TB Report 2019

TB Surveillance Data from Seven Hospitals of Department of Health (DoHe-CTA)

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My daughter, Ms. Tenzin Chodon reran the STATA "do file" to check the codes and verified the numbers in the tables.
I wish to thank Mr. Nawang Tsundue Singhe for proof reading, editing, verifying the numbers in the tables of SECTION THREE of the document and for his valuable suggestions

Preface

In September 2020, I was commissioned to write the Department of Health (DoHe-CTA) Tuberculosis (TB) Report for the year 2019. To maintain continuity from the previous report i.e. "A Report on Analysis of TB Surveillance Data from Seven Hospitals of Department of Health, Central Tibetan Administration 2012 – 2018 (Volume 2)", data for the year 2012 – 2018 is revisited and updated in this report. It was found that Mainpat had misreported data for few years and Kollegal had not reported a MDR case in 2018.

The current report is also based on secondary data analysis of line-listed TB program management data from seven DoHe-CTA surveillance hospitals. SECTION 1 gives an overview of the socio-demographic characteristics. SECTION 2 looks at the data related to TB drug sensitivity testing (DST) and drug resistance patterns based on molecular tests (Gene Xpert/CBNAAT) and sputum smear culture & drug sensitivity testing (C & DST). Four GeneXpert machines (Cephid) are available with DoHe-CTA and they are based at Delek hospital in Dharamsala, DTR hospital in Mundgod, Tso-jhe hospital in Bylakuppe and Dekyiling health centre. Culture and Drug Sensitivity Testing (C & DST) is outsourced to Hinduja hospital in Mumbai. SECTIONS 3 is a reproduction of the advocacy paper I have written on the relevance and benefits of mitigating overcrowding and improving housing conditions (indoor air quality) with special reference to TB in Tibetan residential schools during and after COVID-19 pandemic. The role of overcrowding and poor housing conditions (indoor air quality) in the spread of the COVID-19 has become evident from events that unfolded all over the world since the report of the first case of COVID-19 from Wuhan (China). I feel that there is a lesson to be learned from it for TB control.

The data is cleaned, managed and analysed in STATA 11.0 software. And STATA "do file", cleaned data in STATA file and raw data in MS Excel/CSV format are available for review if any one wishes to conduct one. Using the STATA software, data is cleaned in two steps. Some of the data (e.g. removing duplications) could be performed without having to refer to the printed database i.e. TB Register and TB Treatment cards. Email and telephone medium were used for further cleaning e.g. missing values and doubtful data entries.

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SECTION ONE

TB Program Performance Indicators and Situational Analysis - 2019

The increase in TB cases in 2019 as compared to 2018 could be mainly due to increase in case detection in the monastery population on account of "Zero TB project" activities that was initiated in South India in 2019. However, if we look at 2019 data for only Tibetans, TB cases reported in 2019 had decreased. After disaggregating the data by occupation, there was increase in cases among Monk/Nun group and Unemployed groups, but this was over compensated by decline in cases among the Student group.

TB Cases by Year of Treatment Initiation (Year 2012 – 2019)
All Nationality

Year	2012	2013	2014	2015	2016	2017	2018	2019
Frequency	432	395	338	368	342	301	238	244

TB Cases by Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetans

Year	2012	2013	2014	2015	2016	2017	2018	2019
Frequency	387	337	288	316	278	251	196	185

TB Cases by Occupation and Year of Treatment Initiation (Year 2012 – 2019)
All Nationality

Occupation / Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
Artist/Craftsman	9 (2.08)	6 (1.52)	1 (0.30)	5 (1.36)	3 (0.88)	3 (1.00)	1 (0.42)	4 (1.64)	32 (1.20)
Business	33 (7.64)	30 (7.59)	21 (6.21)	25 (6.79)	15 (4.39)	22 (7.31)	18 (7.56)	17 (6.97)	181 (6.81)
Government	8 (1.85)	5 (1.27)	5 (1.48)	3 (0.82)	3 (0.90)	8 (2.66)	3 (1.26)	2 (0.82)	37 (1.39)
Health Care Worker	11 (2.55)	9 (2.28)	6 (1.78)	9 (2.45)	4 (1.17)	2 (0.66)	5 (2.10)	4 (1.64)	50 (1.88)
Monk/Nun	98 (22.69)	88 (22.28)	63 (18.64)	54 (14.67)	63 (18.42)	46 (15.28)	42 (17.65)	64 (26.23)	518 (19.49)
Other	61 (14.12)	70 (17.72)	62 (18.34)	54 (14.67)	61 (17.84)	39 (12.96)	48 (20.17)	38 (15.57)	433 (16.29)
Student	163 (37.73)	144 (36.46)	137 (40.53)	164 (44.57)	162 (47.37)	150 (49.83)	94 (39.50)	67 (27.46)	1,081 (40.67)
Unemployed	49 (11.34)	43 (10.89)	43 (12.72)	54 (14.67)	31 (9.06)	31 (10.30)	27 (11.34)	48 (19.67)	326 (12.26)
Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**

Table1.1: TB Cases by Occupation and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetans

Occupation/Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
Artist/Craftsman	9 (2.33)	6 (1.78)	1 (0.35)	5 (1.78)	2 (0.70)	2 (0.78)	1 (0.51)	3 (1.62)	29 (1.29)
Business	32	28	19	22	15	22	17	16	171

	(8.27)	(8.31)	(6.60)	(6.92)	(5.26)	(8.63)	(8.67)	(8.65)	(7.60)
Government	7 (1.81)	5 (1.48)	4 (1.39)	3 (0.94)	2 (0.70)	8 (3.14)	3 (1.53)	2 (1.08)	34 (1.51)
Health Care Worker	11 (2.84)	9 (2.67)	6 (2.08)	9 (2.83)	4 (1.40)	2 (0.78)	5 (2.55)	4 (2.16)	50 (2.22)
Monk/Nun	67 (17.31)	49 (14.54)	39 (13.54)	37 (11.64)	42 (14.74)	32 (12.55)	28 (14.29)	33 (17.84)	327 (14.53)
Other	58 (14.99)	62 (18.40)	51 (17.71)	46 (14.47)	48 (16.84)	28 (10.98)	34 (17.35)	31 (16.76)	358 (15.90)
Student	156 (40.31)	136 (40.36)	126 (43.75)	143 (44.97)	146 (51.23)	135 (52.94)	82 (41.84)	52 (28.11)	976 (43.36)
Unemployed	47 (12.14)	42 (12.46)	42 (14.58)	53 (16.67)	26 (9.12)	26 (10.20)	26 (13.27)	44 (23.78)	306 (13.59)
Total	**387**	**337**	**288**	**318**	**285**	**255**	**196**	**185**	**2251**

As compared to the year 2018, there is increase in TB cases among "Monk/Nuns" and "Unemployed" groups in 2019. However, there was overall decline in TB cases in 2019 (=185) as compared to 2018 (=196) even though there were relative increase in TB cases among "Monk/Nun" and "Unemployed" groups and this was because of the of decline in TB among "Student" groups overcompensating the increase in "Monk/Nun" and "Unemployed" groups. The increase in TB among monk/nun in 2019 may be due to increased case detection under Zero TB project in South India

TB Cases by Region and Year of Treatment Initiation (Year 2012 – 2019)
All Nationality

Region /Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
Central	15 (3.47)	6 (1.52)	2 (0.59)	5 (1.36)	11 (3.22)	5 (3.22)	9 (3.78)	3 (1.23)	56 (2.11)
Nepal	3 (0.69)	3 (0.76)	0 (0.00)	2 (0.54)	3 (0.88)	1 (0.33)	2 (0.82)	2 (0.82)	16 (0.60)
North	230 (53.24)	248 (62.78)	222 (65.68)	246 (66.85)	234 (68.42)	197 (65.45)	159 (66.81)	144 (59.02)	1,680 (63.21)
North-East	5 (1.16)	4 (1.01)	6 (1.78)	11 (2.99)	10 (2.92)	5 (1.66)	5 (2.10)	6 (2.46)	52 (1.96)
Other	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.29)	1 (0.33)	4 (1.68)	1 (0.41)	7 (0.26)
South	179 (41.44)	134 (33.92)	108 (31.95)	103 (27.99)	82 (23.98)	91 (30.23)	58 (24.37)	88 (36.07)	843 (31.72)
West	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.27)	1 (0.29)	1 (0.33)	1 (0.42)	0 (0.00)	4 (0.15)
Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2,658**

TB Cases by Region and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetans

Region/Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
Central	15 (3.88)	6 (1.78)	2 (0.69)	3 (0.95)	2 (0.72)	1 (0.40)	9 (4.59)	3 (1.62)	41 (1.83)
Nepal	3 (0.78)	3 (0.89)	0 (0.00)	2 (0.63)	3 (1.08)	0 (0.00)	0 (0.00)	2 (1.08)	13 (0.58)
North	201 (51.94)	209 (62.02)	186 (64.58)	207 (65.51)	193 (69.42)	162 (64.54)	134 (68.37)	107 (57.84)	1,399 (62.51)
North-East	5 1.92)	4 (1.19)	5 (1.74)	8 (2.53)	7 (2.52)	5 (1.99)	4 (2.04)	5 (2.70)	43 (1.92)

Other	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.36)	1 (0.40)	3 (1.53)	1 (0.54)	6 (0.27)
South	163 (42.12)	115 (34.12)	95 (32.99)	95 (30.06)	71 (25.54)	81 (32.27)	45 (22.96)	67 (36.22)	732 (32.71)
West	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.32)	1 (0.36)	1 (0.40)	1 (0.51)	0 (0.00)	4 (0.18)
Total	**387**	**337**	**288**	**316**	**278**	**251**	**196**	**185**	**2,238**

TB Surveillance Data from Seven Hospitals (All Nationality)											
Socio-Demographic and Other Characteristics of TB Cases Disaggregated by Year of Treatment Initiation (2012-2019)											
S no	**Characteristics**	**2012 n (%)**	**2013 n (%)**	**2014 n (%)**	**2015 n (%)**	**2016 n (%)**	**2017 n (%)**	**2018 n (%)**	**2019 n (%)**	**Total n (%)**	**Remark**
1	**Gender**										
	Male	283 (65.51)	254 (64.30)	221 (65.38)	224 (61.20)	221 (65.77)	192 (64.65)	168 (70.59)	166 (68.03)	1737 (65.35)	
	Female	149 (34.49)	141 (35.70)	117 (34.62)	142 (38.80)	115 (34.23)	105 (35.35)	70 (29.41)	78 (31.97)	921 (34.65)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
2	**Age-group**										
	0 – 14	29 (06.71)	18 (04.56)	21 (06.21)	29 (07.88)	26 (07.60)	20 (06.64)	16 (06.72)	13 (05.33)	172 (06.47)	
	15 –29	270 (62.50)	240 (60.76)	202 (59.76)	222 (60.33)	215 (62.82)	175 (58.14)	137 (57.56)	124 (50.82)	1584 (59.63)	
	30 – 44	70 (16.20)	60 (15.19)	51 (15.09)	60 (16.30)	41 (11.99)	43 (14.29)	32 (13.45)	49 (20.82)	406 (15.27)	
	45 – 60	19 (04.40)	26 (06.58)	19 (05.62)	19 (05.16)	29 (08.48)	32 (10.63)	21 (08.82)	28 (11.48)	193 (07.26)	
	60 and above	44 (10.19)	51 (12.19)	45 (13.31)	38 (10.33)	31 (09.06)	31 (10.30)	32 (13.45)	30 (12.30)	302 (11.36)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
3	**Mean Age in Year (Median)**	29.66 (24.00)	31.71 (25.00)	31.32 (23.50)	29.74 (24.00)	29.66 (23.00)	30.72 (22.00)	32.76 (25.00)	34.20 (27.00)	31.00 (24.00)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
4	**Nationality**										
	Tibetan	387 (89.58)	337 (85.32)	288 (85.21)	318 (86.41)	285 (83.33)	255 (84.72)	196 (82.35)	185 (75.82)	2251 (84.69)	
	Indian	25 (05.79)	45 (11.39)	42 (12.43)	42 (11.41)	50 (14.62)	40 (13.29)	35 (14.71)	47 (19.26)	326 (12.26)	
	Nepali	15 (03.47)	12 (3.04)	5 (01.48)	7 (01.90)	5 (01.46)	5 (01.66)	5 (02.10)	9 (03.69)	63 (02.37)	
	Other	5 (01.16)	1 (0.25)	3 (00.89)	1 (00.27)	2 (00.58)	1 (00.33)	2 (00.84)	3 (01.23	18 (00.68)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
5	**Country of Birth**										
	India	255 (59.03)	214 (54.18)	193 (57.10)	229 (62.23)	228 (66.67)	216 (71.76)	161 (67.65)	165 (67.62)	1661 (62.49)	
	Tibet	151 (34.95)	159 (40.25)	126 (37.28)	117 (31.79)	89 (26.02)	63 (20.93)	59 (24.79)	65 (26.64)	829 (31.19)	
	Nepal	21 (04.86)	19 (04.81)	15 (04.44)	20 (05.43)	22 (06.43)	21 (06.98)	15 (06.30)	11 (04.51)	144 (05.42)	
	Others	5 (01.16)	3 (00.76)	4 (01.18)	2 (00.54)	3 (00.88)	1 (00.33)	3 (01.26)	03 (01.23)	24 (00.90)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
6	**Occupation**										
	Student	163 (37.73)	144 (36.46)	137 (40.53)	164 (44.57)	162 (47.37)	150 (49.83)	94 (39.50)	67 (27.46)	1081 (40.67)	
	Monk/Nun	98 (22.69)	88 (22.28)	63 (18.64)	54 (14.67)	63 (18.42)	46 (15.28)	42 (17.65)	64 (26.23)	518 (19.49)	
	Business	33 (07.64)	30 (07.59)	21 (06.21)	25 (06.79)	15 (04.39)	22 (07.31)	18 (07.56)	17 (06.97)	181 (06.81)	
	Government	8 (01.85)	5 (01.27)	5 (01.48)	3 (00.82)	3 (00.88)	8 (02.66)	3 (01.26)	2 (00.82)	37 (01.39)	

	Unemployed	49 (11.34)	43 (10.89)	43 (12.72)	54 (14.67)	31 (09.06)	31 (10.30)	27 (11.34)	48 (19.67)	326 (12.26)	
	Other	61 (14.12)	70 (17.72)	62 (18.34)	54 (14.67)	61 (17.84)	39 (12.96)	48 (20.17)	38 (15.57)	433 (16.29)	
	Health Care Worker	11 (02.55)	9 (02.28)	6 (01.78)	9 (02.45)	4 (01.17)	2 (00.66)	5 (02.10)	4 (01.64)	50 (01.88)	
	Artist/Craftsman	9 (02.08)	6 (01.52)	1 (00.30)	5 (01.36)	3 (00.88)	3 (01.00)	1 (00.42)	4 (01.64)	32(01.20)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
7	**HIV Status**										
	Positive	7 (01.62)	0 (00.00)	3 (00.89)	9 (02.45)	1 (00.29)	5 (01.66)	3 (01.26)	0 (00.00)	28 (01.05)	
	Negative	417 (96.53)	393 (99.49)	329 (97.34)	357 (97.01)	335 (97.95)	294 (97.67)	232 (97.48)	244 (100.00)	2601 (97.86)	
	Missing/Not Tested	8 (01.85)	2 (00.51)	6 (01.78)	2 (00.54)	6 (01.75)	2 (00.66)	3 (01.26)	0 (00.00)	29 (01.09)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
8	**Hepatitis B (HBsAg) Status**										
	Positive	28 (06.48)	34 (08.61)	26 (07.69)	27 (07.34)	24 (07.02)	22 (07.31)	11 (04.62)	13 (05.33)	185 (06.96)	
	Negative	396 (91.67)	358 (90.63)	306 (90.53)	339 (92.12)	315 (92.11)	276 (91.69)	226 (94.96)	231 (94.67)	2447 (92.06)	
	Missing/Not Tested	8 (01.85)	3 (00.76)	6 (01.78)	2 (00.54)	3 (00.88)	3 (01.00)	1 (00.42)	0 (00.00)	26 (00.98)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
9.1	**Classification of TB Based on Anatomy**										
	Pulmonary TB	330 (76.39)	305 (77.22)	255 (75.44)	273 (74.18)	258 (75.44)	233 (77.41)	192 (80.67)	206 (84.43)	2052 (77.20)	
	Extra-Pulmonary	102 (23.61)	90 (22.78)	83 (25.56)	95 (25.82)	84 (24.56)	68 (22.59)	46 (19.33)	38 (15.57)	606 (22.80)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
9.2	**Classification of TB Based on Past History**										
	New	334 (77.31)	319 (80.76)	285 (84.32)	309 (83.97)	285 (83.63)	258 (85.71)	194 (81.51)	205 (84.02)	2189 (82.36)	
	Previously Treated	98 (22.69)	76 (19.24)	53 (15.68)	58 (15.76)	54 (15.79)	42 (13.95)	44 (18.49)	39 (15.98)	464 (17.46)	
	Treatment After Failure	0 (00.00)	0 (00.00)	0 (00.00)	1 (00.27)	3 (00.88)	1 (00.33)	0 (00.00)	0 (00.00)	5 (00.19)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
10.1	**Treatment Outcome (Non-MDR cohort)**										
	Cured (Non_MDR)	172 (46.11)	166 (47.43)	136 (45.03)	140 (46.67)	164 (55.41)	168 (59.36)	141 (65.28)		1087 (51.27)	
	Treatment Completed (Non_MDR)	174 (46.65)	164 (46.86)	144 (47.68)	138 (46.00)	118 (39.86)	101 (35.69)	60 (27.78)		899 (42.41)	
	Treatment Success (Non_MDR)	346 (92.76)	330 (94.29)	280 (92.71)	278 (92.67)	282 (95.37)	269 (95.05)	201 (93.06)		1986 (93.68)	
	Died (Non_MDR)	9 (02.41)	7 (02.00)	12 (03.97)	7 (02.33)	6 (02.03)	8 (02.83)	2 (00.93)		51 (02.41)	
	Lost to Follow-Up (Non_MDR)	8 (02.14)	7 (02.00)	6 (01.99)	7 (02.33)	3 (01.01)	2 (00.71)	7 (03.24)		40 (01.89)	
	Moved to 2nd line	0 (00.00)	0 (00.00)	0 (00.00)	2 (00.67)	0 (00.00)	1 (00.35)	0 (00.00)		3 (00.14)	
	Not Evaluated (Non_MDR)	1 (00.27)	0 (00.00)	0 (00.00)	1 (00.33)	0 (00.00)	1 (00.35)	0 (00.00)		3 (00.14)	
	Transfer Out	5 (01.34)	3 (00.86)	2 (00.66)	3 (01.00)	1 (00.34)	1 (00.35)	3 (01.39)		18 (00.85)	
	Treatment Failure	4 (01.07)	3 (00.86)	2 (00.66)	2 0(0.67)	4 (01.35)	1 (00.35)	3 (01.39)		19 (00.90)	
	Total	**373**	**350**	**302**	**300**	**296**	**283**	**216**		**2120**	

10.2	**Treatment Outcome (MDR/XDR/NTM cohort)**										
	Cured (MDR)	30 (66.67)	22 (66.67)	17 (70.83)	45 (88.24)	21 (72.41)	7 (70.00)			142 (73.96)	
	Treatment Completed (MDR)	4 (8.89)	5 (15.15)	3 (12.50)	2 (03.92)	6 (20.69)	2 (20.00)			22 (11.46)	
	Treatment Success (MDR)	34 (75.56)	27 (81.82)	20 (83.33)	47 (92.16)	27 (93.10)	9 (90.00)			164 (85.42)	
	Died (MDR)	6 (13.33)	3 (09.09)	2 (08.33)	4 (07.84)	1 (03.45)	1 (10.00)			17 (08.85)	
	Lost to Follow-Up (MDR)	4 (08.89)	2 (06.06)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)			6 (03.13)	
	Transfer Out	0 (00.00)	1 (03.03)	2 (08.33)	0 (00.00)	1 (03.45)	0 (00.00)			4 (02.08)	
	Treatment Failure	1(02.22)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)			1 (00.52)	
	Total	**45**	**33**	**24**	**51**	**29**	**10**			**192**	
10.3	**Treatment Outcome (INH Mono-resistant cohort)**										
	Cure	9 (64.29)	12 (100.00)	10 (83.33)	13 (76.47)	13 (76.47)	5 (62.50)	8 (100.00)		70 (79.55)	
	Treatment Complete	3 (21.43)	0 (00.00)	2 (16.67)	3 (17.65)	3 (17.65)	1 (12.50)	0 (00.00)		12 (13.64)	
	Treatment Success	12 (85.72)	12 (100.00)	12 (100.00)	16 (94.12)	16 (94.12)	6 (75.00)	8 (100.00)		82 (93.19)	
	Death	0 (00.00)	0 (00.00)	0 (00.00)	1 (05.88)	0 (00.00)	2 (25.00)	0 (00.00)		3 (03.41)	
	Lost To Follow Up	1 (07.14)	0 (00.00)	0 (00.00)	0 (00.00)	1 (05.88)	0 (00.00)	0 (00.00)		2 (02.27)	
	Transfer Out	1 (07.14)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)		1 (01.14)	
	Total	**14**	**12**	**12**	**17**	**17**	**8**	**8**		**88**	
11	**Proportion of Total TB patients Who were Children Below 14 Years (Pediatric TB)**										
	TB patients who were children	16 (03.70)	11 (02.78)	17 (05.03)	18 (04.89)	18 (05.26)	15 (04.98)	8 (03.36)	10 (04.10	113 (04.25)	
	14 & above	416 (96.30)	384 (97.22)	321 (94.97)	350 (95.11)	324 (94.74)	286 (95.02)	230 (96.64)	234 (95.74)	2545 (95.74)	
	Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**	
Note: Unless specified, the number in parenthesis is in %.											

SECTION TWO

Drug Resistant TB 2019

As compared to 2017 and 2018, there was an absolute and relative increase in MDR cases in 2019 and this is a cause for concern. GeneXpert and culture sensitivity testing are used as TB diagnostic and drug sensitivity testing tools for early detection of drug resistant TB. The expenses for GeneXpert cartridges and culture sensitivity testing from Hinduja hospital in Mumbai was funded by USAID.

TB Cases by TB Type and Year of Treatment Initiation (Year 2012 – 2019)
All Nationality

TB Regimen	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
NonMDR/H-Mono TB	387 (89.58)	362 (91.65)	314 (92.90)	317 (86.14)	313 (91.52)	291 (96.68)	224 (94.12)	222 (90.98)	2,430 (91.42)
MDR/XDR/NTM TB	45 (10.42)	33 (08.35)	24 (07.10)	51 (13.86)	29 (08.48)	10 (03.32)	14 (05.88)	22 (09.02)	228 (08.58)
Total	**432**	**395**	**338**	**368**	**342**	**301**	**238**	**244**	**2658**

TB Cases by TB Type and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetans

TB Regimen	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
NonMDR/H-Mono TB	344 (88.89)	308 (91.39)	269 (93.40)	271 (85.22)	261 (91.58)	245 (96.08)	183 (93.37)	165 (89.19)	2046 (90.89)
MDR/XDR/NTM TB	43 (11.11)	29 (08.61)	19 (06.60)	47 (14.78)	24 (08.42)	10 (03.92)	13 (06.63)	20 (10.81)	205 (9.11)
Total	**387**	**337**	**288**	**318**	**318**	**255**	**196**	**185**	**2251**

TB Cases by Occupation and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetans and NonMDR/H-MonoResistant

Occupation/Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
Artist/Craftsman	8 (2.33)	6 (1.95)	1 (0.37)	4 (1.48)	2 (0.77)	2 (0.82)	1 (0.55)	3 (1.82)	27 (1.32)
Business	26 (7.56)	23 (7.47)	17 (6.32)	17 (6.27)	12 (4.60)	19 (7.76)	14 (7.65)	12 (7.27)	140 (6.84)
Government	6 (1.74)	4 (1.30)	3 (1.12)	3 (1.11)	2 (0.77)	8 (3.27)	3 (1.64)	2 (1.21)	31 (1.52)
Health Care Worker	7 (2.03)	9 (2.92)	5 (1.86)	3 (1.11)	4 (1.53)	2 (0.82)	5 (2.73)	2 (1.21)	37 (1.81)
Monk/Nun	64 (18.60)	45 (14.61)	39 (14.50)	34 (12.55)	39 (14.94)	32 (13.06)	27 (14.75)	32 (19.39)	312 (15.25)
Other	54 (15.70)	56 (18.18)	46 (17.10)	39 (14.39)	41 (15.71)	27 (11.02)	31 (16.94)	27 (16.36)	321 (15.69)
Student	144 (41.86)	129 (41.88)	120 (44.61)	127 (46.86)	139 (53.26)	132 (53.88)	78 (42.62)	46 (27.88)	915 (44.72)

Unemployed	35 (10.17)	36 (11.69)	38 (14.13)	44 (16.24)	22 (8.43)	23 (9.39)	24 (13.11)	41 (24.85)	263 (12.85)
Total	**344**	**308**	**269**	**271**	**261**	**245**	**183**	**165**	**2,046**

TB Cases by Occupation and Year of Treatment Initiation (Year 2012 – 2019) Only Tibetans and MDR/XDR/NTM									
Occupation/Year	**2012 n (%)**	**2013 n (%)**	**2014 n (%)**	**2015 n (%)**	**2016 n (%)**	**2017 n (%)**	**2018 n (%)**	**2019 n (%)**	**Total n (%)**
Artist/Craftsman	1 (2.33)	0 (0.00)	0 (0.00)	1 (2.13)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.98)
Business	6 (13.95)	5 (17.24)	2 (10.53)	5 (10.64)	3 (12.50)	3 (30.00)	3 (23.08)	4 (20.00)	31 (15.12)
Government	1 (2.33)	1 (3.45)	1 (5.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (1.46)
Health Care Worker	4 (9.30)	0 (0.00)	1 (5.26)	6 (12.77)	0 (0.00)	0 (0.00)	0 (0.00)	2 (10.00)	13 (6.34)
Monk/Nun	3 (6.98)	4 (13.79)	0 (0.00)	3 (6.38)	3 (12.50)	0 (0.00)	1 (7.69)	1 (5.00)	15 (7.32)
Other	4 (9.30)	6 (20.69)	5 (26.32)	7 (14.89)	7 (29.17)	1 (10.00)	3 (23.08)	4 (20.00)	37 (18.05)
Student	12 (27.91)	7 (24.14)	6 (31.58)	16 (34.04)	7 (29.17)	3 (30.00)	4 (30.77)	6 (30.00)	61 (29.76)
Unemployed	12 (27.91)	6 (20.69)	4 (21.05)	9 (19.15)	4 (16.67)	3 (30.00)	2 (15.38)	3 (15.00)	43 (20.98)
Total	**43**	**29**	**19**	**47**	**24**	**10**	**13**	**20**	**205**

TB Report 2019 TB Surveillance Data from Seven Hospitals (All Nationality) Treatment Category and TB Drug Sensitivity Testing (DST) Based on CBNAAT/Gene X-pert and Culture (2012-2019)											
S. No		**2012 n (%)**	**2013 n (%)**	**2014 n (%)**	**2015 n (%)**	**2016 n (%)**	**2017 n (%)**	**2018 n (%)**	**2019 n (%)**	**Total n (%)**	**Remark**
1	**Classification of TB Based on Treatment Category (All)**										
	Non-MDR	373 (86.34)	350 (88.61)	302 (89.35)	300 (89.35)	296 (86.55)	283 (94.02	216 (90.76)	218 (89.34	2338(87.96)	
	MDR/XDR	44 (10.19)	31 (07.85)	22 (06.51)	50 (13.59)	29 (08.48)	9 (02.99)	14 (05.88)	22 (09.02)	221 (08.31)	
	H Mono-resistant	14 (03.24)	12 (03.04)	12 (03.55)	17 (04.62)	17 (04.97)	8 (02.66)	8 (03.36)	4 (01.64)	92 (03.46)	
	NTM	1 (00.23)	2 (00.51)	2 (00.59)	1 (00.27)	0 (00.00)	1 (00.33)	0 (00.00)	0 (00.00)	7 (00.26)	
	Total	432	395	338	368	342	301	238	244	2658	
1.1	**Classification of TB Based on Treatment Category (New Patient only)**										
	Non-MDR	307 (91.92)	293 (91.85)	260 (91.23)	265 (85.76)	257 (90.18)	245 (94.96)	180 (92.78)	187 (91.22)	1994 (91.09)	
	MDR/XDR	14 (04.19)	17 (05.33)	15 (05.26)	29 (09.39)	16 (05.61)	5 (01.94)	8 (04.12)	15 (07.32)	119 (05.44)	
	H Mono-resistant	12 (03.59)	9 (02.82)	9 (03.16)	15 (04.85)	12 (04.21)	7 (02.71)	6 (03.09)	3 (01.46)	73 (03.33)	
	NTM	1 (00.30)	0 (00.00)	1 (00.35)	0 (00.00)	0 (00.00)	1 (00.39)	0 (00.00)	0 (00.00)	3 (00.14)	
	Total	334	319	285	309	285	258	194	205	2189	
1.2	**Classification of TB Based on Treatment Category (Previously Treated Patient only)**										
	Non-MDR	66 (67.35)	57 (75.00)	42 (79.25)	35 (60.34)	36 (66.67)	38 (90.48)	36 (81.82)	31 (79.49)	341 (73.49)	
	MDR/XDR	30 (30.61)	14 (18.42)	7 (13.21)	20 (34.48)	13 (24.07)	3 (07.14)	6 (13.64)	7 (17.95)	100 (21.55)	
	H-Mono-resistant	2 (02.04)	3 (03.95)	3 (05.66)	2 (03.45)	5 (09.26)	1 (02.38)	2 (04.55)	1 (02.56)	19 (04.09)	
	NTM	0 (00.00)	2 (02.63)	1 (01.89)	1 (01,72)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00,00)	4 (00.86)	
	Total	98	76	53	58	54	42	44	39	464	
2	**TB Drug Sensitivity Testing Xpert: Only for cases for which the test was done and result is R or S (All)**										
	Rif Resistant	37 (16.02)	30 (11.67)	22 (11.58)	46 (20.09)	26 (10.61)	10 (04.52)	15 (8.06)	21 (10.55)	207 (11.77)	
	Rif Sensitive	194 (83.98)	227 (88.33)	168 (88.42)	183 (79.91)	219 (89.29)	211 (95.48)	171 (91.94)	178 (89.45)	1551 (88.23)	
	Total	231	257	190	229	245	221	186	199	1758	
2.1	**TB Drug Sensitivity Testing Xpert: Only for cases for which the test was done and result is R or S (New Patients)**										
	Rif Resistant	14 (08.09)	19 (09.60)	15 (09.43)	27 (14.67)	16 (08.04)	6 (03.17)	8 (05.19)	15 (09.09)	120 (08.44)	
	Rif Sensitive	159 (91.91)	179 (90.40)	144 (90.57)	157 (85.33)	183 (91.96)	183 (96.83)	146 (94.81)	150 (90.91)	1301 (91.56)	
	Total	173	198	159	184	199	189	154	165	1421	
2.2	**TB Drug Sensitivity Testing Xpert: Only for cases for which the test was done and result available (Previously Treated Patients)**										
	Rif Resistant	23 (39.66)	11 (18.64)	7 (22.58)	18 (40.91)	10 (22.22)	3 (09.68)	7 (21.88)	6 (17.65)	85 (25.45)	
	Rif Sensitive	35 (60.34)	48 (81.36)	24 (77.42)	26 (59.09)	35 (77.78)	28 (90.32)	25 (78.13)	28 (82.35)	249 (74.55)	

	Total	58	59	31	44	45	31	32	34	334	
3	**TB Drug Sensitivity Testing (DST) All Patients: Culture Rifampicin & INH - Only for cases for which the DST was done and result R or S is available**										
	H Resistant & R Sensitive	14 (06.83)	12 (06.38)	12 (07.55)	17 (08.67)	17 (08.42)	8 (04.79)	8 (05.93)	6 (06.06)	94 (06.79)	
	H Sensitive & R Resistant	0 (00.00)	1 (00.53)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	2 (01.48)	0 (00.00)	3 (00.22)	
	H Resistant & R Resistant	38 (18.54)	28 (14.89)	23 (14.47)	41 (20.92)	26 (12.87)	10 (5.99)	10 (07.41)	18 (13.64)	194 (14.12)	
	H Sensitive & R Sensitive	153 (74.63)	147 (78.19)	124 (77.99)	138 (70.41)	159 (78.71)	149 (89.22)	115 (85.19)	108 (81.82)	1093 (78.97)	
	Total	205	188	159	196	202	167	135	132	1384	
3.1	**TB Drug Sensitivity Testing (DST) New Patients: Culture Rifampicin & INH - Only for cases for which the DST was done and result R or S available)**										
	H Resistant & R Sensitive	12 (08.51)	9 (06.43)	9 (06.92)	15 (09.62)	12 (07.23)	7 (04.93)	6 (05.77)	5 (04.59)	75 (06.81)	
	H Sensitive & R Resistant	0 (00.00)	1 (00.71)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	1 (00.85)	0 (00.00)	2 (00.18)	
	H Resistant & R Resistant	13 (09.22)	16 (11.43)	15 (11.54)	25 (16.03)	14 (08.43)	6 (04.23)	6 (05.77)	13 (11.93)	108 (09.81)	
	H Sensitive & R Sensitive	116 (82.27)	114 (81.43)	106 (81.54)	116 (74.36)	140 (84.34)	129 (90.85)	104 (88.89)	91 (83.49)	916 (83.20)	
	Total	141	140	130	156	166	142	117	109	1101	
3.2	**TB Drug Sensitivity Testing (DST) Previously Treated Patients: Culture Rifampicin & INH - Only for cases for which the DST was done and result R or S available**										
	H Resistant & R Sensitive	2 (03.13)	3 (06.25)	3 (10.34)	2 (05.13)	5 (13.89)	1 (04.17)	2 (11.11)	1 (04.35)	19 (06.76)	
	H Sensitive & R Resistant	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	1 (05.56)	0 (00.00)	1 (00.36)	
	H Resistant & R Resistant	25 (39.06)	12 (25.00)	8 (27.59)	15 (38.46)	12 (33.33)	3 (12.50)	4 (22.22)	5 (21.74)	84 (29.89)	
	H Sensitive & R Sensitive	37 (57.81)	33 (68.75)	18 (62.07)	22 (56.41)	19 (52.78)	20 (83.33)	11 (61.11)	17 (73.91)	177 (62.99)	
	Total	64	48	29	39	36	24	18	23	281	

2nd Line DST for MDR/XDR Cases (2012 – 2019)											
S No	**DST (KEPO/MAAC)***	**2012 n (%)**	**2013 n (%)**	**2014 n (%)**	**2015 n (%)**	**2016 n (%)**	**2017 n (%)**	**2018 n (%)**	**2019 n (%)**	**Total n (%)**	**Remark**
1	**TB Drug Sensitivity Testing (DST) Culture Kanamycin MDR/XDR cases - Only for cases for which the DST was done and result available (All Patient)**										
	R	3 (07.89)	2 (07.14)	2 (10.00)	3 (07.69)	3 (12.50)	1 (12.50)	2 (18.18)	3 (15.79)	19 (10.16)	
	S	35 (92.11)	26 (92.86)	18 (90.00)	36 (92.31)	21 (87.50)	7 (87.50)	9 (81.82)	16 (84.82)	168 (89.84)	
	Total	38	28	20	39	24	8	11	19	187	
1.1	**TB Drug Sensitivity Testing (DST) Culture Kanamycin MDR/XDR cases - Only for cases for which the DST was done and result available (New Patients)**										
	R	1 (06.67)	1 (09.09)	2 (16.67)	3 (12.50)	1 (07.69)	1 (25.00)	0 (00.00)	2 (10.78)	11 (10.78)	
	S	14 (93.33)	10 (90.91)	10 (83.33)	21 (87.50)	12 (92.31)	3 (75.00)	8 (100.00)	13 (89.22)	91 (89.22)	
	Total	15	11	12	24	13	4	8	15	87	
1.2	**TB Drug Sensitivity Testing (DST) Culture Kanamycin MDR/XDR cases - Only for cases for which the DST was done and result available (Previously Treated Patients)**										
	R	2 (08.70)	1 (05.88)	0 (00.00)	0 (00.00)	2 (18.18)	0 (00.00)	2 (66.67)	1 (25.00)	8 (09.14)	
	S	21 (91.30)	16 (94.12)	8 (100.00)	15 (100.00)	9 (81.82)	4 (100.00)	1 (33.33)	03 (75.00)	77 (90.59)	
	Total	23	17	8	15	11	4	3	4	85	

2	**TB Drug Sensitivity Testing (DST) Culture Ethionamide MDR/XDR cases - Only for cases for which the DST was done and result available (All Patient)**										
	R	21 (56.76)	20 (71.43)	8 (40.00)	25 (64.10)	20 (80.00)	7 (87.50)	10 (90.91)	12 (66.67)	123 (66.13)	
	S	16 (43.24)	8 (28.57)	12(60.00)	14 (35.90)	5 (20.00)	1 (12.50)	1 (09.09)	6 (33.33)	63 (33.87)	
	Total	37	28	20	39	25	8	11	18	186	
2.1	**TB Drug Sensitivity Testing (DST) Culture Ethionamide MDR/XDR cases - Only for cases for which the DST was done and result available (New Patient)**										
	R	8 (53.33)	9 (81.82)	6 (50.00)	16 (66.67)	9 (69.23)	4 (100.00)	7 (87.50)	10 (71.43)	69 (68.32)	
	S	7 (46.67)	2 (18.18)	6 (50.00)	8 (33.33)	4 (30.77)	0 (00.00)	1 (12.50)	4 (28.57)	32 (31.68)	
	Total	15	11	12	24	13	4	8	14	87	
2.2	**TB Drug Sensitivity Testing (DST) Culture Ethionamide MDR/XDR cases - Only for cases for which the DST was done and result available (Previously Treated Patient)**										
	R	13 (59.09)	11 (64.71)	2 (25.00)	9 (60.00)	11 (91.67)	3 (75.00)	3 (100.00)	2 (50.00)	54 (63.53)	
	S	9 (40.19)	6 (35.29)	6 (75.00)	6 (40.00)	1 (08.33)	1 (25.00)	0 (00.00)	2 (50.00)	31 (36.47)	
	Total	22	17	8	15	12	4	3	4	85	
3	**TB Drug Sensitivity Testing (DST) Culture PAS MDR/XDR cases - Only for cases for which DST was done and result available (All Patient)**										
	R	4 (11.11)	2 (7.14)	2 (10.53)	9 (23.08)	6 (24.00)	0 (00.00)	2 (18.18)	5 (16.30)	30 (16.30)	
	S	32 (88.89)	26 (92.86)	17 (89.47)	30 (76.92)	19 (76.00)	8 (100.00)	9 (81.82)	154 (83.70)	154 (83.70)	
	Total	36	28	19	39	25	8	11	18	184	
3.1	**TB Drug Sensitivity Testing (DST) Culture PAS MDR/XDR cases - Only for cases for which DST was done and result available (New Patient)**										
	R	1 (07.14)	1 (09.09)	2 (16.67)	7 (29.17)	3 (23.08)	0 (00.00)	0 (00.00)	4 (28.57)	18 (18.00)	
	S	13 (92.86)	10 (90.91)	10 (83.33)	17 (70.83)	10 (76.92)	4 (100.00)	8 (100.00)	10 (71.43)	82 (83.00)	
	Total	14	11	12	24	13	4	8	14	100	
3.2	**TB Drug Sensitivity Testing (DST) Culture PAS MDR/XDR cases - Only for cases for which DST was done and result available (Previously Treated Patient)**										
	R	3 (13.64)	1 (05.88)	0 (00.00)	2 (13.33)	3 (25.00)	0 (00.00)	2 (66.67)	1 (25.00)	12 (14.29)	
	S	19 (86.36)	16 (94.12)	7 (100.00)	13 (86.67)	9 (75.00)	4 (100.00)	1 (33.33)	3 (75.00)	72 (85.71)	
	Total	22	17	7	15	12	4	3	4	84	
4	**TB Drug Sensitivity Testing (DST) Culture Ofloxacin MDR/XDR cases: Only for cases for which the DST was done and result available (All patient)**										
	R	18 (47.37)	12 (42.86)	10 (50.00)	19 (50.00)	12 (52.17)	5 (62.50)	3 (27.27)	9 (47.37)	88 (47.57)	
	S	20 (52.63)	16 (57.14)	10 (50.00)	19 (50.00)	11 (47.83)	3 (37.50)	8 (72.73)	10 (52.63)	97 (52.43)	
	Total	38	28	20	38	23	8	11	19	185	
4.1	**TB Drug Sensitivity Testing (DST) Culture Ofloxacin MDR/XDR cases: Only for cases for which the DST was done and result available (New Patient)**										
	R	4 (26.67)	5 (45.45)	6 (50.00)	12 (50.00)	6 (46.15)	3 (75.00)	2 (25.00)	6 (40.00)	44 (43.14)	
	S	11(73.33)	6 (54.55)	6 (50.00)	12 (50.00)	7 (53.85)	1 (25.00)	6 (75.00)	9 (60.00)	58 (56.86)	
	Total	15	11	12	25	13	4	8	15	87	
4.2	**TB Drug Sensitivity Testing (DST) Culture Ofloxacin MDR/XDR cases: Only for cases for which the DST was done and result available (Previously Treated Patient)**										
	R	14 (60.87)	7 (41.18)	4 (50.00)	7 (50.00)	6 (60.00)	2 (50.00)	1 (33.33)	3 (75.00)	44 (53.01)	

	S	9 (39.13)	10 (58.82)	4 (50.00)	7 (50.00)	4 (40.00)	2 (50.00)	2 (66.67)	1 (25.00)	39 (46.99)	
	Total	23	17	8	14	10	4	3	4	83	
5	**TB Drug Sensitivity Testing (DST) Culture Clofazamine MDR/XDR cases: Only for cases for which the DST was done and result available (All Patient)**										
	R	1 (4.76)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	1 (00.83)	
	S	20 (95.24)	17 (100.00)	12 (100.00)	25 (100.00)	17 (100.00)	5 (100.00)	8 (100.00)	15 (100.00)	119 (99.17)	
	Total	21	17	12	25	17	5	8	15	120	
5.1	**TB Drug Sensitivity Testing (DST) Culture Clofazamine MDR/XDR cases: Only for cases for which the DST was done and result available (New Patient)**										
	R	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (00.00)	0 (0.00)	
	S	5 (100.00)	8 (100.00)	8 (100.00)	15 (100.00)	8 (100.00)	4 (100.00)	5 (100.00)	12 (100.00)	65 (100.00)	
	Total	5	8	8	15	8	4	5	12	65	
5.2	**TB Drug Sensitivity Testing (DST) Culture Clofazamine MDR/XDR cases: Only for cases for which the DST was done and result available (Previously Treated Patient)**										
	R	1 (06.25)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	1 (01.82)	
	S	15 (93.75)	9 (100.00)	4 (100.00)	10 (100.00)	9 (100.00)	1 (100.00)	3 (100.00)	3 (100.00)	54 (98.18)	
	Total	16	9	4	10	9	1	3	3	55	
6	**TB Drug Sensitivity Testing (DST) MDR/XDR TB Culture Kanamycin & Ofloxacin: Only for cases for which the DST was done and result available (All Patient)**										
	Km Sensitive & Ofx Sensitive	19 (50.00)	15 (53.57)	9 (45.00)	18 (47.37)	9 (39.13)	3 (37.50)	7 (14.29)	9 (47.37)	89 (48.11)	
	Km Resistant & Ofx Sensitive	1 (02.63)	1 (03.57)	1 (05.00)	1 (02.63)	2 (08.70)	0 (00.00)	1 (09.09)	1 (05.26)	8 (04.32)	
	Km Sensitive & Ofx Resistant	16 (42.11)	11 (39.29)	9 (45.00)	17 (44.74)	11 (47.83)	4 (50.00)	2 (18.18)	7 (36.84)	77 (41.62)	
	Km Resistant & Ofx Resistant	2 (05.26)	1 (03.57)	1 (05.00)	2 (05.26)	1 (04.35)	1 (12.50)	1 (09.09)	2 (10.53)	11 (05.95)	
	Total	38	28	20	38	23	8	11	19	185	
6.1	**TB Drug Sensitivity Testing (DST): MDR/XDR TB Culture Kanamycin & Ofloxacin- Only for cases for which the DST was done and result available (New Patient)**										
	Km Sensitive & Ofx Sensitive	10 (66.67)	5 (45.45)	5 (41.67)	11 (45.83)	6 (46.15)	1 (25.00)	6 (75.00)	8 (53.33)	52 (50.98)	
	Km Resistant & Ofx Sensitive	1 (06.67)	1 (09.09)	1 (08.33)	1 (04.17)	1 (07.69)	0 (00.00)	0 (00.00)	1 (06.67)	6 (05.88)	
	Km Sensitive & Ofx Resistant	4 (26.67)	5 (45.45)	5 (41.67)	10 (41.67)	6 (46.15)	2 (50.00)	2 (25.00)	5 (33.33)	39 (38.24)	
	Km Resistant & Ofx Resistant	0 (00.00)	0 (00.00)	1 (08.33)	2 (08.33)	0 (00.00)	1 (25.00)	0 (00.00)	1 (06.67)	5 (04.90)	
	Total	15	11	12	24	13	4	8	15	102	
6.2	**TB Drug Sensitivity Testing (DST): MDR/XDR TB Culture Kanamycin & Ofloxacin- Only for cases for which the DST was done and result available (Previously Treated)**										
	Km Sensitive & Ofx Sensitive	9 (39.13)	10 (58.82)	4 (50.00)	7 (50.00)	3 (30.00)	2 (50.00)	1 (33.33)	1 (25.00)	37 (44.58)	
	Km Resistant & Ofx Sensitive	0 (00.00)	0 (00.00)	0(00.00)	0 (00.00)	1 (10.00)	0 (00.00)	1 (33.33)	0 (00.00)	2 (02.41)	
	Km Sensitive & Ofx Resistant	12 (52.17)	6 (35.29)	4 (50.00)	7 (50.00)	5 (50.00)	2 (50.00)	0 (00.00)	2 (50.00)	38 (45.78)	
	Km Resistant & Ofx Resistant	2 (08.70)	1 (05.88)	0 (00.00)	0 (00.00)	1 (10.00)	0 (00.00)	1 (33.33)	1 (25.00)	6 (07.23)	
	Total	23	17	8	14	10	4	3	4	83	
** KEPO = Kanamycin, Ethionamide, PAS, Ofloxacin. * MACC = Moxifloxacin, Amikacin, Clofazimine, Capreomycin*											

SECTION THREE

Opportunity to Address Social Determinants of Tuberculosis (TB) in Large Tibetan Residential Schools in the Era of COVID-19 Pandemic

(An Advocacy Paper)

The world has made great strides in addressing biomedical determinants of TB and we are now doing universal drug sensitivity testing to catch drug resistant TB early which is made possible by newer diagnostics like Cartridge Based Nucleic Acid Amplification Test (CBNAAT) and Line Probe Assay (LPA). We also have shorter course regimen for multidrug resistant (MDR) TB and may soon have a similar one for drug sensitive TB i.e. shorter than the short course 6 month regimen. However, similar progress in addressing the social determinants of TB have been lacking. An article by Hargreaves J R et al[1] published in the American Journal of Public Health makes a compelling case for need to act "from evidence to action". The disease burden of TB is skewed towards poor developing nations with limited economic means and political will to address these determinants. Within the developing countries, political and socio-cultural hierarchy leading to imbalances in equity, equality, access to care, etc. put people who are at higher risk of TB at more disadvantages. Overcrowding and poor housing conditions are risk factors for TB and addressing them are cost intensive and they may be intertwined in habits, traditions and cultures. COVID-19 pandemic has demonstrated how overcrowding and poorly ventilated dwellings can produce outbreaks through air-borne spread of the virus. TB bacteria is transmitted through air-borne droplets. That means both overcrowding and poor housing conditions are risk factors for the spread of COVID-19 and TB.

Overcrowding and poor housing conditions are risk factors that may play an important role in propagating TB transmission among the Tibetan community in India, sometimes with outbreaks of TB as unfortunate consequences in large residential schools. Outbreaks of TB have been occurring in the large residential Tibetan schools in India. Because of demographic transition such as lower fertility rate, lower birth rate, reduced in-migration into India and increased out-migration from India; the student population is decreasing in the residential Tibetan schools and problem of overcrowding should have been mitigated automatically to some extent without interventions. However, some schools have used these vacant dormitories / hostels for other purposes and sadly, we have lost a window of opportunity at decongestion and to mitigate the problem of overcrowding in the residential schools. This is worrisome as the TB surveillance data from seven hospitals (including Delek hospital) maintained by DoHe-CTA shows absolute and relative increase in MDR TB among the occupation "student" for the years 2018 and 2019 with 2017 as the baseline. The seven TB surveillance hospitals also serve as the catchment hospitals for TB cases for most of the large residential schools. Tables 1.2 and 1.3 show that, in 2019, there was an increase in MDR TB cases both absolute and relative to the year 2017 and 2018. There are two projects that address Latent TB Infection (LTBI) for Tibetan community in India. One is the "Zero TB" project by Delek hospital and Johns Hopkins University (JHU) targeting Tibetan schools in India. The second is the RNTCP TB programs of government of India (GoI)

[1] *Hargreaves J R, Boccia D, Evan C A et al. The Social Determinants of Tuberculosis: From Evidence to Action, American Journal of Public Health 2011 Vol 101, No4 654-662. Doi:10.2105/AJPH.2010.199505 1*

which focus on children who are under-6 years of age or people living with HIV (PLHIV). However, neither of the projects address MDR LTBI.

Table1.1: TB Cases by Occupation and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetan

Occupation/Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
Artist/Craftsman	9 (2.33)	6 (1.78)	1 (0.35)	5 (1.78)	2 (0.70)	2 (0.78)	1 (0.51)	3 (1.62)	29 (1.29)
Business	32 (8.27)	28 (8.31)	19 (6.60)	22 (6.92)	15 (5.26)	22 (8.63)	17 (8.67)	16 (8.65)	171 (7.60)
Government	7 (1.81)	5 (1.48)	4 (1.39)	3 (0.94)	2 (0.70)	8 (3.14)	3 (1.53)	2 (1.08)	34 (1.51)
Health Care Worker	11 (2.84)	9 (2.67)	6 (2.08)	9 (2.83)	4 (1.40)	2 (0.78)	5 (2.55)	4 (2.16)	50 (2.22)
Monk/Nun	67 (17.31)	49 (14.54)	39 (13.54)	37 (11.64)	42 (14.74)	32 (12.55)	28 (14.29)	33 (17.84)	327 (14.53)
Other	58 (14.99)	62 (18.40)	51 (17.71)	46 (14.47)	48 (16.84)	28 (10.98)	34 (17.35)	31 (16.76)	358 (15.90)
Student	156 (40.31)	136 (40.36)	126 (43.75)	143 (44.97)	146 (51.23)	135 (52.94)	82 (41.84)	52 (28.11)	976 (43.36)
Unemployed	47 (12.14)	42 (12.46)	42 (14.58)	53 (16.67)	26 (9.12)	26 (10.20)	26 (13.27)	44 (23.78)	306 (13.59)
Total	**387**	**337**	**288**	**318**	**285**	**255**	**196**	**185**	**2251**

As compared to the year 2018, there is increase in TB cases among "Monk/Nuns" and "Unemployed" groups in 2019. However, there was overall decline in TB cases in 2019 (=185) as compared to 2018 (=196) even though there were relative increase in TB cases among "Monk/Nun" and "Unemployed" groups and this was because of the of decline in TB among "Student" groups overcompensating the increase in "Monk/Nun" and "Unemployed" groups. The increase in TB among monk/nun in 2019 may be due to increased case detection under Zero TB project in South India

TB Cases by TB Type and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetans

TB Regimen	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
NonMDR/H-Mono TB	344 (88.89)	308 (91.39)	269 (93.40)	271 (85.22)	261 (91.58)	245 (96.08)	183 (93.37)	165 (89.19)	2046 (90.89)
MDR/XDR/NTM TB	43 (11.11)	29 (08.61)	19 (06.60)	47 (14.78)	24 (08.42)	10 (03.92)	13 (06.63)	20 (10.81)	205 (9.11)
Total	**387**	**337**	**288**	**318**	**318**	**255**	**196**	**185**	**2251**

Table 1.3: TB Cases by TB Type and Year of Treatment Initiation (Year 2012 – 2019)
Only Tibetan Students

TB Regimen/Year	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	Total n (%)
NonMDR/H-Mono Resistant TB	144 (92.31)	129 (94.85)	120 (95.24)	127 (88.81)	139 (95.21)	132 (97.78)	78 (95.12)	46 (88.46)	915 (93.75)
MDR/XDR/NTM TB	12 (07.69)	7 (05.15)	6 (04.76)	16 (11.19)	7 (04.79)	3 (02.22)	4 (04.88)	6 (11.54)	61 (06.25)
Total	**156**	**136**	**126**	**143**	**146**	**135**	**82**	**52**	**976**

As compared to 2017 and 2018, there was absolute and relative increase in MDR cases in 2019 and this is a cause for concern.

Important Events (interventions) in DoHe-CTA TB Program Timeline
2011 - 2012: Universal Drug Sensitivity Testing (DST) in DoHe-CTA TB Program started
2015-16: Annual ACF in schools strengthened with Standard Operating Procedure (SOP) and build-in contact tracing. Routine intensified Contact Tracing introduced in the TB program
2017: Treatment of Latent TB Infection started for schools (Delek/JHU Zero TB Project for School kid)
2018: Infection Control Project for improved "Indoor Air Quality" started in four schools (Pilot Project)

DoHe-CTA Infection Control Project:

In 2018, Department of Health, Central Tibetan Administration (DoHe-CTA) launched a pilot project in four residential schools to improve the indoor air quality in certain high risk dwellings. As a key person designing and implementing the pilot project for DoHe-CTA, I was ably supported by TB Program Manager Mr. Migmer and later Ms. Tenzin Tsetan when Mr. Migmer resigned. When I moved to Dehradun, Ms. Tsetan had the added burden of individually performing the activities related to follow-up work including onsite visits and monitoring. We were fortunate to have Ms. Thea Zuccotti, an architect with specialization in infection control that provided us with technical guidance. She had the experience of working as consultant in many countries in this area. She provided us the support as an unpaid voluntary "Health Structure Design and TB Infection Control Strategies" consultant. I take this opportunity to thank her on behalf of DoHe-CTA.

Where ever possible, we explored every representative dwellings and determined the number of students occupying them. We used a "Laser Distance Meter" tool to measure the room volumes to get an assessment of the extent of overcrowding and found that most of them were overcrowded compared to the Government of India (GoI) recommendation which states: "The minimum living space available to each inmate should be 40 sq. feet excluding kitchen, toilet and other common space." 40 sq. feet corresponds to 3.7 sq. m, meaning a room of 14.8 sq. m is the minimum required per a 4 person occupancy room. Table 2.1 shows an example of dwelling measurements in a pilot school and appropriate occupancy.

Table 2.1: Type of dwelling, their covered area and appropriate number of occupants

Type of dwelling	m^2 room	m^2/person	Maximum children/room
Home	48.5	3.7	13
Girl hostel	9.3	3.7	2 (very well) to 3 ("almost acceptable")
Boy hostel	14.4	3.7	3 (very well) to 4 ("acceptable")

We also used a "Digital Anemometer" to measure air velocity from an extractor (exhaust fan) to provide assisted ventilation to improve the air exchange per hour (ACH) of a room. For example, more than 6 ACH in existing buildings could be equivalent to 40 l/s for a 4×2×3 m^3 room. We explored Dharamsala for the types of extractor availability and some example of technical details are specified in Table 2.2.

Table 2.2: Technical details are provided for some air extractor that can be bought in lower Dharamsala

www.crompton.co.in/drift-air/

Crompton

Drift Air

Technical Specifications:

Cat Ref.	Sweep (mm)	Power Input (W)	Air Delivery (cu.mtr/hr)	Color	Speed (RPM)
Drift Air 150	150 mm	42	400 cu.mtr/hr	Silver	2300
Drift Air 225	225 mm	38	800 cu.mtr/hr	Silver	1370
Drift Air 300	300 mm	50	1160 cu.mtr/hr	Silver	1350
Drift Air HS	225mm	55	1300 cu.mtr.hr	Silver	2500

ANCHOR by **Panasonic**

Exhaust Fans

Model Name	Sweep Available (mm)	Speed in RPM	Air Delivery (m3/hour)	Power Input in Watts
ANMOL DELUXE	230	1350	750	45
	300	1300	1750	65
ANMOL	150	2500	500	35
	230	1350	500	50
	300	1300	1250	70

Ventilation Fan

Model Name	Sweep Available (mm)	Speed in RPM	Air Delivery (m3/hour)	Power Input in Watts
SMART AIR	150	1350	300	35
	200	1300	550	40
	250	1250	750	45
SMART AIR V-01	100	2500	90	22
	150	2100	240	25
SMART AIR V-02	150	2100	240	25

Our intended intervention was twofold: “environmental” control and “administrative” control. Administrative controls require triage for presumptive TB cases and their rapid diagnosis for potentially infectious cases and drug resistance and prompt initiation of effective therapy through **FAST** which stands for FIND cases ACTIVELY by surveillance, SEPARATE temporarily, and TREAT effectively. Environmental controls relate mainly to natural and mechanical ventilation. The pilot project was to understand issues and barriers related to administrative and environmental control of indoor air quality and implement a few mitigation activities on a priority basis. It was also to serve as

a learning experience for the staff of DoHe-CTA TB section based at Dharamsala as this field is relatively new to us. A budget of about INR 800000.00 was allocated and the budget included expenses for field visits which included need assessment, supervision & monitoring activities.

Environment Control: For a behavior change intervention to be successful, it requires multiple thought and action processes for the target (an individual or a group) to materialize. Here is a case example. The target needs to be aware that opening windows during a class session will improve natural ventilation and thereby decrease risk of TB to the inhabitants of the class room. Awareness need to be followed by "willingness or motivation" to open the windows which could be "I do not want to be a TB patient". However, there may be numerous factors impeding this behavior change, i.e. opening windows. Monkey or mosquito menace could be the impeding factors and one of the solutions could be to provide iron grill with wire net to prevent monkey and mosquitoes troubling inhabitants of the class room.

Because of the small budget allocated for the project, we focused on priority areas. We assessed individual and group behaviors and tried to highlight behaviors that are helpful in the improvement of indoor air circulation. This could be a simple suggestion such as opening windows and doors when children were around, making an extra window or two to improve cross ventilation, or installing a fan (ceiling, wall mounted or extractors) for assisted ventilation. We also looked at rooms to see other possibilities of improving infection control measures. For example, creating a barrier wall between consultation room and student isolation room.

Administrative Control: These measures included appraising the decision makers of the schools in administering rules regarding individual and group behavior such as cough etiquettes, personal hygiene, and bio-waste disposal. And other rules meant to reduce exposure of TB bacteria to children or staff of the school and also rules in relation to classrooms, sleeping quarters etc. It also involves rules related to a resident with "Presumptive TB" provisional diagnosis.

Lessons learned from the pilot project:

i. Measuring Impact indicators were difficult because of various "other" variables involved and the numerous biomedical interventions that were being implemented at the same time. However, output indicators were easy to measure and outcome indicators could be quantifiable to an extent.
ii. Changing behavior (both individual and group) was a very hard "nut" to crack. In future, expertise of a hired Social & Behavior Change Communication (SBCC) specialist may yield better result.
iii. Even on a small budget, it was possible to address few priority areas that mitigate issues of indoor air quality.
iv. The attrition rate of DoHe-CTA staff was high and by the end of the pilot project, all the key persons involved in the project were either not working with DoHe-CTA or not based in Dharamsala.

<u>Opportunity</u>

COVID-19 pandemic lockdown and the events thereafter such as the phased opening of schools give us the opportunity to reinforce and sustain individual and group behaviors that minimize the risk of droplet/airborne infection. It is very important because there are indicators/evidences in the recent

past to show that outbreaks of TB cases have taken place in the large residential schools with potentials for future MDR outbreaks.

TB outbreaks in large residential schools: What do the data indicate?

I have been working in the field (grass root level) for many years and following case series are presented here from my archive which indicate that outbreaks were taking place in residential schools. With the limited resources at our disposal, it was very difficult to track how, when and where TB transmission was taking place. Table 3.1.1, is a case series which used history of contact, residence and culture & DST to get an idea of possible extent of transmission and the table shows three groups where MDR TB transmission had occurred. Tracking of contacts for activation of TB could be done for about two years only as the group left schools after grade 10 or 12. But I have known at-least one case among the contacts of group1 cohort who developed active TB with same culture/DST findings after about 6 years, well beyond her school years. Prior to 2012, MDR cases were suspected based on clinical response to 1st line TB medicines and, as per the protocol, sometimes the wait could be more than 5 months. Universal culture & DST was adopted in 2012.

One thing apparent from table 3.1.1 was that the number of students affected seem to be directly proportional to the students living in a residential quarter especially sleeping rooms even though the curve may not be a straight line. Group 1 belonged to a dormitory system (called hostels) where more than 20 students were sleeping in a dormitory. Group 2 and group 3 were houses which were organized like a large family (called homes) with sleeping rooms for about 4 – 14 students per room and they were more spacious in terms of distance between beds.

Fig 3.1.1 is a bar graph of a school; the data collection for the monthly graph began at the time when it was realised that the school had a possible outbreak of TB. TB screening i.e. active case finding (ACF) and contact tracing followed by active surveillance was initiated. Table 3.1.2 shows the number of TB cases reported by year at a hospital and school I and II. The hospital serves as the catchment hospital for school I, II and III. Notice that there is decrease in the number of TB cases reported from the hospital after the Active Case Finding and Contacting Tracing activities were started in the school I, II and III.

Table 3.1.1: Line-listing of Three Group of Drug Resistant (MDR) TB Cases from School I and II

Group	Age	School	ATT Start Date	MDR Date	DST Result	Address	Diagnostic Centre
1	14 F	I	31-12-09 New CAT3	08-05-10	Resistant to: Sm, H, R, Eto, PAS, Ofx Sensitive to: Km, Am, Clf, Cm	Hostel	Hinduja
1	16 F	I	06-05-10 New CAT1	07-07-10	Resistant to: Sm, H, R, Eto, PAS, Ofx Sensitive to: Km, Am, Clf, Cm	Hostel	Hinduja
1	17 F	I	22-05-10 Relapse, CAT2	08-07-10	Resistant to: Sm, H, R, Eto, PAS, Ofx Sensitive to: Km, Am, Clf, Cm	Hostel	Hinduja
1	18 F	I	13-05-10 New CAT1	27-07-10	Resistant to: Sm, H, R, Eto, PAS, Ofx Sensitive to: Km, Am, Clf, Cm	Hostel	Hinduja
1	14 F	I	03-02-11 New CAT1	03-02-11	Resistant to: Sm, H, R, Eto, PAS, Ofx Sensitive to: Km, Am, Clf, Cm	Hostel	Hinduja
2	23 M	II	25-11-09 Failure	15-04-10	Resistant to: Sm, H, R, E, Eto Sensitive to: K, Am, Ofx, PAS, Clf, Cm	H-30	Hinduja
2	17 F	II	27-11-09 New, CAT1	15-04-10	Resistant to: Sm, H, R, E, Eto, PAS, Ofx Sensitive to: K, Am, Clf, Cm	H-30	Hinduja

2	19 M	II	13-11-09 New, CAT1	12-02-10	Resistant to: Sm, H, R, E, PAS Sensitive to: K, Am, Eto, Clf, Cm, Ofx	H-30	Hinduja
3	15 M	II	28-07-10 New CAT1	14-08-10	Resistant to: H, R, Cipro Sensitive to: K, Eto, PAS, Ofx	H-12	Ranbaxy
3	16 F	II	19-11-10 New, CAT1	30-12-10	Resistant to: Sm, H, R, Ofx Sensitive to: E, Eto, PAS, Km	H-12	Hinduja
3	20 M	II	03-12-10 New CAT1	27-01-11	Resistant to: Sm, H, R, Ofx Sensitive to: E, Eto, PAS, Km	H-12	Hinduja

Fig 3.1.1: TB Cases Diagnosed in School III - All Drug Sensitive (2009-2011)

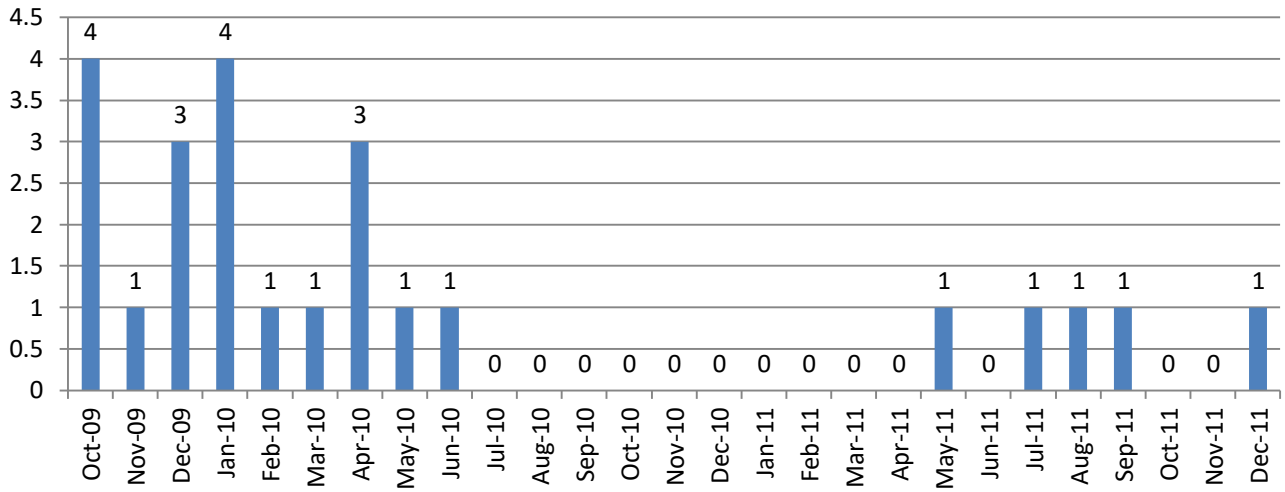
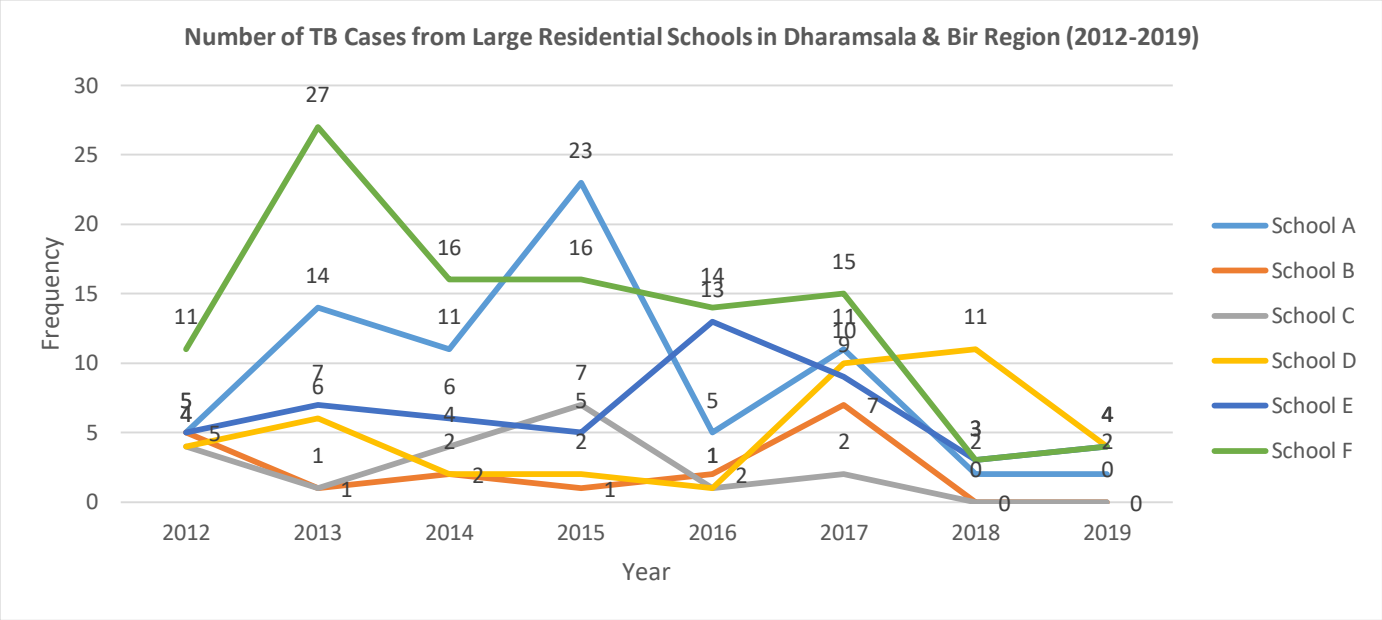


Table 3.1.2: Number of TB Cases Reported in Hospital*, School I and II

School/Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
II	23	42	36	35	25	29	35	28	25	4	9	9
I						11	17	9	10	4	4	9
Hospital			64	71	56	86	78	59	48	47	45	39
Note: Hospital serves as the catchment hospital for school I, II and III												

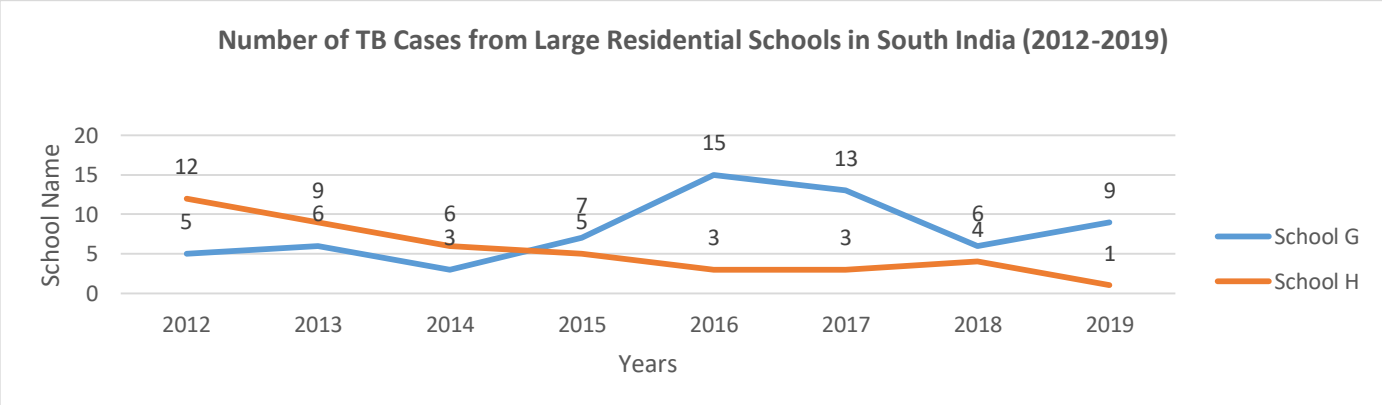
I joined DoHe-CTA at Dharamsala in 2015. Tables 3.2 show the TB data from large residential schools as reflected from their catchment hospitals i.e. Delek hospital for Dharamsala and Bir region, Dekyiling hospital for Doon valley and Sirmour region and Tso-jhe hospital for Bylakupee and DTR hospital for Mundgod. Abnormal spike in a graph may represent outbreaks in schools.

Fig 3.2.1: Number of TB Cases from Large Residential Schools in Dharamsala & Bir Region (2012-2019)



School/Year	2012	2013	2014	2015	2016	2017	2018	2019
School A	5	14	11	23	5	11	2	2
School B	5	1	2	1	2	7	0	0
School C	4	1	4	7	1	2	0	0
School D	4	6	2	2	1	10	11	4
School E	5	7	6	5	13	9	3	4
School F	11	27	16	16	14	15	3	4

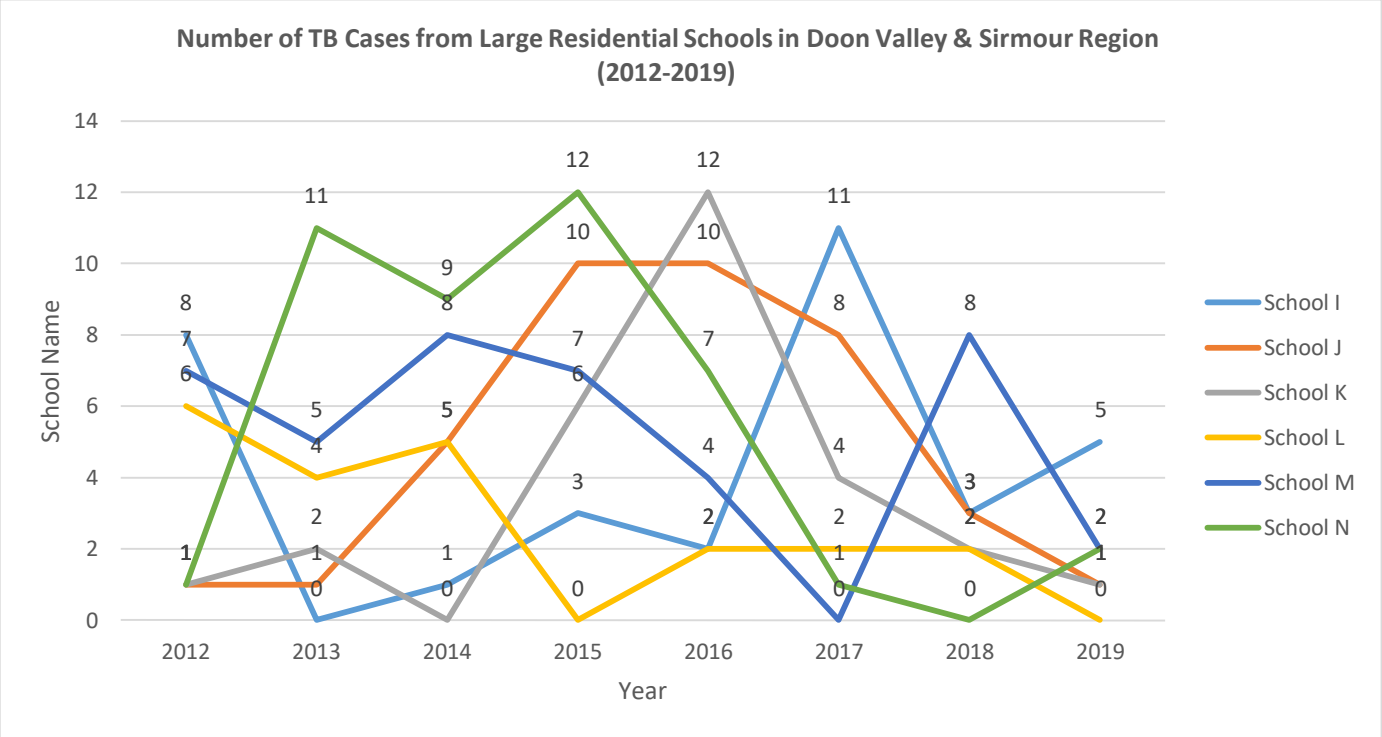
Fig 3.2.2: Number of TB Cases from Large Residential Schools in South India Reported from DTR and Tso-Jhe Hospitals (2012-2019)



	2012	2013	2014	2015	2016	2017	2018	2019
School G	5	6	3	7	15	13	6	9
School H	12	9	6	5	3	3	4	1

Note: In Mundgod database, the address did not mention CST School, the numbers recorded are "students" reported and some of them may not be from the local school and may represent outstation colleges.

Fig 3.2.3: Number of TB Cases from Large Residential Schools in Doon Valley & Sirmour Region (2012-2019)



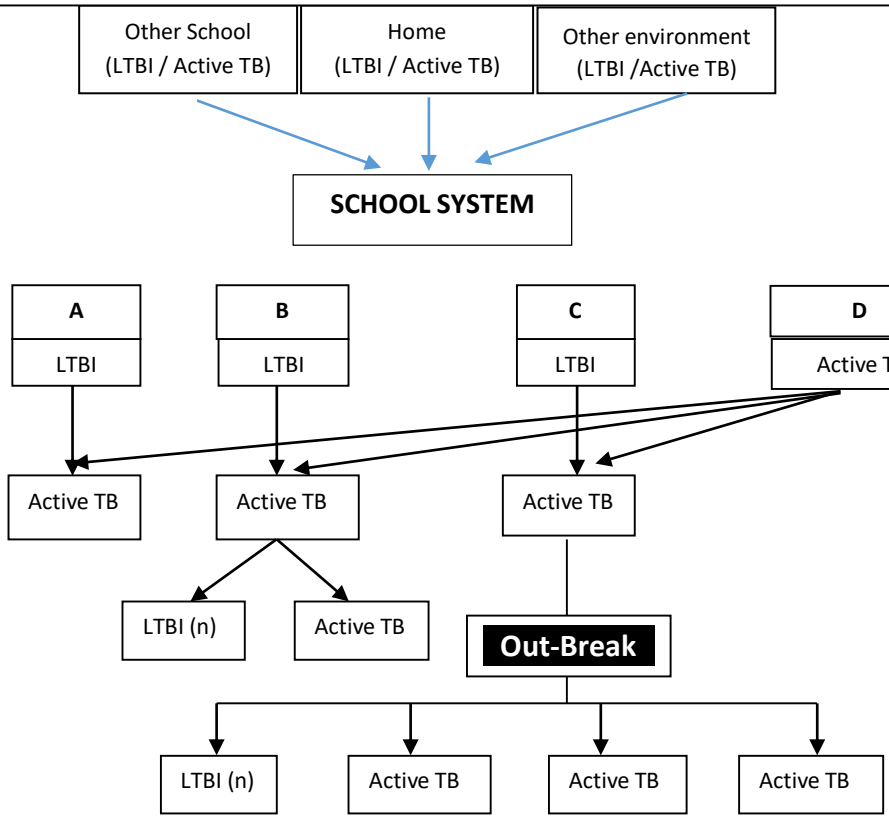
School / Year	2012	2013	2014	2015	2016	2017	2018	2019
School I	8	0	1	3	2	11	3	5
School J	1	1	5	10	10	8	3	1
School K	1	2	0	6	12	4	2	1
School L	6	4	5	0	2	2	2	0
School M	7	5	8	7	4	0	8	2
School N	1	11	9	12	7	1	0	2

Important Events (interventions) in DoHe-CTA TB Program Timeline

2011 - 2012: Universal Drug Sensitivity Testing (DST) in DoHe-CTA TB Program started
2015-16: Annual ACF in schools strengthened with Contact Tracing and Standard Operating Procedure (SOP). Routine intensified Contact Tracing introduced in the TB program
2017: Treatment of Latent TB Infection started for schools (Delek/JHU Zero TB Project for School kid)
2018: Infection Control Project for improved "Indoor Air Quality" started in four schools (Pilot Project)

Note: Active Case Finding (ACF) activities under Zero TB project may be more effective due to two additional activities - routine chest x-ray and gastric lavage for those not able to produce sputum for smear microscopy/Gene-Xpert.

Fig 3.2: Schematic Framework of How TB Transmission and Propagation May Occur in a Tibetan School



Opportunity to Address Social Determinants of TB in the Era of Covid-19 Pandemic

Behavior modification either enforced or adopted voluntarily during the COVID-19 pandemic to reduce the risk of SARS CoV2 transmission will also reduce a person's risk to TB infection. Awareness regarding COVID-19 and how to minimize its risk is high and the motivation and adoption of positive behaviors should also be high. We should maintain and reinforce these behaviors post COVID-19 era as they would help decrease the incidence of TB cases in our community in the future. Behavior that could be routinely enforced and maintained post COVID-19 era:

1. **Cough etiquette**
2. **Compulsory masking of a person with cough/cold**
3. **Personal hygiene (e.g. washing hands)**
4. **Improve ventilation of a dwelling in residential setting i.e. non-hospital/dispensary setting to more than 6 ACH**
5. **Improve ventilation of hospital/dispensary to more than 12 ACH**
6. **Reduce overcrowding of a dwelling to a level recommended by Government of India**
7. **Safe bio-waste disposal**