collection,  
45 463 reviewed the first and subsequent drafts and approved the final version. AK and JC contributed  
46 464 to data analysis, reviewed the first and subsequent drafts and approved the final version.

49 465 The contents of the article are the responsibility of the authors alone and do not necessarily  
50 466 reflect the views of donors or employers of the authors.

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## 54 468 **COMPETING INTERESTS**

56 469 We declare we have no competing interest.

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4 471 **FUNDING**

6 472 This project was funded by the STOP TB Partnership under TB REACH Wave 7. The grant  
7 number was STBP/TBREACH/GSA/W7-8044.  
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9 474 **DATA SHARING STATEMENT**

11 475 Aggregate data will be available for sharing immediately after publication.  
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3 570 **FIGURE LEGEND**  
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5 571 Figure 1: Map of study sites  
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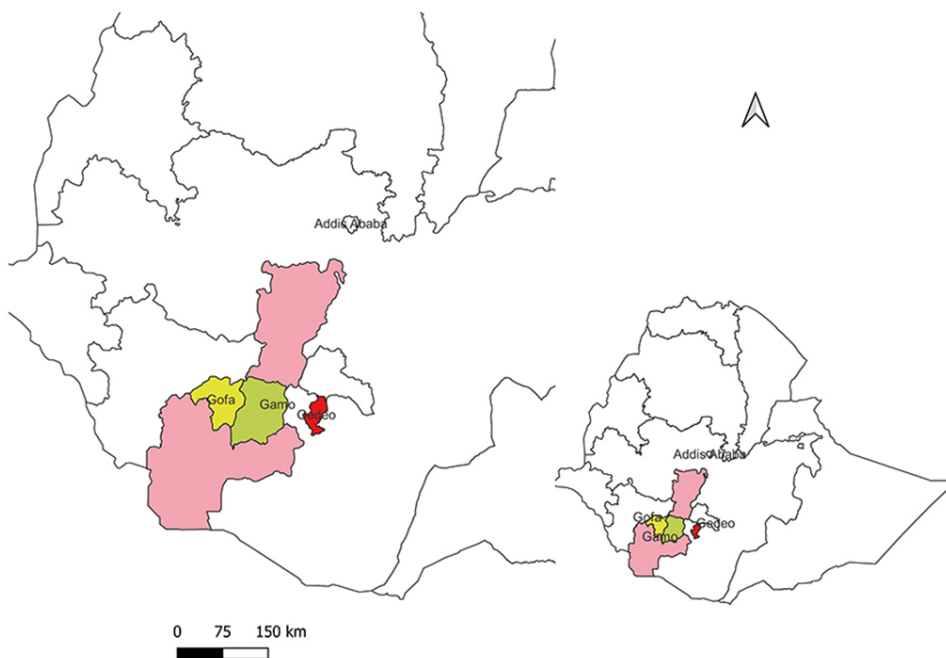
7 572 Figure 2: Schematic representation of the core interventions and key players  
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9 573 Figure 3: Trends in the number of U15C put on TPT  
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11 574 Figure 4: Trends in TPT initiation rate in U5C  
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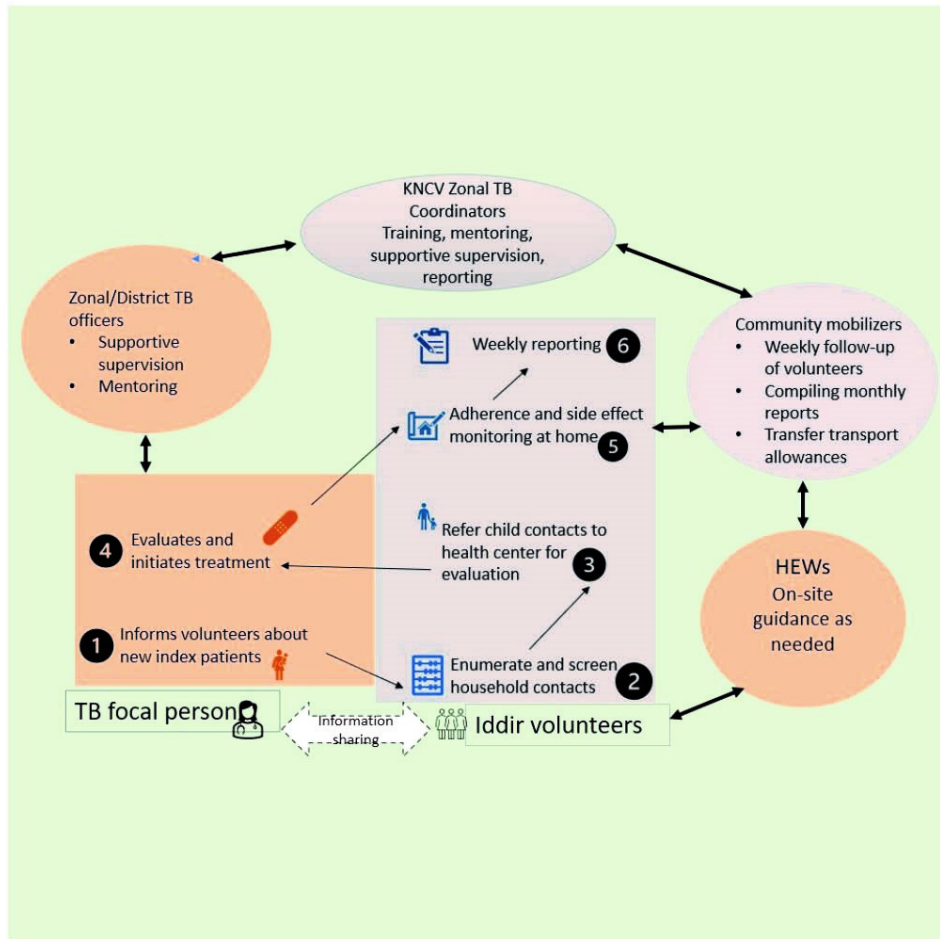
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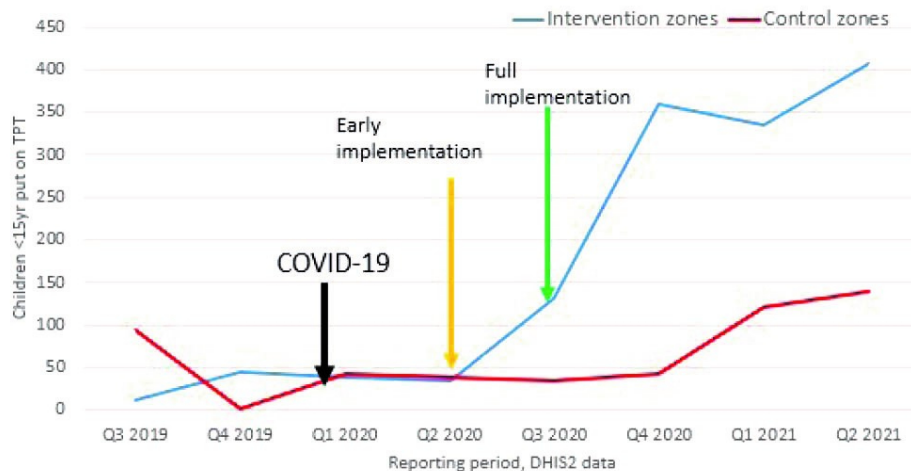
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Schematic representation of the core interventions and key players

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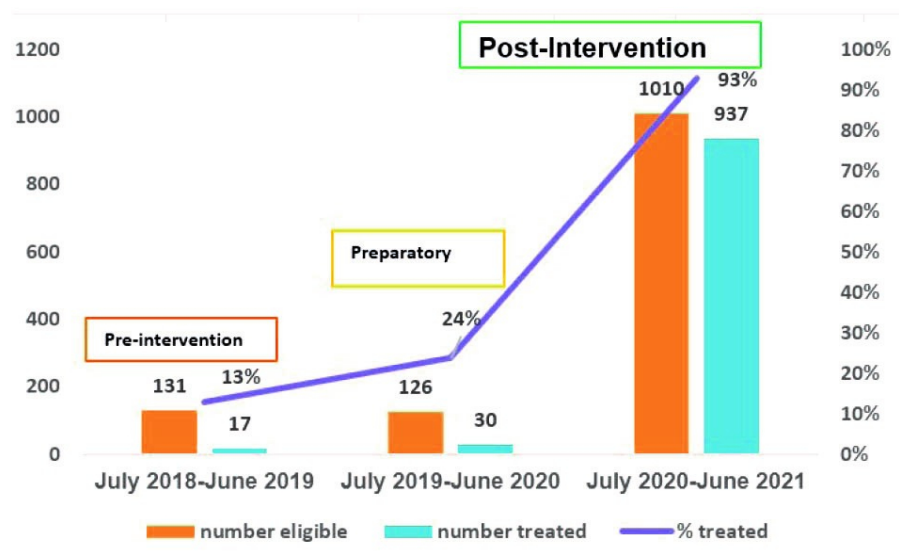


Trends in the number of U15C put on TPT

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Trends in TPT initiation rate in U5C

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## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	8
	(c) Explain how missing data were addressed	n/a	
	(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	n/a	
	(e) Describe any sensitivity analyses		

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-9
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	n/a
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	n/a
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	n/a
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
		(b) Report category boundaries when continuous variables were categorized	n/a
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a

**Discussion**

Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10 & 12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12

**Other information**

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15
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\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).