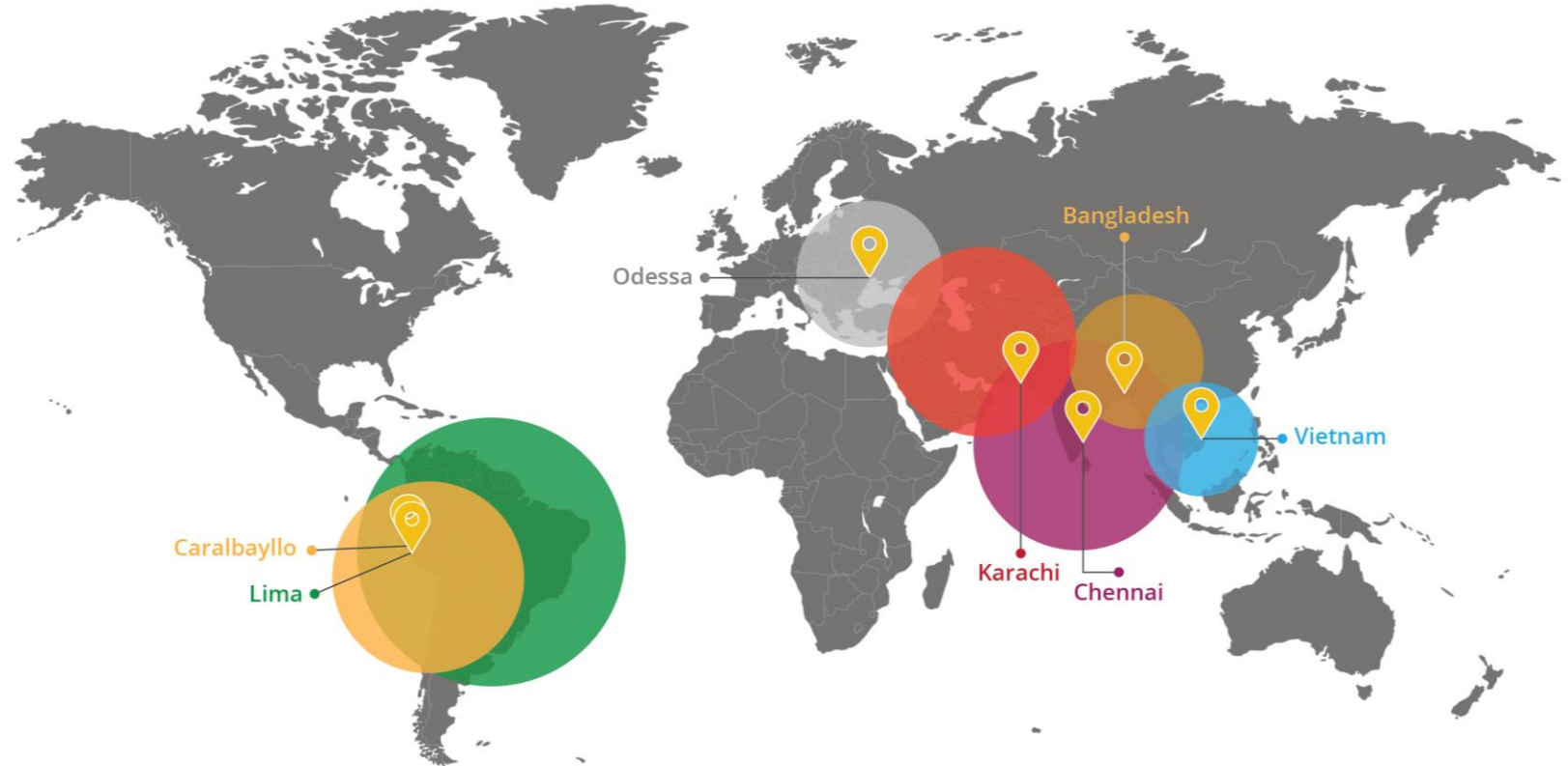Zero TB Karachi :
What models do Search-Treat-Prevent Implementors want?

Aamir Khan MD, PhD
Executive Director, IRD

Zero TB Cities and districts – Current, new and potential:

Almaty, Kazakhstan**

Balti, Moldova

Chennai, India

Dhaka, Bangladesh*

Geissen, Germany

Hai Phong, Vietnam

Hanoi, Vietnam

Ho Chi Mihn City, Vietnam

Indore, India**

Karachi, Pakistan

Kathmandu, Nepal**

Kisumu, Kenya

Lagos, Nigeria **

Lima (Carabayllo), Peru

Manila, Philippines**

Melbourne, Australia**

Mexicali, Mexico

Mthata, South Africa**

Mumbai, India**

Muscat, Oman**

Odessa, Ukraine

Pattaya, Thailand**

Peshawar, Pakistan

Quetta, Pakistan**

Shenzhen, China*

Sofia, Bulgaria**

Tbilisi, Georgia**

Ulaanbaatar, Mongolia

Vladimir, Moscow

ZERO TB Initiative

* First of multiple cities planned
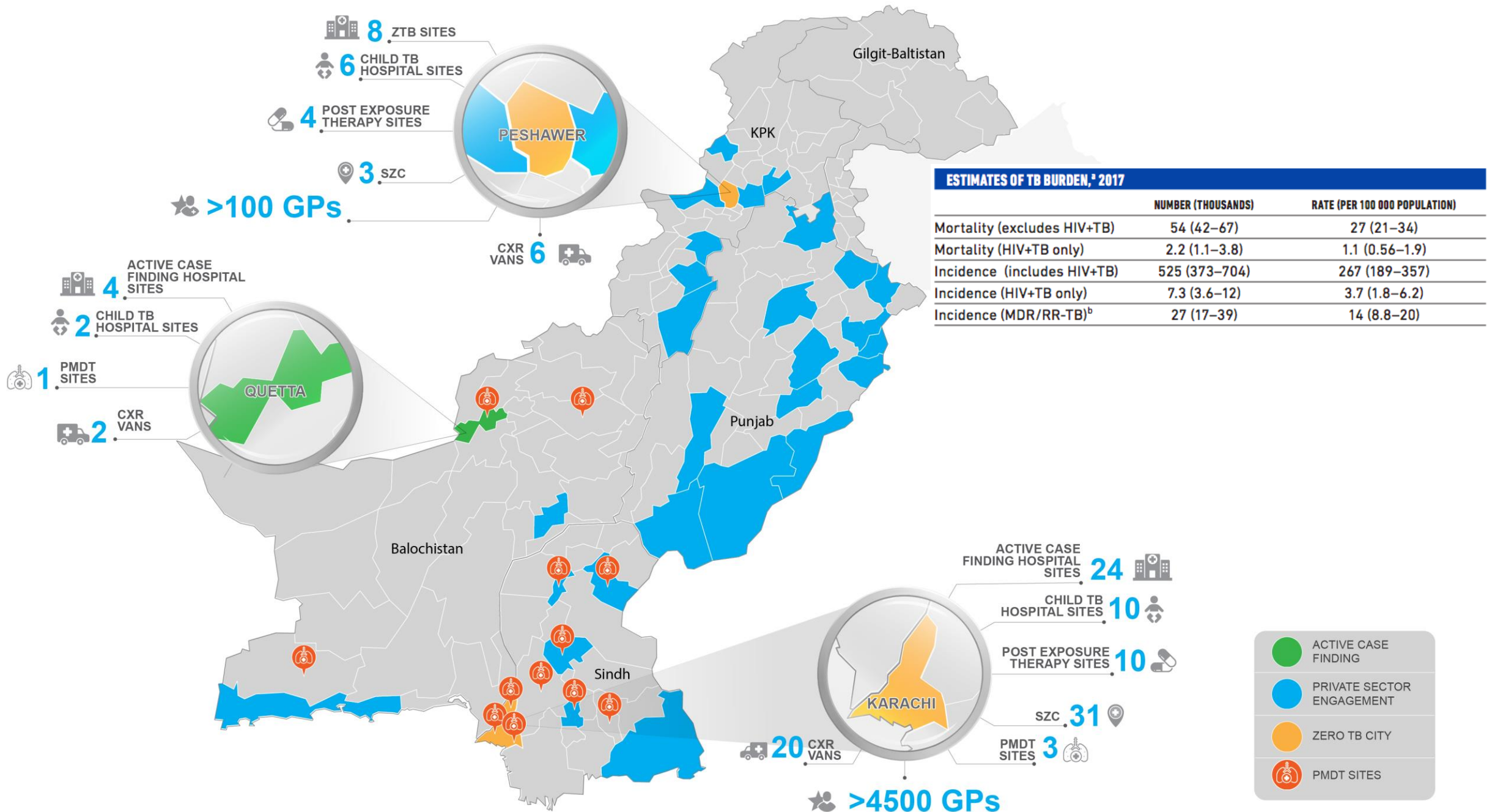** Discussions of alignment underway

Pakistan's Zero TB Initiative

Global Fund Support
2016-2017 USD 40m – Zero TB Karachi +32 districts
2018-2020 USD 40m – Zero TB Karachi, Peshawar, Quetta + 32 districts

PESHAWER

- **8** ZTB SITES
- **6** CHILD TB HOSPITAL SITES
- **4** POST EXPOSURE THERAPY SITES
- **3** SZC
- **>100 GPs**
- CXR VANS **6**

QUETTA

- **4** ACTIVE CASE FINDING HOSPITAL SITES
- **2** CHILD TB HOSPITAL SITES
- **1** PMDT SITES
- **2** CXR VANS

KARACHI

- ACTIVE CASE FINDING HOSPITAL SITES **24**
- CHILD TB HOSPITAL SITES **10**
- POST EXPOSURE THERAPY SITES **10**
- SZC **31**
- PMDT SITES **3**
- **20** CXR VANS
- **>4500 GPs**

Map labels: Gilgit-Baltistan, KPK, Punjab, Balochistan, Sindh

ESTIMATES OF TB BURDEN,[a] 2017		
	NUMBER (THOUSANDS)	RATE (PER 100 000 POPULATION)
Mortality (excludes HIV+TB)	54 (42–67)	27 (21–34)
Mortality (HIV+TB only)	2.2 (1.1–3.8)	1.1 (0.56–1.9)
Incidence (includes HIV+TB)	525 (373–704)	267 (189–357)
Incidence (HIV+TB only)	7.3 (3.6–12)	3.7 (1.8–6.2)
Incidence (MDR/RR-TB)[b]	27 (17–39)	14 (8.8–20)

Legend:
- ACTIVE CASE FINDING
- PRIVATE SECTOR ENGAGEMENT
- ZERO TB CITY
- PMDT SITES

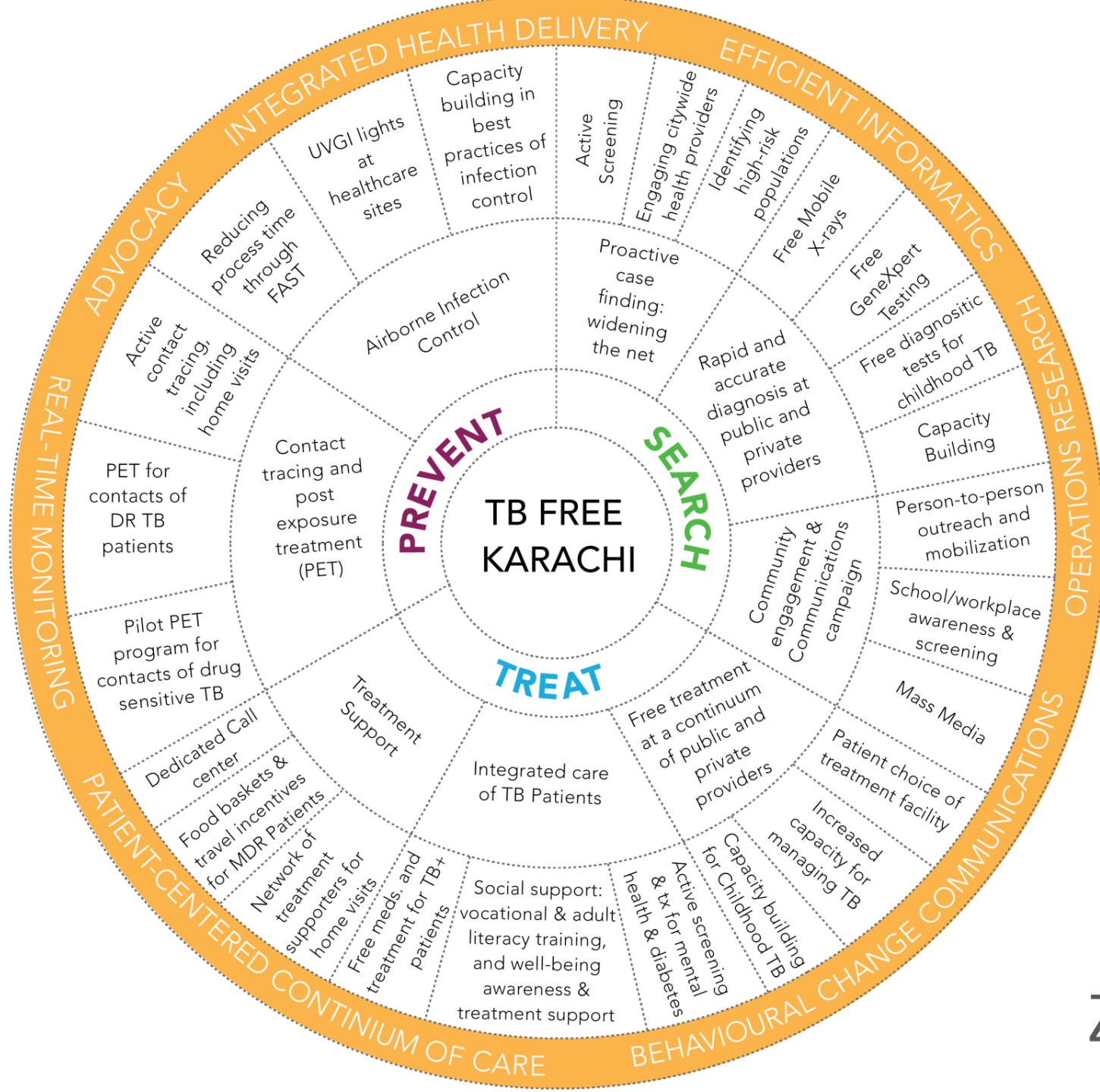**3** Zero TB Cities / **32** districts

~1200 staff

>3m screened on verbal symptoms

55 mobile X-ray vans/ **70** fixed X-rays

>1.5m Chest X-ray screens

>61,000 patients with TB notified

TB FREE KARACHI

PREVENT
- Airborne Infection Control
  - UVGI lights at healthcare sites
  - Capacity building in best practices of infection control
  - Reducing process time through FAST
- Contact tracing and post exposure treatment (PET)
  - Active contact tracing, including home visits
  - PET for contacts of DR TB patients
  - Pilot PET program for contacts of drug sensitive TB

SEARCH
- Proactive case finding: widening the net
  - Active Screening
  - Engaging citywide health providers
  - Identifying high-risk populations
  - Free Mobile X-rays
- Rapid and accurate diagnosis at public and private providers
  - Free GeneXpert Testing
  - Free diagnositic tests for childhood TB
  - Capacity Building
- Community engagement & Communications campaign
  - Person-to-person outreach and mobilization
  - School/workplace awareness & screening
  - Mass Media

TREAT
- Treatment Support
  - Dedicated Call center
  - Food baskets & travel incentives for MDR Patients
  - Network of treatment supporters for home visits
  - Free meds. and treatment for TB+ patients
- Integrated care of TB Patients
  - Social support: vocational & adult literacy training, and well-being awareness & treatment support
  - Active screening & tx for mental health & diabetes
  - Capacity building for Childhood TB
- Free treatment at a continuum of public and private providers
  - Patient choice of treatment facility
  - Increased capacity for managing TB

Outer ring themes
- INTEGRATED HEALTH DELIVERY
- EFFICIENT INFORMATICS
- OPERATIONS RESEARCH
- BEHAVIOURAL CHANGE COMMUNICATIONS
- PATIENT-CENTERED CONTINIUM OF CARE
- REAL-TIME MONITORING
- ADVOCACY

ZERO TB

آف... TB مٹاؤ!

Public Health Facilities

Not-for-Profit (Private Sector)

Zindagi Centers (Private Sector)

COMMUNITY ENGAGEMENT

ZERO TB

STOP TWO
MINUTES
TO SAVE
YOUR LIFE

Free CHEST
X-RAYS
for
TUBERCULOSIS

NO DISROBING NECESSARY

STAMP OUT TB

FREE TB skin tests and chest X-rays

Active Case Finding ≠ 'Active Case Finding'

- What is the focus and intensity of case finding?
  - Which populations are targeted for systematic screening?
    - Low-income communities, outpatients, prison inmates, factory workers
    - Adults vs children
  - How does one measure intensity of ACF?
    - Number of bacteriological tests done
    - Yield of patients from screening at specific settings
    - Proportion of target population screened or tested
  - Cost of CAD and GeneXpert cartridges as impediment to scale

Zero TB Karachi: All Forms TB Notifications
2008 – 2018*
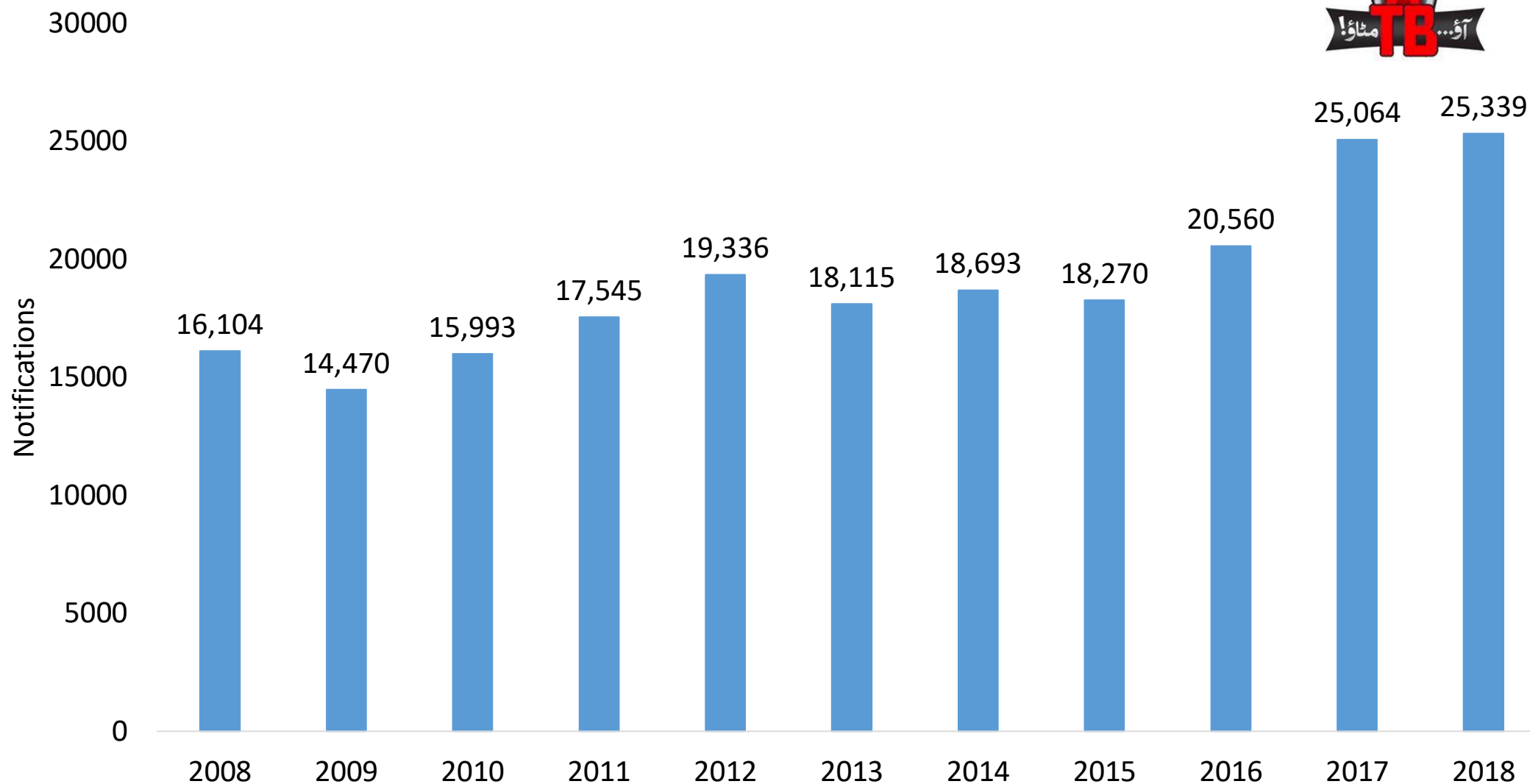
*Q4 2018 numbers are self counted from TB03 registers

Zero TB Karachi: Mobile Chest X-ray Screening among Adults
Jan 2018 – Dec 2018

Screening Site	Chest X-ray / Computer Aided Detection Screening (CAD > 70)					Other X-ray based Case-finding Models	
	Large Hospital OPDs	Community Camps (Not for Profit)	Community Camps (Social Enterprise)	Prisons	Factories	GP-Linked Camps	Household Contacts
Screened	197,346	86,622	111,909	10,071	10,221	41,276	5,069
Presumptive	17, 839	6,147	9,584	597	686	5,174	-
B+ve (Rif+ Included)	1,708	396	172	23	5	57	16
Cases	2,332	475	669	106	13	283	49
Yield from presumptive	13%	8%	7%	18%	2%	6%	-
Yield from screened	1.2 %	0.5 %	0.6 %	1 %	0.1 %	0.7 %	1 %
Number Needed to Screen (NNS)	**85**	**182**	**167**	**95**	**786**	**146**	**103**

Childhood TB Screening: Karachi, Lahore, Peshawar: July 2016 – June 2018

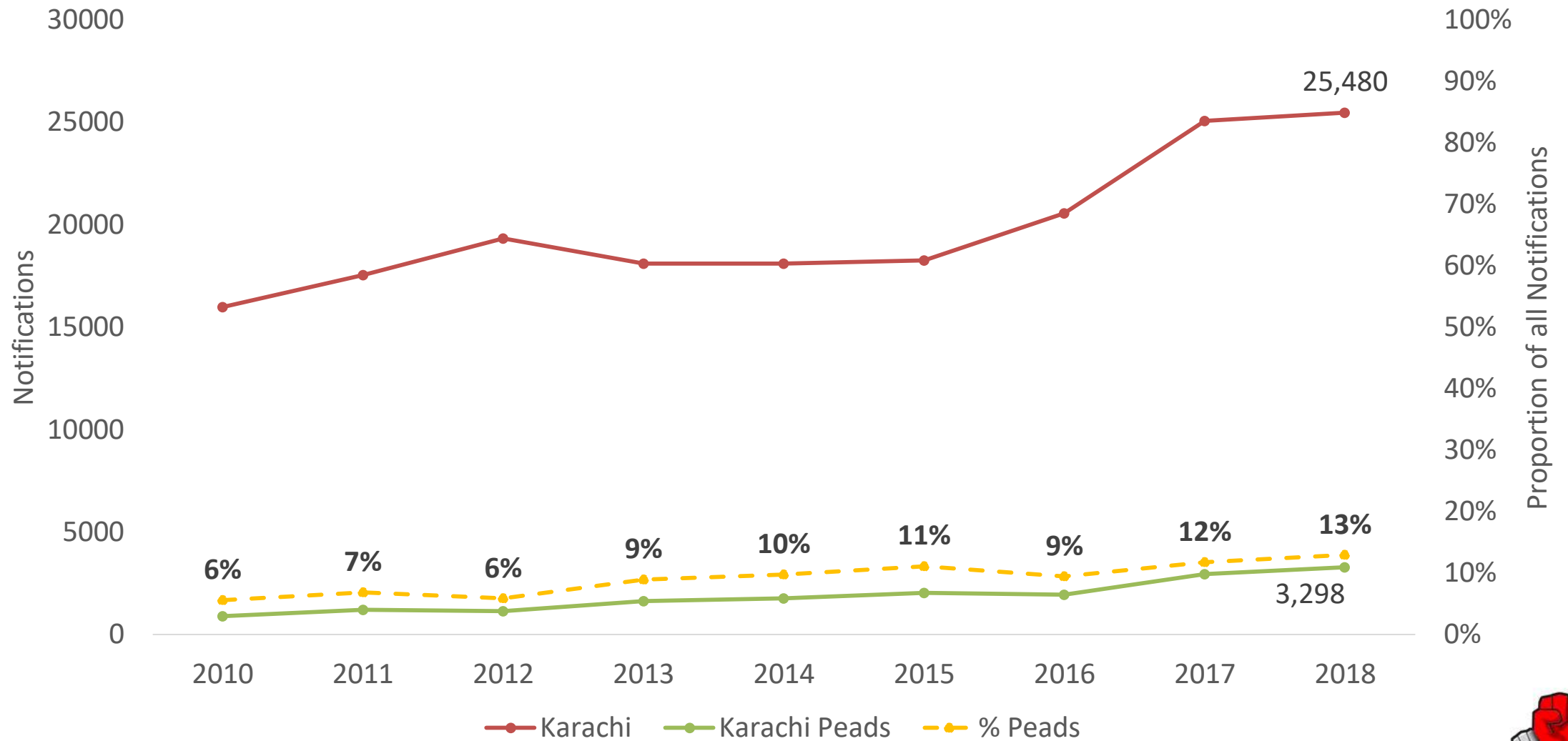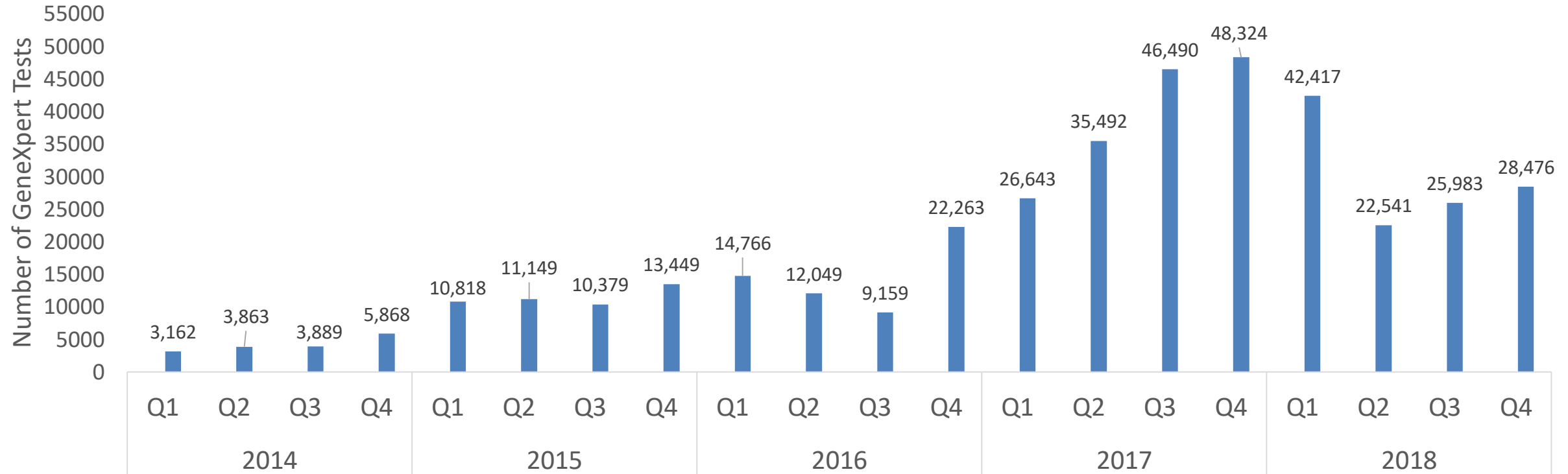|	**Zero TB Karachi**	**Lahore**	**Zero TB Peshawar**
Screened	212,132	81,705	36,966
Presumptive	13,631 (6%)	3,997 (5%)	2,909 (8%)
TB Diagnosed	1,568 (12%)	758 (19%)	297 (14%)
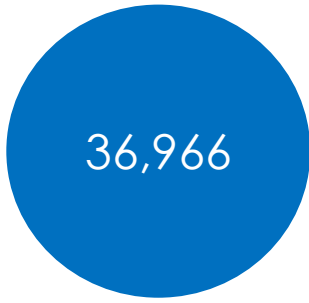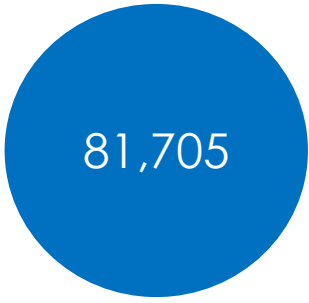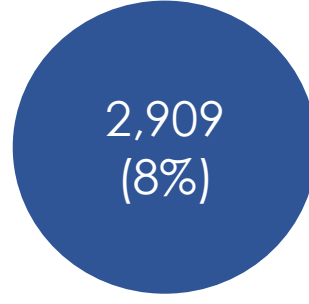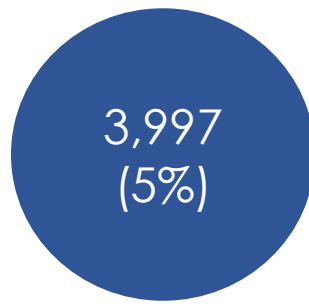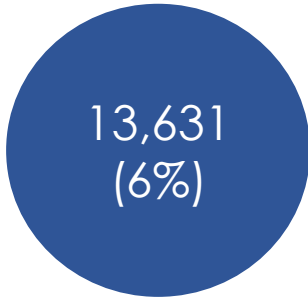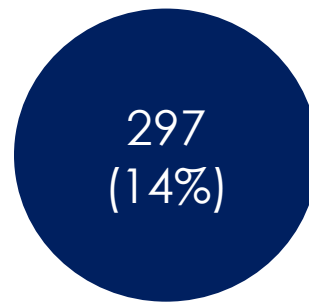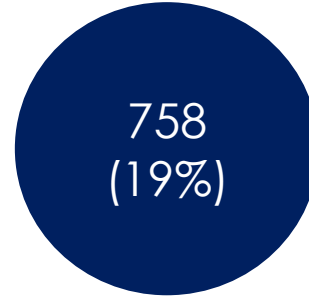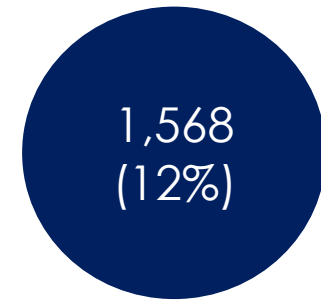
Zero TB Karachi: Childhood TB as a Proportion of All Forms Case Notifications
2010 – 2018

Zero TB Karachi: GeneXpert Cartridge Use 2014 - 2018

ZERO TB Karachi

Number of GeneXpert Tests

Year	Quarter	Value
2014	Q1	3,162
2014	Q2	3,863
2014	Q3	3,889
2014	Q4	5,868
2015	Q1	10,818
2015	Q2	11,149
2015	Q3	10,379
2015	Q4	13,449
2016	Q1	14,766
2016	Q2	12,049
2016	Q3	9,159
2016	Q4	22,263
2017	Q1	26,643
2017	Q2	35,492
2017	Q3	46,490
2017	Q4	48,324
2018	Q1	42,417
2018	Q2	22,541
2018	Q3	25,983
2018	Q4	28,476

Karachi: Quarterly tests and trend of MTB+/Rif+ Detected
Q3 2013 – Q1 2019
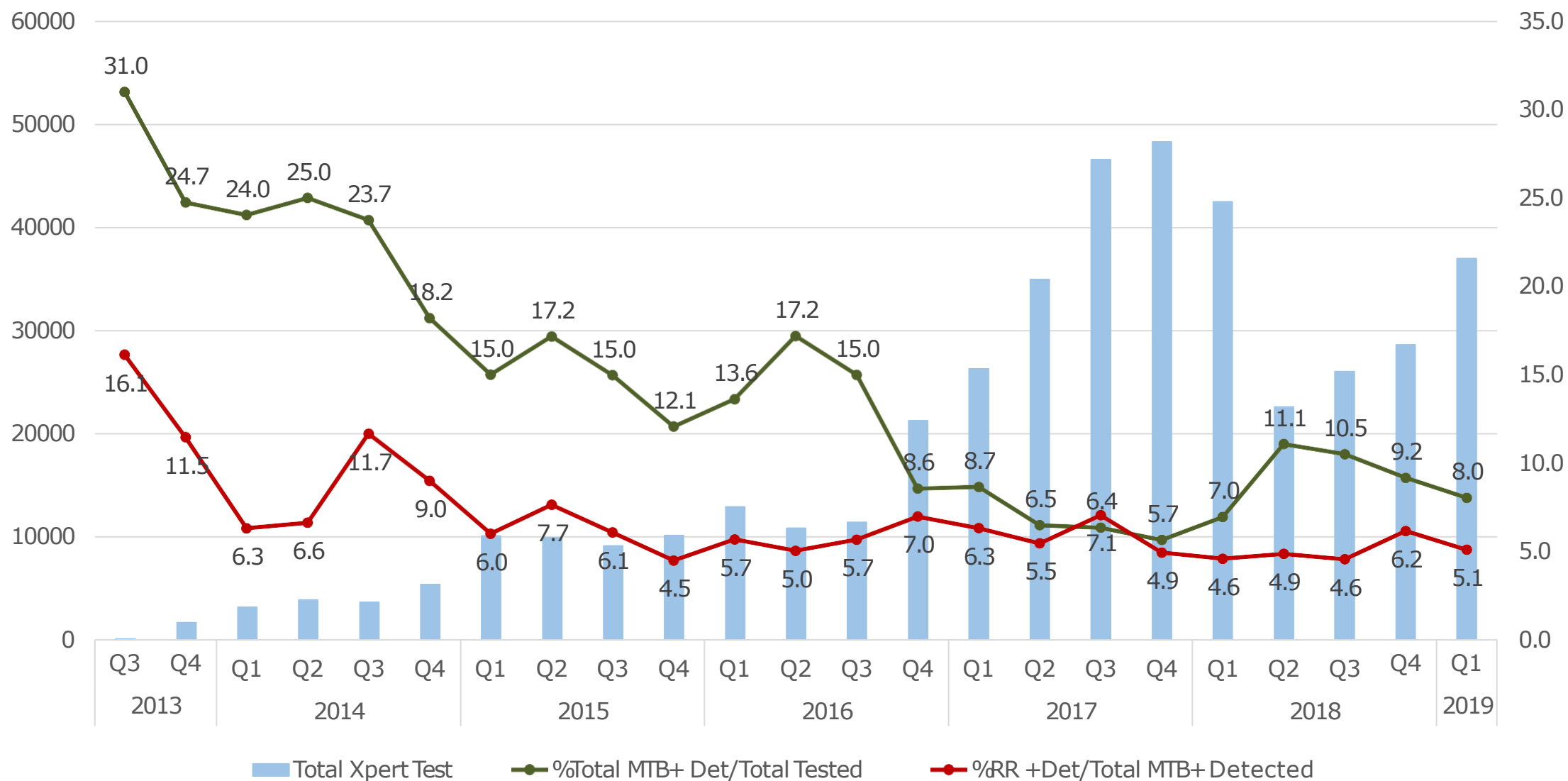
Karachi Residents: DR-TB Enrolments and Proportion of New Cases 2009 – May 2019
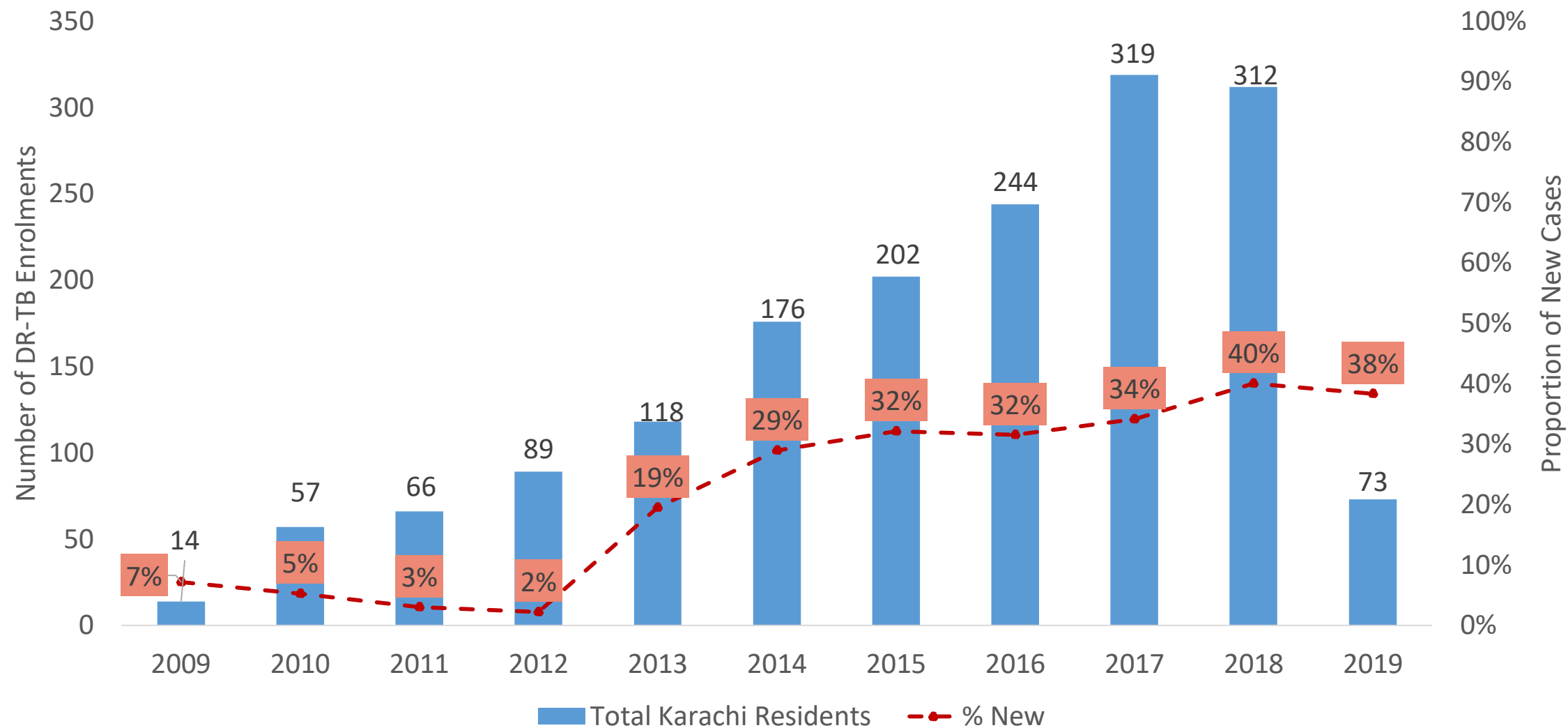
Karachi City: Active Case Finding Resources Invested and Case Notifications
2010 - 2018

Case Notifications per 100,000 (left axis): 250, 200, 150, 100, 50, 0

Resources Invested per 100,000 (right axis): 6000, 5000, 4000, 3000, 2000, 1000, 0

Years: 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018

Legend:
- Adult DSTB Case Notificaton Rates
- All Ages B+ DSTB Case Notification Rate
- Xpert Tests/Population *100000
- XRAYs/Population *100000
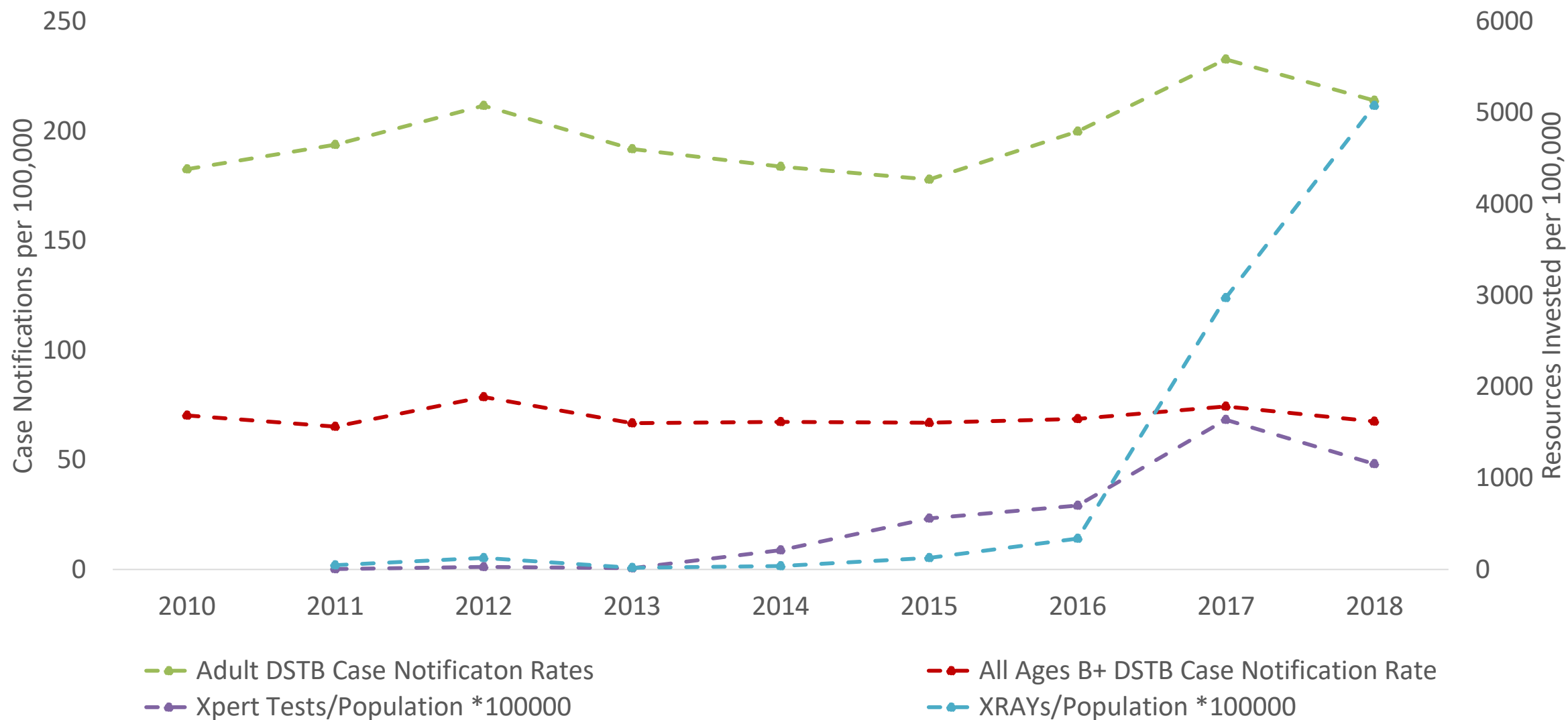
XRAYs/Population = Fixed and mobile

Contact Tracing and Prevention

- What is the focus and coverage of contact tracing and prophylaxis?
  - Household contact tracing vs all contact tracing
  - Drug susceptible vs drug resistant TB contacts
  - Uptake of prevention regimens among contacts
    - 3HP vs others
  - Cost of Rifapentine as impediment to scale

Drug Susceptible TB Prevention Regimen: 6 months INH vs 3HP
Zero TB Karachi 2017

Indicators	6 months INH		3HP	
	N	%	N	%
Contacts offered treatment	1258		956	
Contacts started treatment	1029	82	715	75
Contacts refused after initiating treatment	**247**	**24**	**41**	**6**
Contacts completed treatment	171	17	194	27
Contacts not completing treatment	**125**	**12**	**28**	**4**
Contacts with unknown outcomes	3	0	2	0
Contacts still on treatment	483	47	464	65

TB Prevention Cascade – Drug Resistant TB
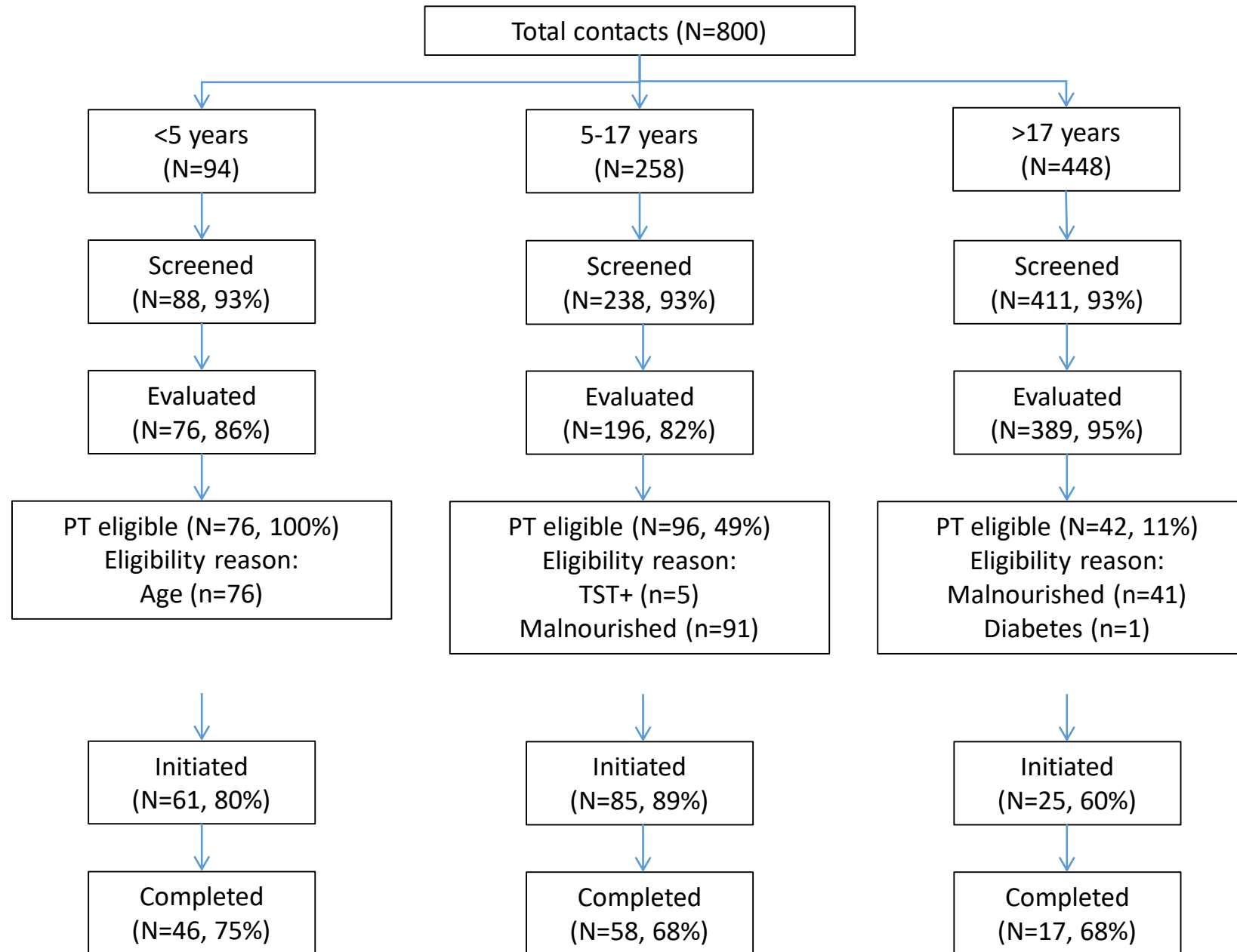
Zero TB Karachi: Cumulative probabilities for evaluation, prescription, uptake and completion of treatment for presumed DR-TB infection treatment by age group

(N=792, Karachi Zero TB, unpublished Amyn Malik, Mercedes Becerra, Hamidah Hussain et al)

Prevention Cascade (CP)
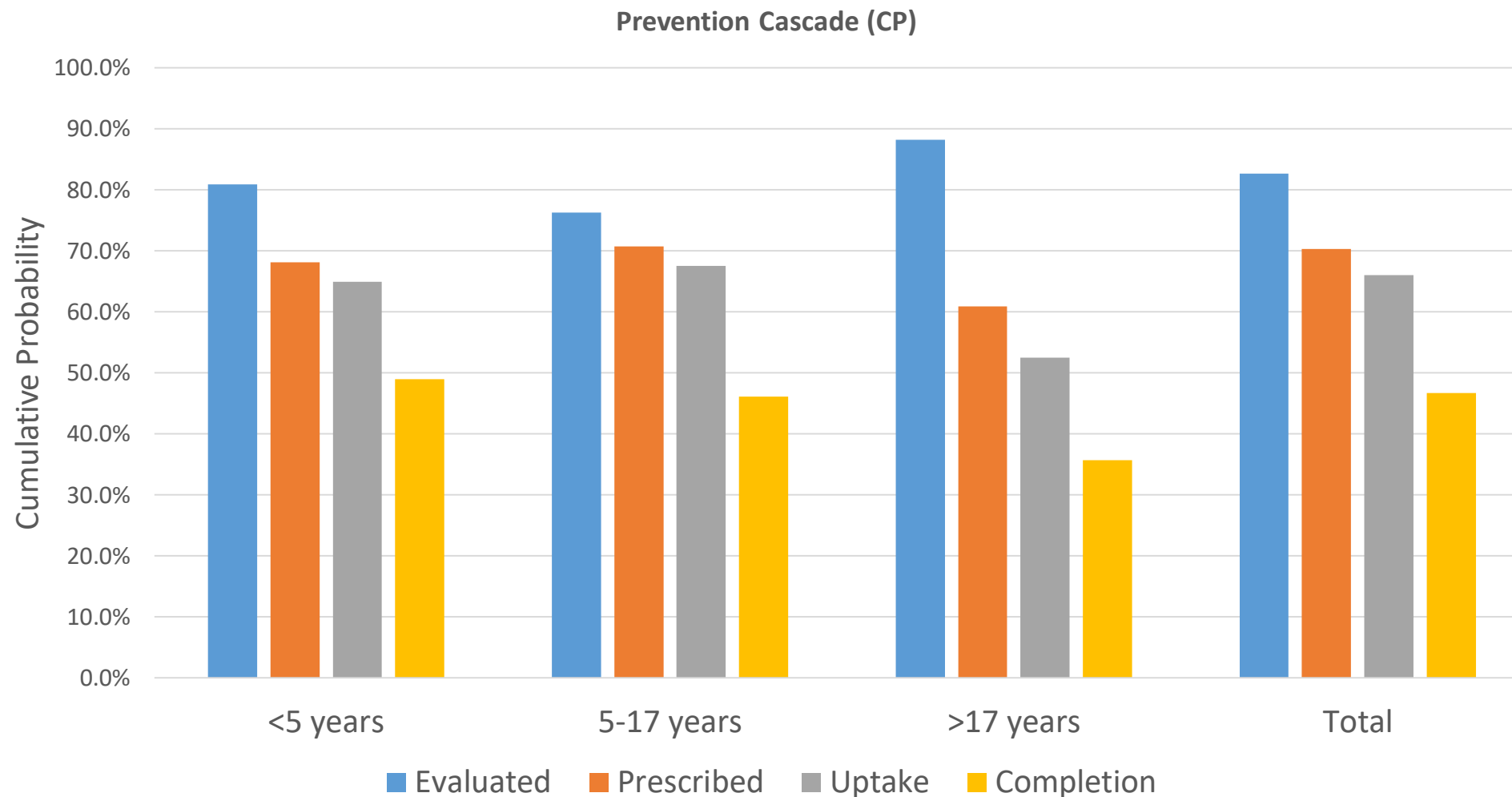
Modeling Zero TB Karachi Impact

- ## Modeling from 2013 (David Dowdy and Andrew Azman)
  - Significant declines in 5-year mortality and incidence (2013 Dowdy paper)

- ## Modeling from Zero TB baseline (Sourya Shreshta and David Dowdy)
  - Targeted case finding can double reductions in TB incidence

- ## But what is the combined impact of targeted Active Case Finding and targeted Preventive Therapy? (Sourya Shreshta and David Dowdy)

Population-Level Impact of Active Tuberculosis Case Finding in an Asian Megacity

David W. Dowdy[1,2*], Ismat Lotia[3], Andrew S. Azman[1], Jacob Creswell[4], Suvanand Sahu[4], Aamir J. Khan[3,5]

1 Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, United States of America, 2 Center for Tuberculosis Research, Johns Hopkins University, Baltimore, Maryland, United States of America, 3 Interactive Research and Development, Karachi, Sindh, Pakistan, 4 Stop TB Partnership, Geneva, Switzerland, 5 Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, United States of America
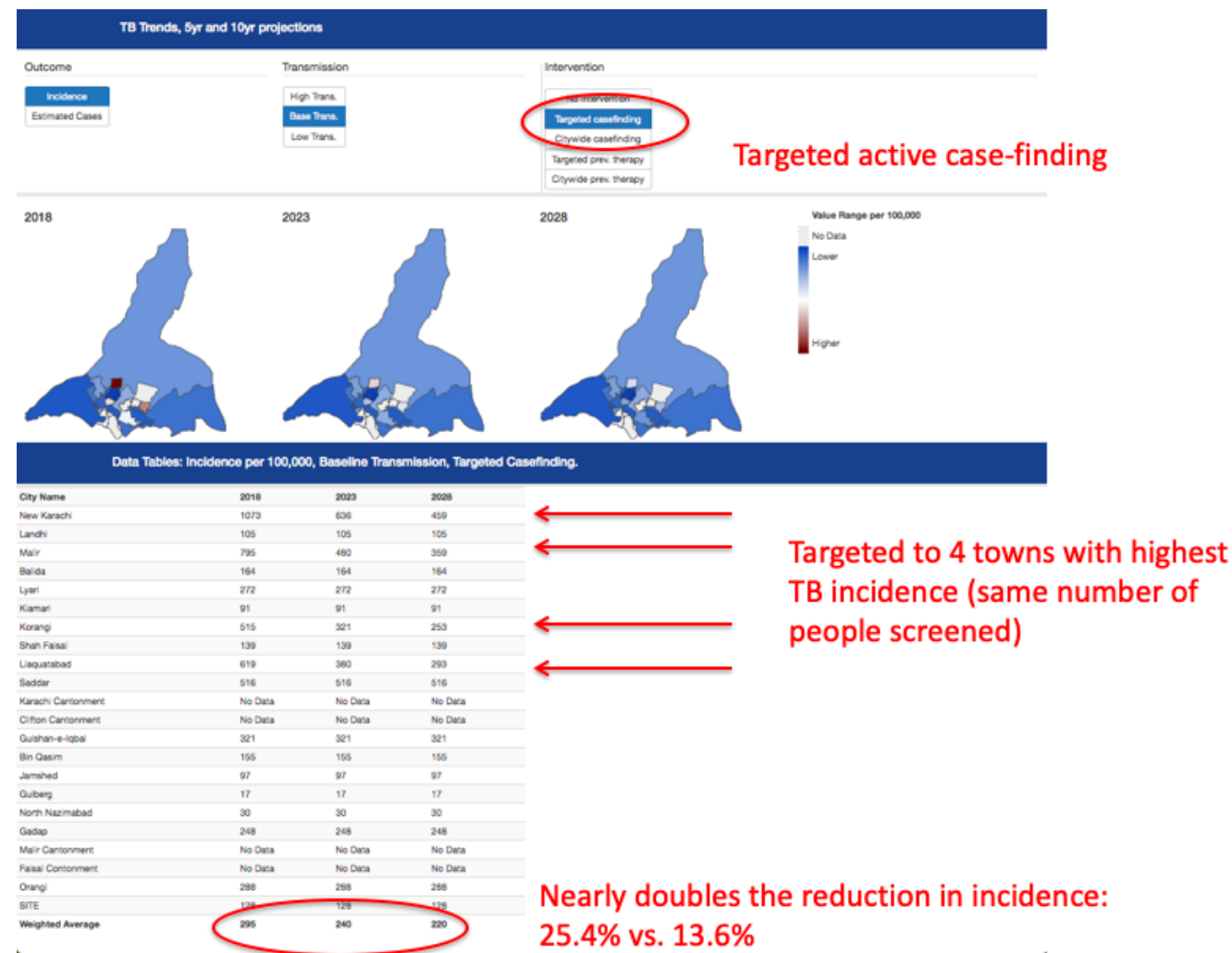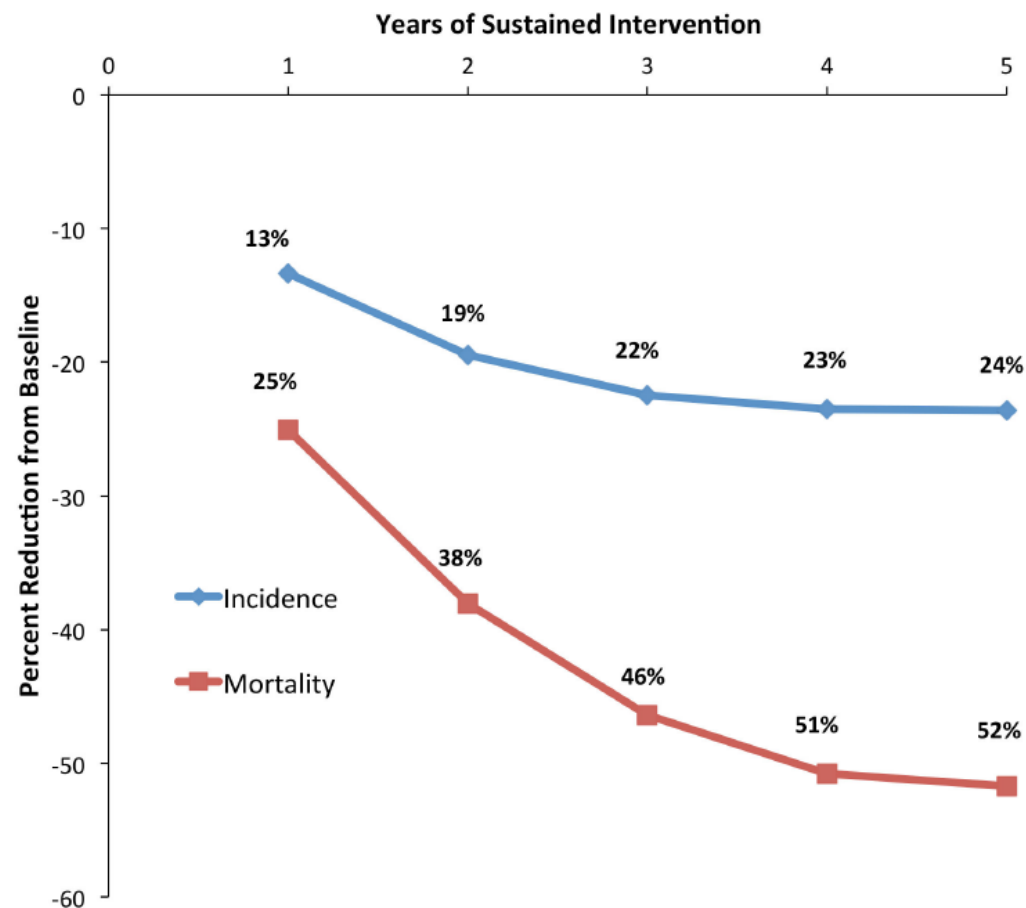
Figure 3. Relationship Between Duration of Intervention and Impact on Cumulative Five-Year Outcomes. The x-axis shows the duration of the intervention, scaled up to a maximum TB diagnostic rate over one year, assuming that the diagnostic rate then declines back to baseline over the subsequent year. Thus, a one-year duration corresponds to a single time step at maximum diagnostic rate, preceded by one year of scale-up and followed by one year of gradual return to baseline, then three years of baseline diagnostic intensity. The y-axis shows cumulative percent reduction in five-year incidence and mortality. The five-year intervention corresponds to the primary analysis reported in the manuscript text.
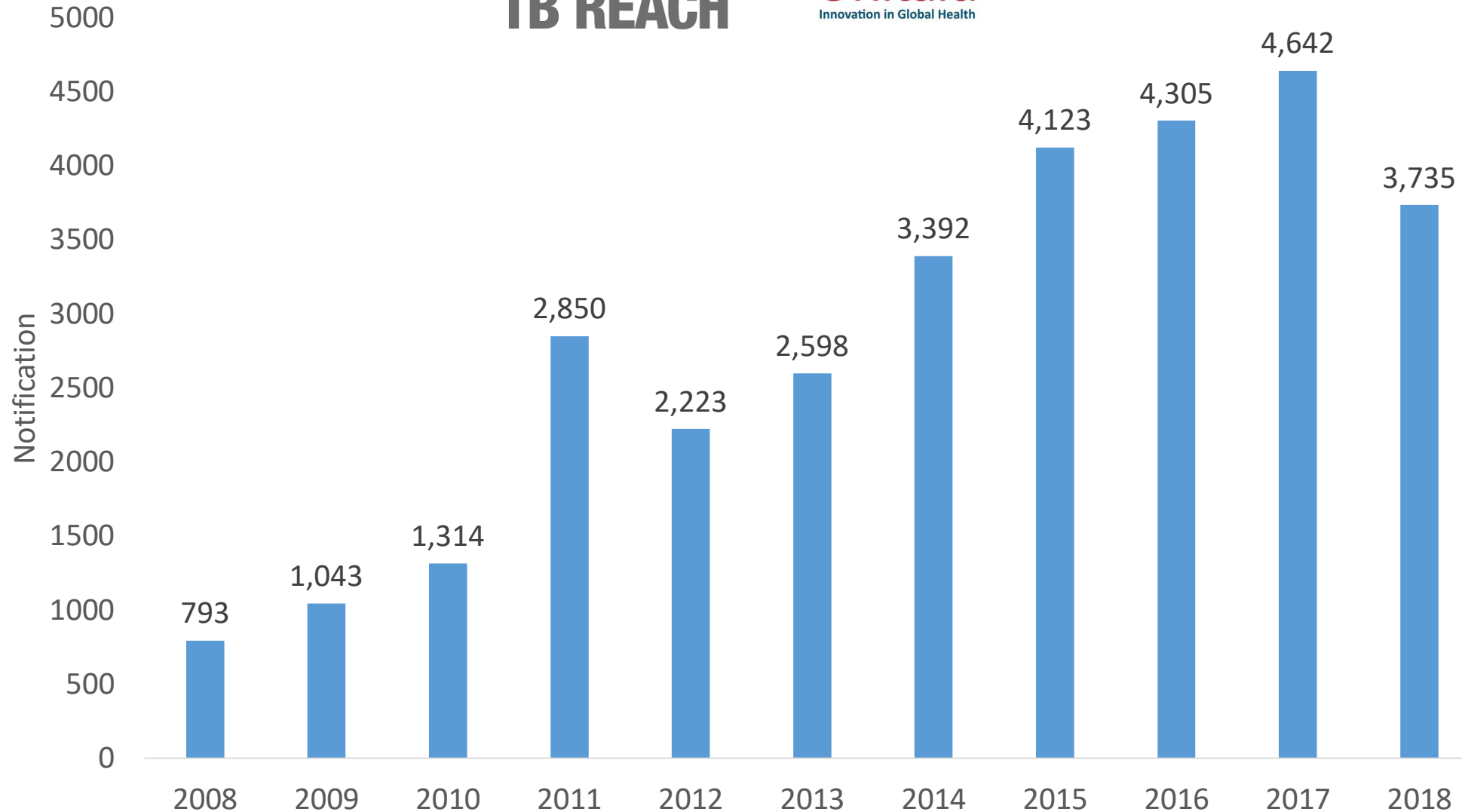
doi: 10.1371/journal.pone.0077517.g003

Korangi Town: All Ages All Forms Notifications
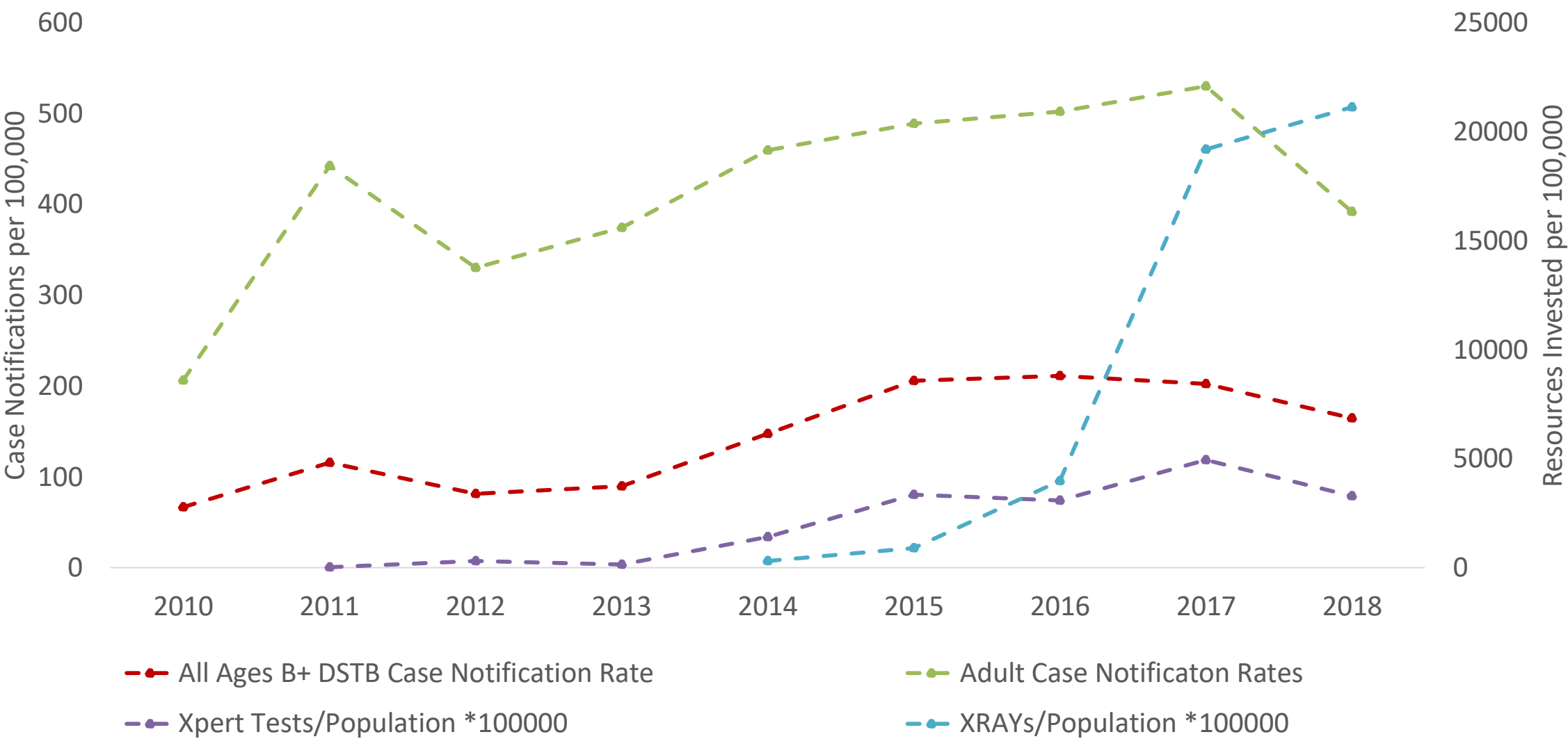## 2010 – Q4 2018

20% decrease in notifications reported from Korangi Town

Korangi Town includes 5 BMUs: Indus Hospital, SZC Korangi, SGH Korangi, Sindh Anti TB Association, and Baldia Maternity Home
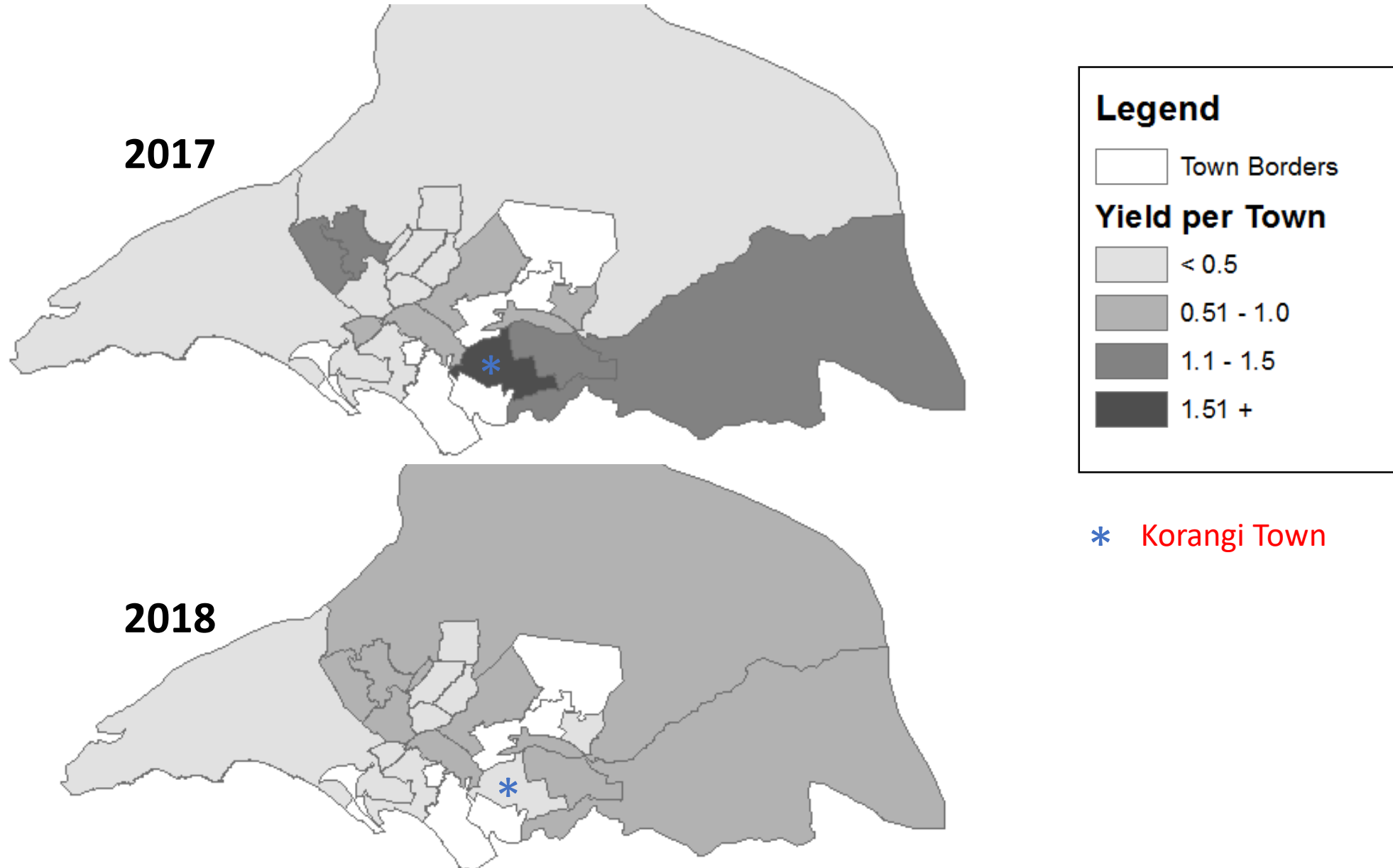
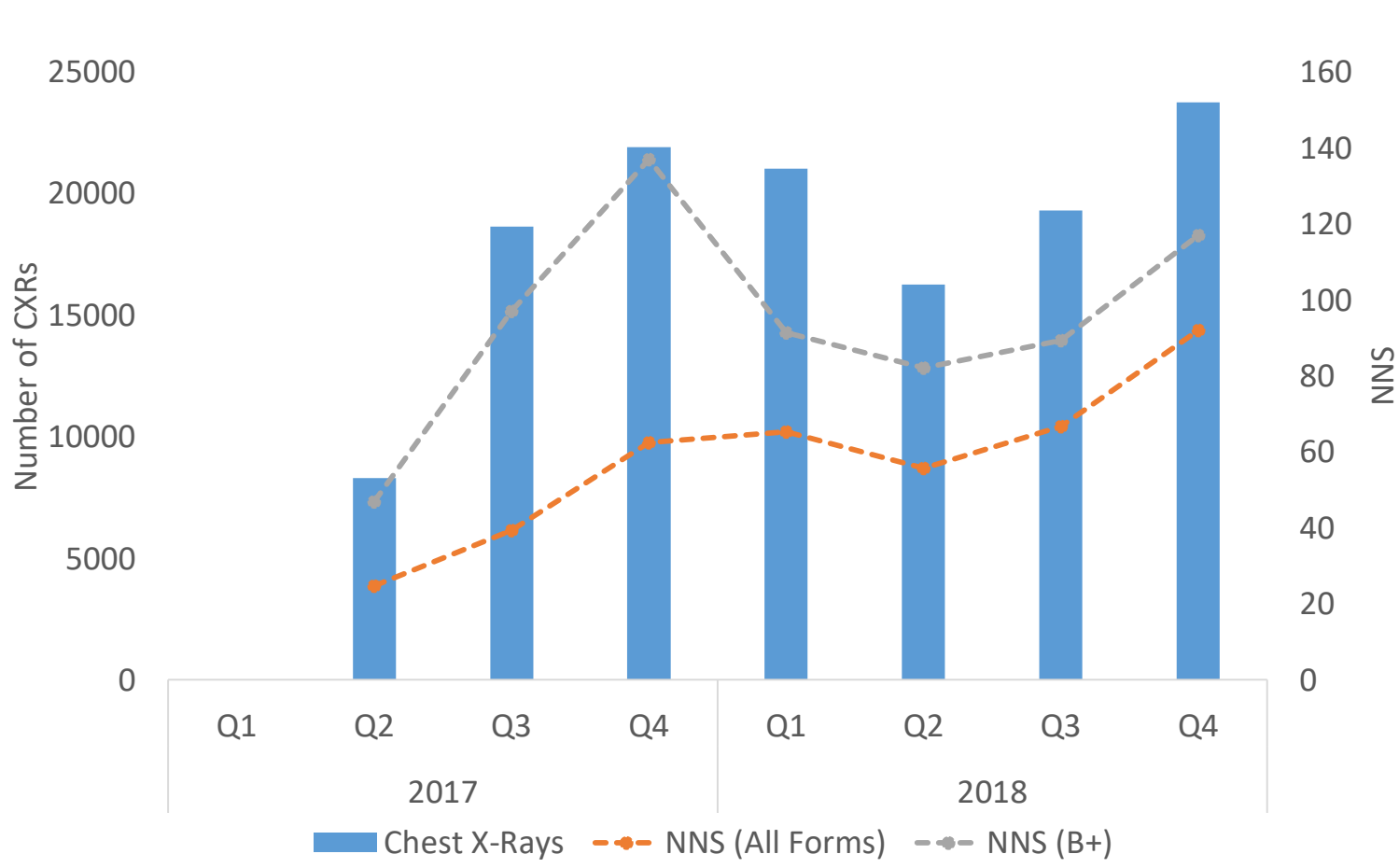**Korangi Town**: Active Case Finding Resources Invested and Case Notifications 2010 - 2018

Legend:
- All Ages B+ DSTB Case Notification Rate
- Adult Case Notificaton Rates
- Xpert Tests/Population *100000
- XRAYs/Population *100000

XRAYs/Population = Fixed and mobile

Karachi : All Forms TB Yield through Community Chest X-ray Camps
2017 and 2018

2017

2018

Legend

Town Borders

Yield per Town

< 0.5

0.51 - 1.0

1.1 - 1.5

1.51 +

*   Korangi Town

Zero TB Interventions in Korangi: CXRs and Increasing NNS
Q1 2017 – Q4 2018

	CXRs	NNS (All Forms)	NNS (B+)
2017 Q1	--	--	--
2017 Q2	8,294	25	47
2017 Q3	18,639	39	97
2017 Q4	21,909	62	137
2018 Q1	21,004	65	91
2018 Q2	16,251	56	82
2018 Q3	19,293	67	89
2018 Q4	23,749	92	117

NNS: Number Needed to Screen # of CXRs/# of cases
ZTB Interventions include GHD performed CXRs (community and facility), CHS run community camps and CHS center CXRs

# Indus Hospital: All Forms Notifications and Proportion of Korangi Residents
2008 – 2018
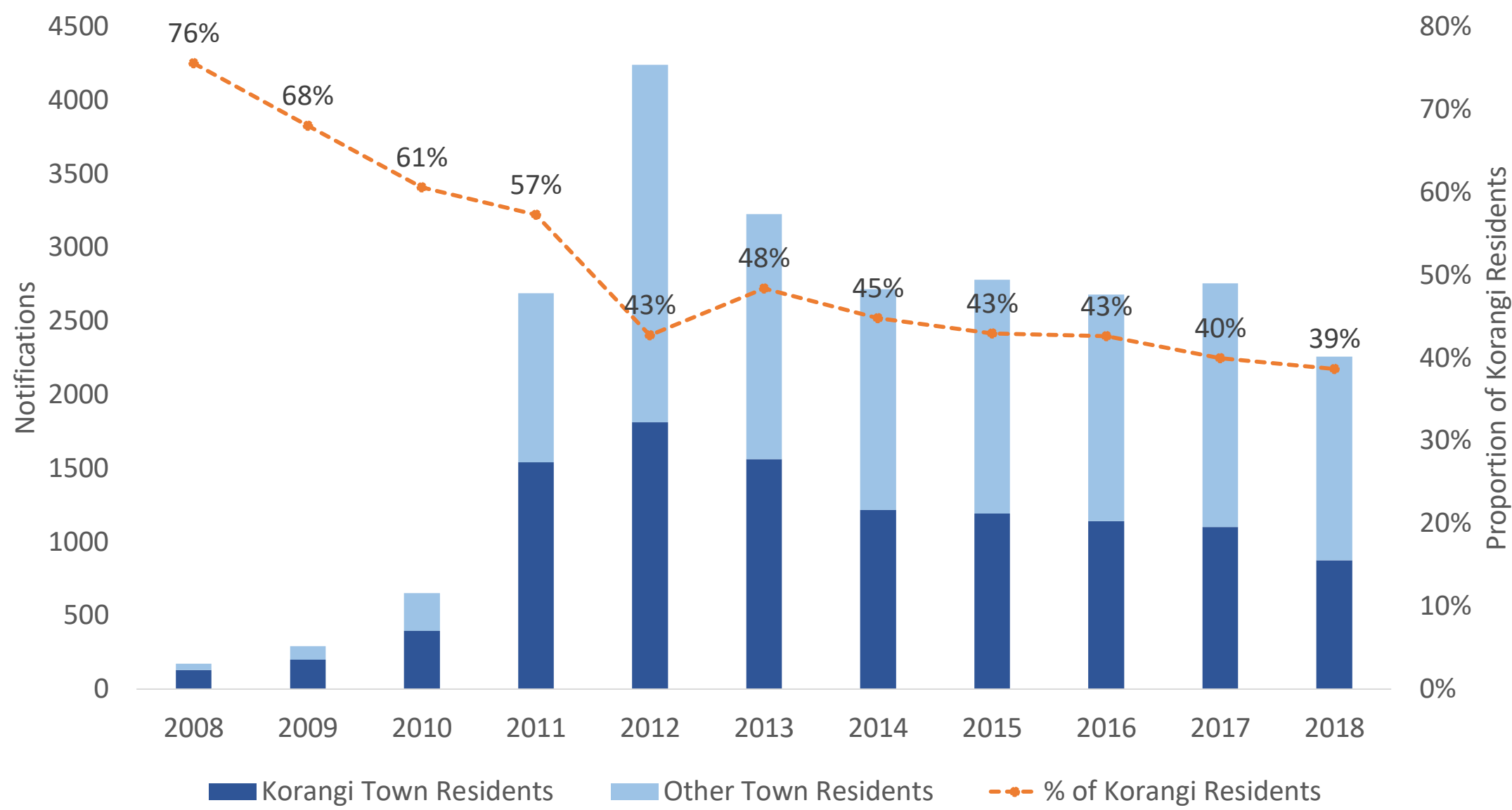
Korangi Adult Tuberculosis Case Notification Rate compared to the rest of Karachi

- Koangi- TB (all forms) Case Notification Rate
- Karachi w/o Korangi - TB (all forms) Case Notification Rate
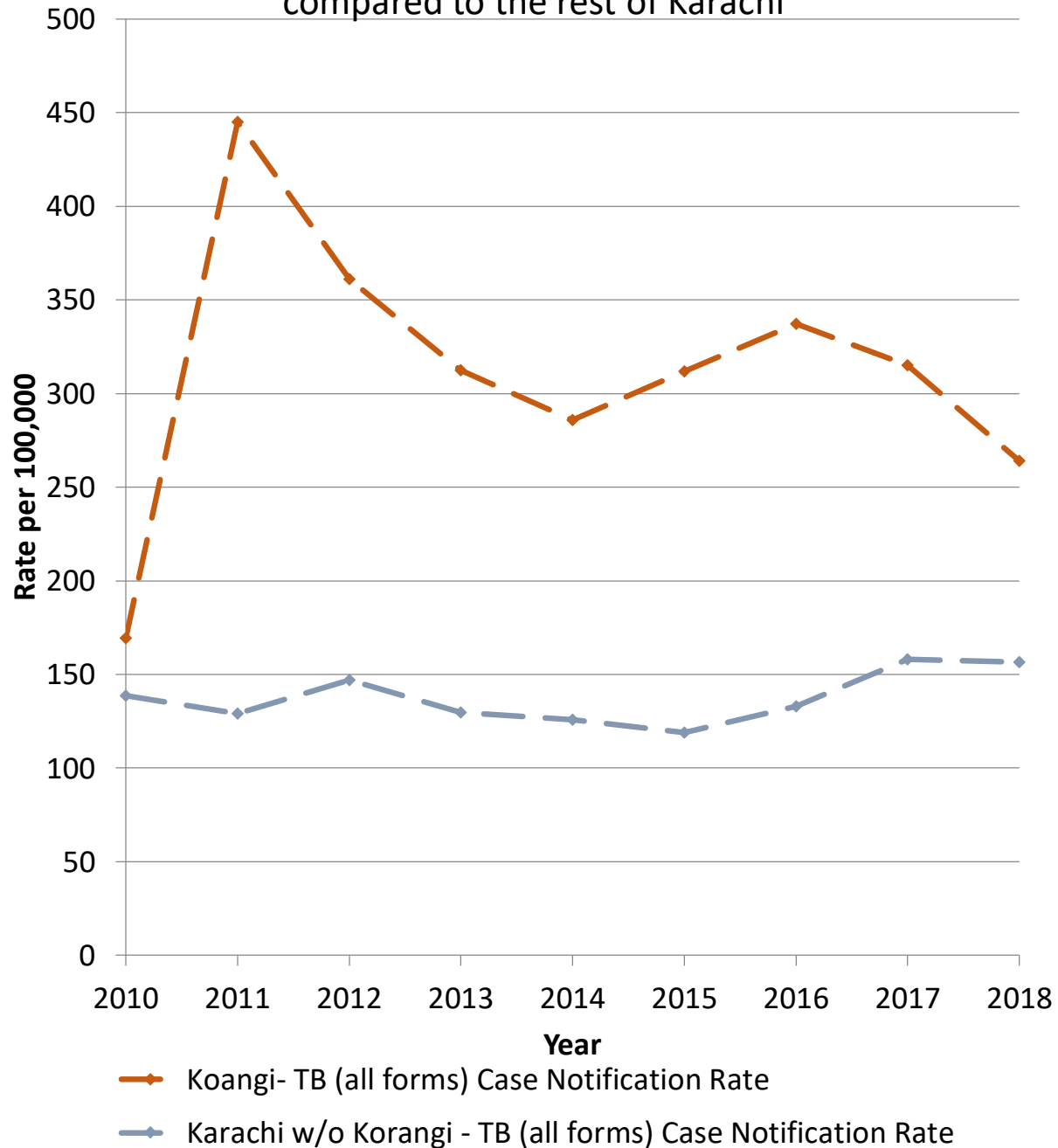
Korangi Pediatric Tuberculosis Case Notification Rate compared to the rest of Karachi

- Korangi - TB (all forms) Case Notification Rate
- Karachi w/o Korangi - TB (all forms) Case Notification Rate
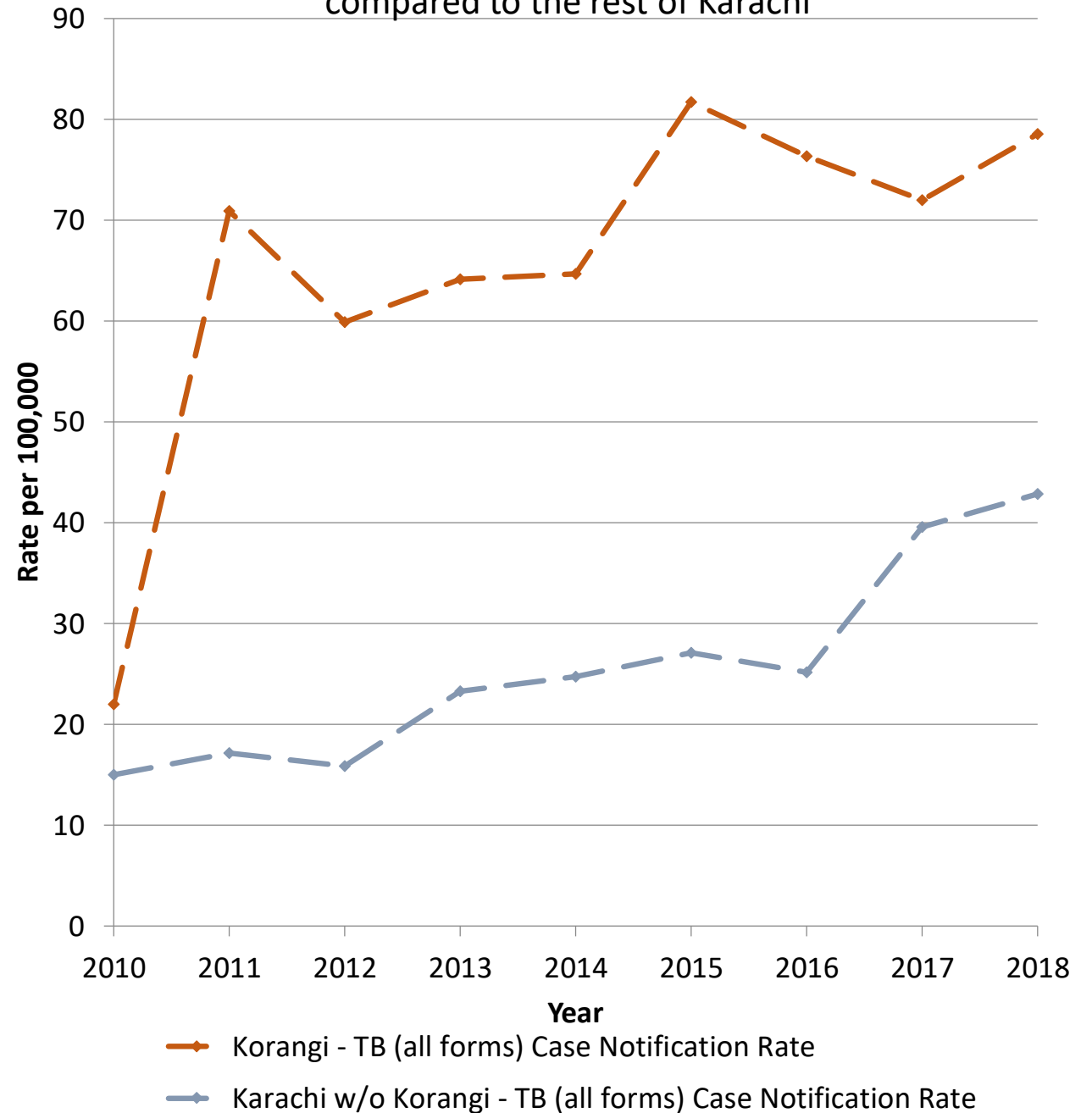
TB Modeling and Universal Health Care

- Modeling TB investments as a conduit to delivering screening and linkage to care for other public health priority diseases
  - Capturing benefits to patients and costs saved to UHC by early diagnosis and referral
    - Diabetes
    - Depression and anxiety
    - Hepatitis C
    - COPD

Zero TB Karachi: HCV Testing and Treatment Cascade

Jan to July 2019
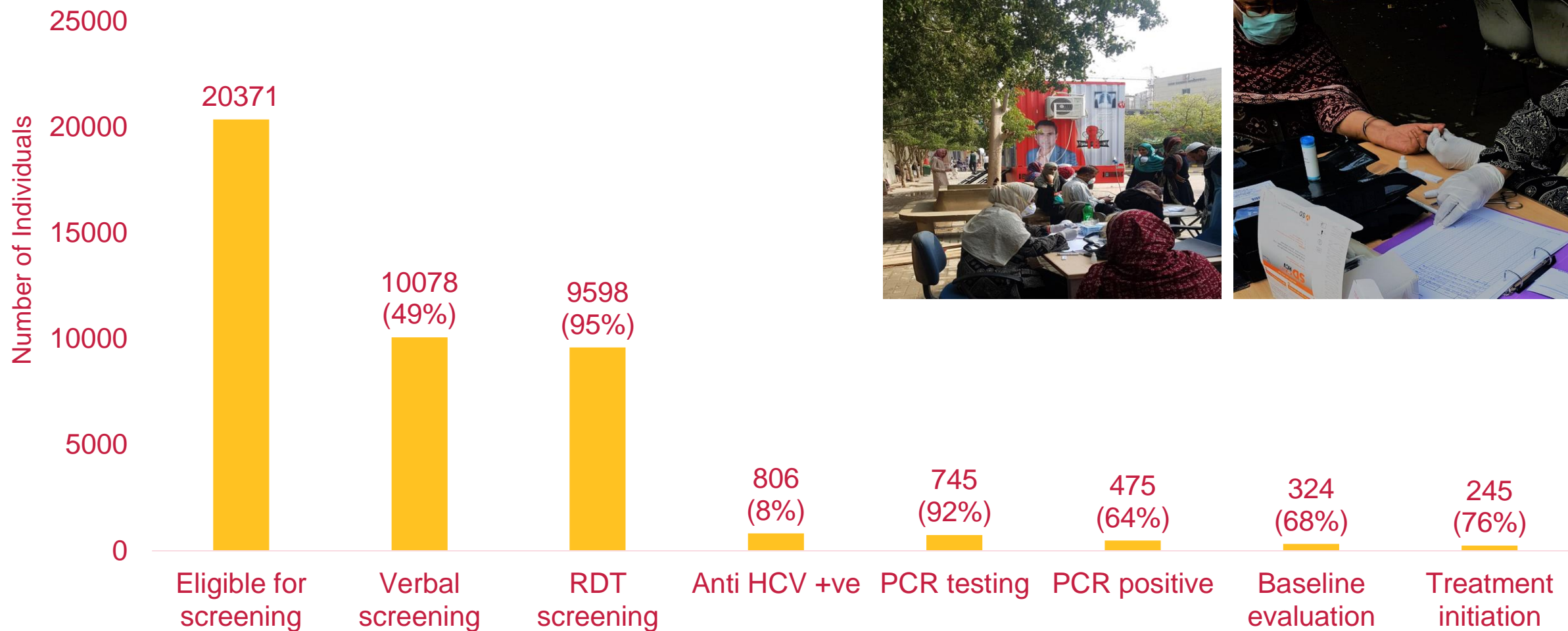
TB Program: Screening for Diabetes and Depression
Integrated Practice Units (IPU)

Supported by the Harvard Medical School-Center for Global Health Delivery-Dubai

Integration of mental health and diabetes services with existing TB treatment sites to improve adherence, treatment outcomes and provide holistic care

Mass screening for Depression & Anxiety

TB Adherence & Mental Health Counseling
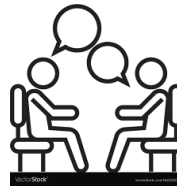
Psychologist-Severe Case Consultation

Diabetes Screening and Consultation

Diabetes Medication and Counseling

TB Program: Screening for Diabetes and Depression
Integrated Practice Units (IPU)

6	10	3,500	1,012	3,441
IPUs developed across public and private hospital settings	Counselors trained and deployed	Screened for Depression and Anxiety. **30%** Symptomatic	Enrolled and given baseline adherence counselling. **562** completed intervention	Screened for Diabetes. **21%** (known diabetics and RBS+) linked to HbA1c testing/care

Key Finding from Integrated Practice Unit (IPU) for Mental Health and TB

92% of patients who completed the mental health intervention also completed TB treatment, compared to a **75%** TB treatment completion rate in those who did not complete the mental health intervention *(Unpublished data)*

Summary (of sorts)

- Data availability drives the development of TB models

  – Increasingly models should drive <u>good practice</u>

- Good epidemic control practice = Search, Treat, Prevent

  – Models can shine a bright light on the Search, Treat, Prevent path

  – Implementers will tell you what is useful and what isn't (for them)

- Effective modeling can help advocate for

  – price reductions of mobile X-ray vans, CAD software, GeneXpert, Rifapentine – high prices are barriers to scale

  – Use of TB investments for delivering UHC and social protection services

Acknowledgement of Zero TB Partners

Discussion Slides (only if needed)

Why stop at UHC? Why not Social Protection?

- Should we model TB programs as conduit for social protection services?
  - Improved targeting of poorest for social protection services
  - Cost savings in integrating social protection services
- Rationale for TB Program
  - Improved uptake of services
  - Improved patient outcomes

Psycho-Social Support Interventions (PSSI)

Improve treatment adherence by addressing the social determinants of health.
Pilot conducted with **250** MDR-TB patients

Life-Skills Based Education

Financial Security/ Microfinance

Well-being Kits

Home Renovation

Counseling

Psycho-Social Support Interventions (PSSI)

Improve treatment adherence by addressing the social determinants of health.
Pilot conducted with MDR-TB patients

345
Patients and Family Members given Life-Skills Education

20
Patients Referred for Microfinance Loans

233
Well-being Kits Distributed

23
Homes Assessed for Infection Control

239
DR-TB Patients Identified for Mental Health Counseling

Korangi Town Residents: MDR-TB Enrolments and Proportion that are New Infections 2009 – May 2019
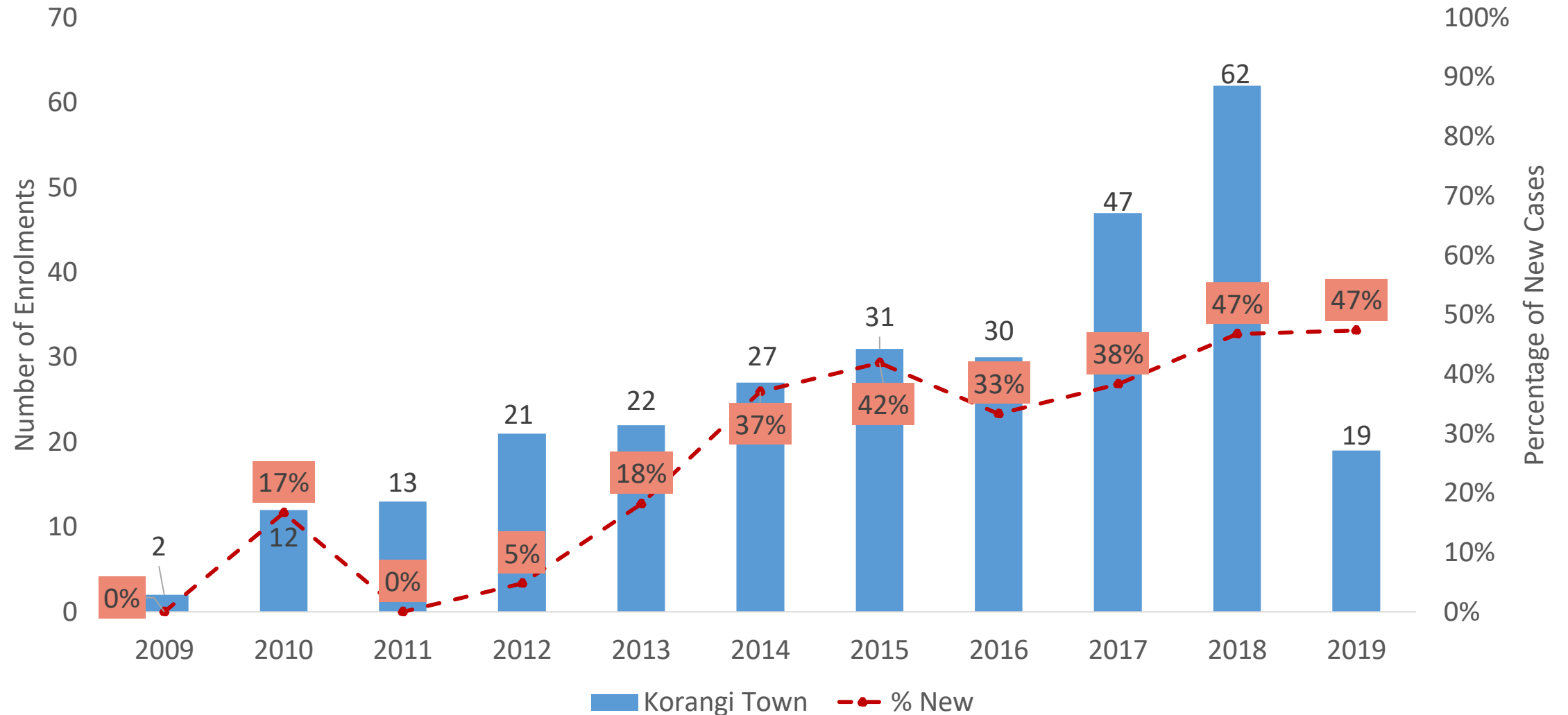
Should we account for emerging models of private care in costing diagnostics and treatment?

- Out-of-pocket costs for diagnosis and care (TB and other diseases) often not captured

- Social enterprises can reduce costs to donors/governments by cross-subsidizing TB care from revenues generated by general patient services (e.g. laboratory tests)
  - Still a cost to society, even if no longer being borne by donor/government

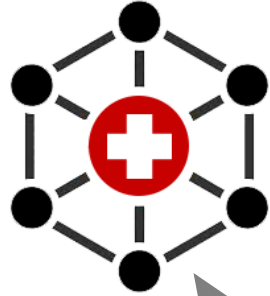# Social Enterprise Scale-up in Pakistan
(2017-Current)

51 private provider network diagnostic centers in 27 districts
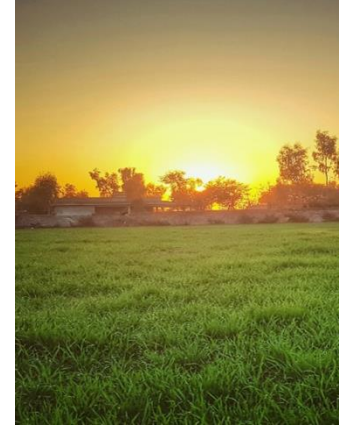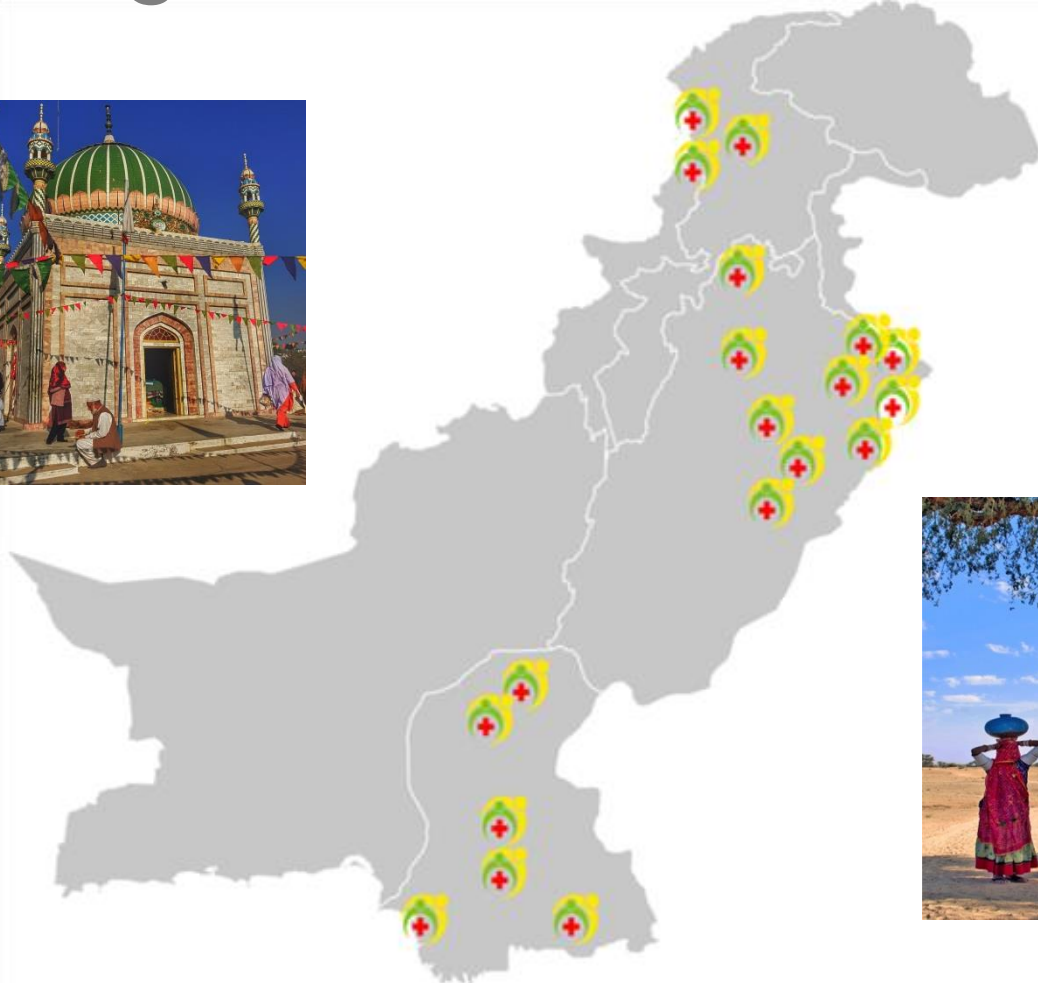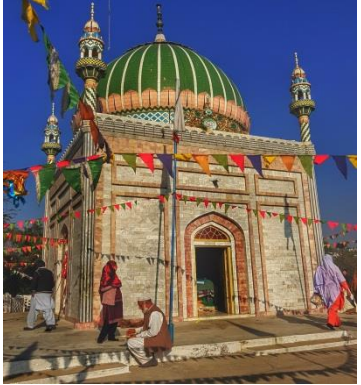
TB Services Model and Aggregator Platform

Private Sector Network

Referrals generated through network of 100 health providers around each of the 61 centers of excellence

Provincial Tuberculosis Program

All TB cases registered at SZ centers are notified to the Department of Health TB program,

Active Case Finding

Free TB Screening through GP clinic camps and Mobile X-Ray camps in the community

TB Treatment

All patients detected with TB are registered on free 1st line treatment, counselled and followed-up

Walk-Ins

Patients referred by people they trust who have experienced SZ services
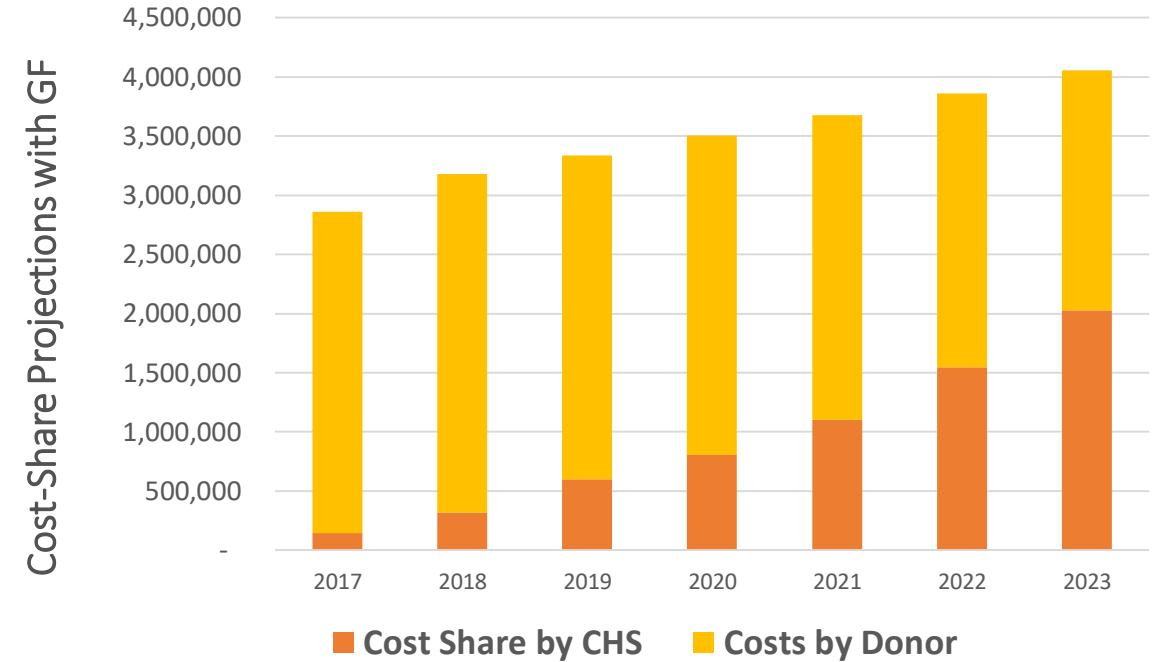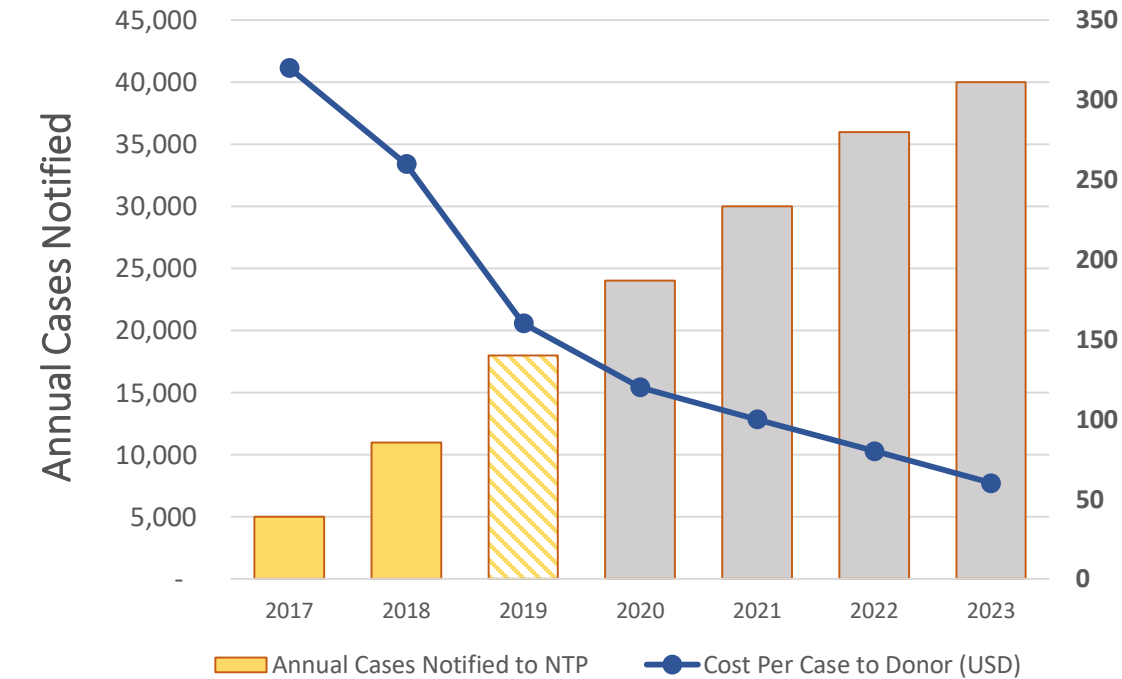
Drug Resistant TB Management sites

All cases with DR-TB are referred to Programmatic Management of DR-TB sites

Social Enterprise Models for Sustainable TB Care

-A capitation-based reimbursement for TB under UHC can create incentives for increased cost-effectiveness and cost-sharing through cross-subsidization models

رشتہ احساس کا
صحت مند زندگی
SEHATMAND ZINDAGI

Chart 1 (left): Annual Cases Notified (left y-axis: - to 45,000) vs Cost Per Case to Donor (USD) (right y-axis: 0 to 350), years 2017–2023.

- Legend: Annual Cases Notified to NTP | Cost Per Case to Donor (USD)

Chart 2 (right): Cost-Share Projections with GF (y-axis: - to 4,500,000), years 2017–2023.

- Legend: **Cost Share by CHS** | **Costs by Donor**

$4,000
Monthly Revenue

Generated for **supporting operational** costs by **each of first 3 centers** in 2017
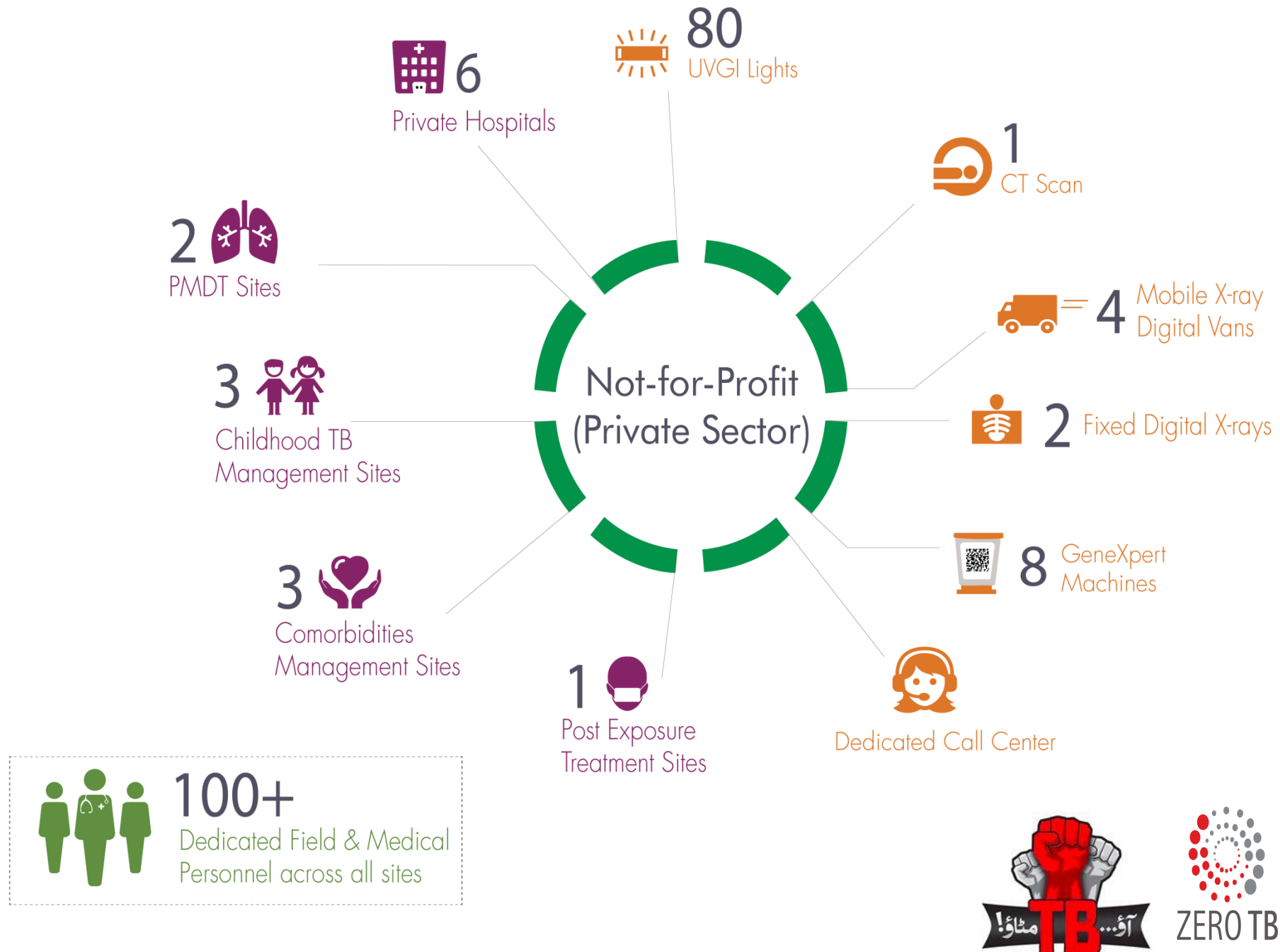
$1,500
Mega Cities

Average monthly revenue from **36 new centers** in **Karachi and Lahore**

$700
Urban and Rural

Average monthly revenue from **22 new centers** in **smaller cities** and **rural** districts

Not-for-Profit (Private Sector)

- 6 Private Hospitals
- 80 UVGI Lights
- 1 CT Scan
- 4 Mobile X-ray Digital Vans
- 2 Fixed Digital X-rays
- 8 GeneXpert Machines
- Dedicated Call Center
- 1 Post Exposure Treatment Sites
- 3 Comorbidities Management Sites
- 3 Childhood TB Management Sites
- 2 PMDT Sites

100+ Dedicated Field & Medical Personnel across all sites

TB آؤ...مٹاؤ!

ZERO TB