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Impact Assessment of Typhoid Conjugate Vaccine in Sindh, Pakistan

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Outline

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 - Impact of TCV from lab network data in Sindh (interrupted time series)
 - Impact of TCV from hospital-based surveillance data in Karachi
- Conclusion
- Acknowledgement

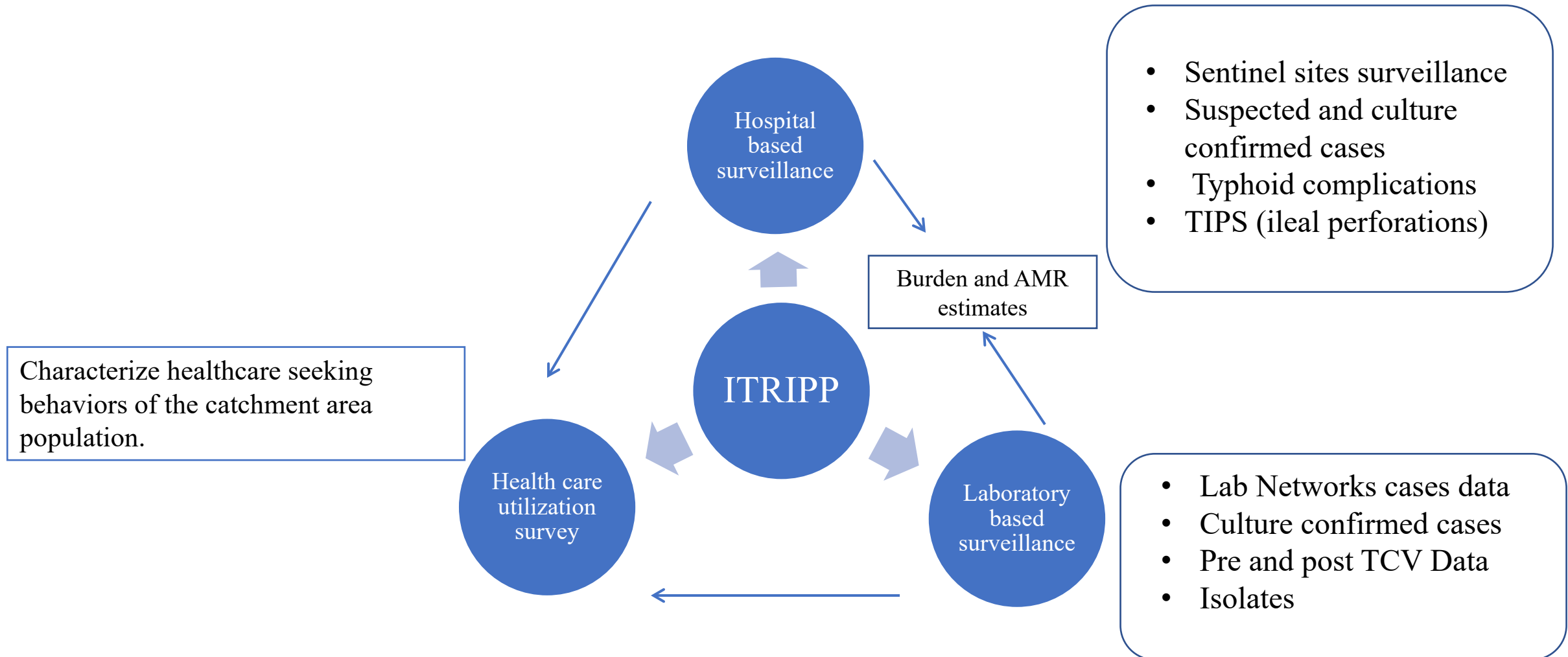


Background

- Typhoid is a significant public health problem globally
- XDR outbreak in 2016 → limited treatment options in Pakistan
- TCV introduction in Pakistan in 2019/20 in Sindh, 2021 in Punjab and 2022 in other provinces
- Routine immunization at 9 months
- Catch up campaign 9 mo to 15 years (Nov-Dec 2019 in Sindh)
- SEAP study (2016 to 2019) and ITRIPP study (2020 to 2023) provides data for impact assessment in Karachi



Study methods





Laboratory networks



- Aga Khan University Lab network (AKU)
- Liaquat University of Medical and Health Sciences (LUMHS)



- Chughtai Laboratory Network (CLL)

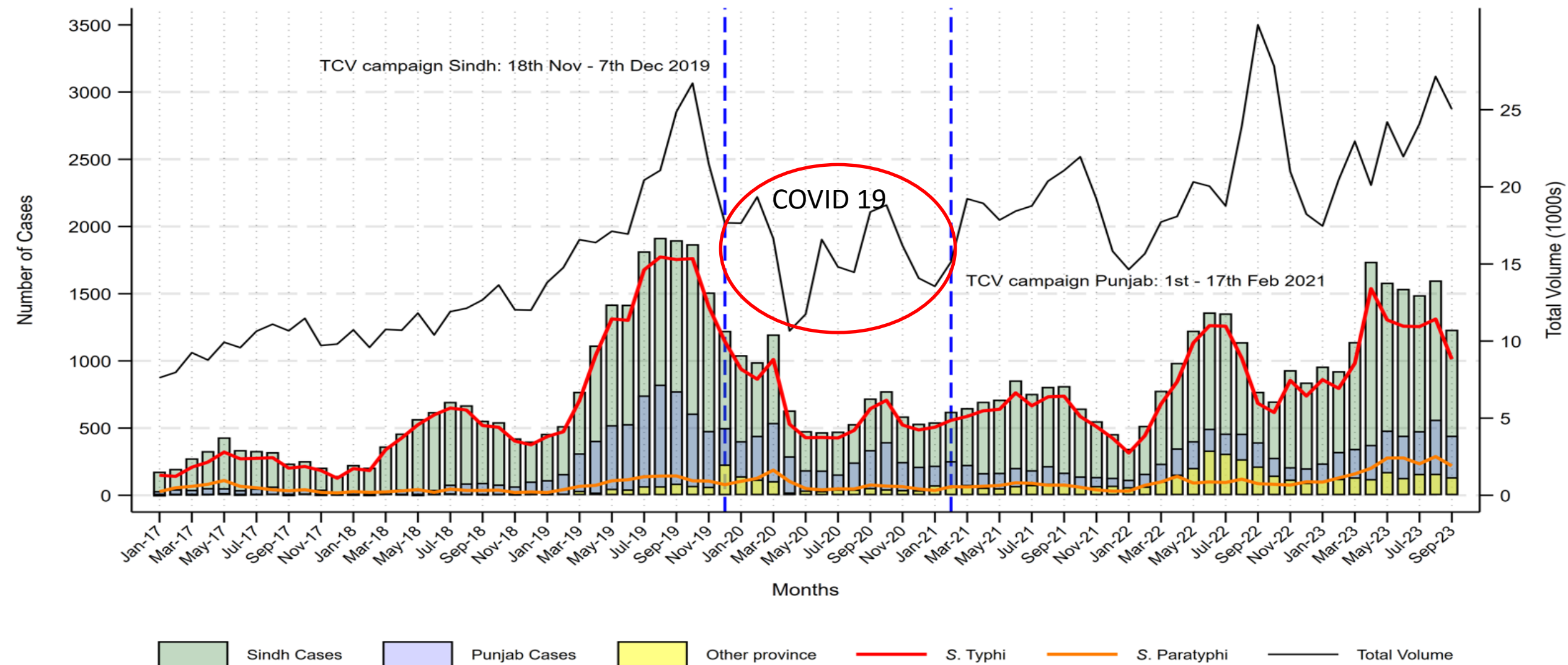


- Shaukat Khanum Memorial Hospital and Research Center Lab (SKMCH)
- Shifa Labs

Trend of culture confirmed typhoid in Pakistan 2017- 2023

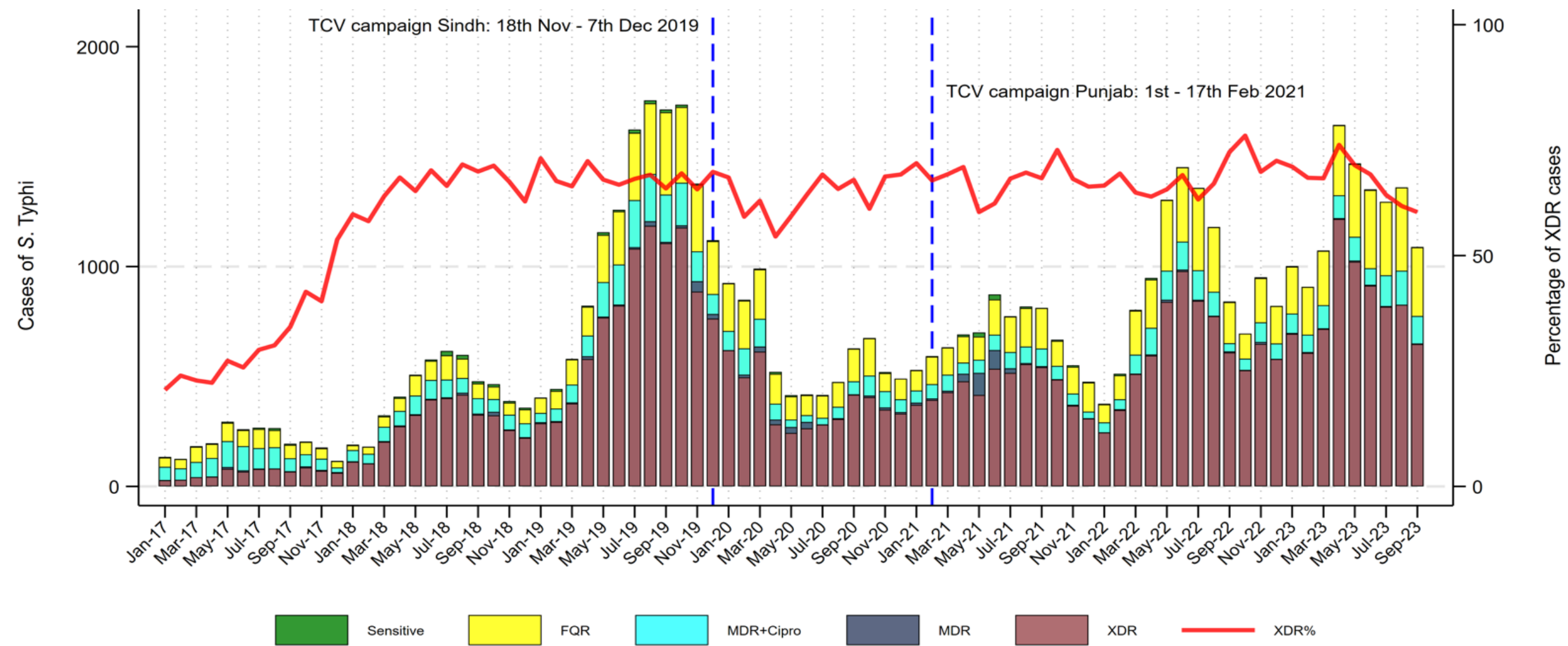


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Trend of AMR in typhoid in Pakistan 2017- 2023

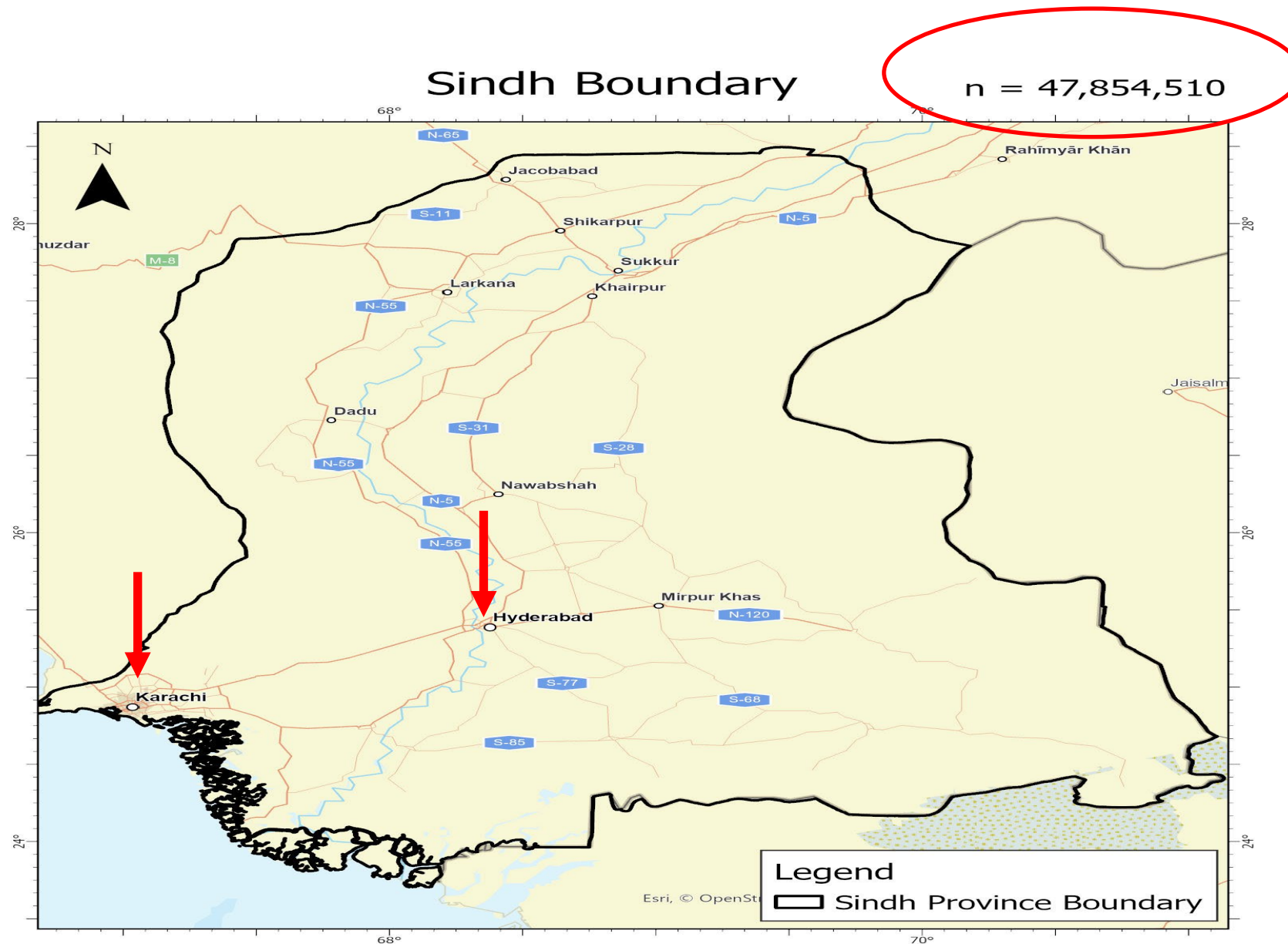


XDR: Resistant to Ampicillin, Co-trimoxazole, chloramphenicol, ciprofloxacin and ceftriaxone/ cefixime
MDR: Resistant to Ampicillin, Co-trimoxazole and chloramphenicol
MDR+Cipro: Resistant to Ampicillin, Co-trimoxazole, chloramphenicol and ciprofloxacin
FQR: Resistant to Ciprofloxacin only
Sensitive: Sensitive to Ampicillin, Co-trimoxazole, chloramphenicol, ciprofloxacin and ceftriaxone/cefixime

Laboratory surveillance catchment in Sindh



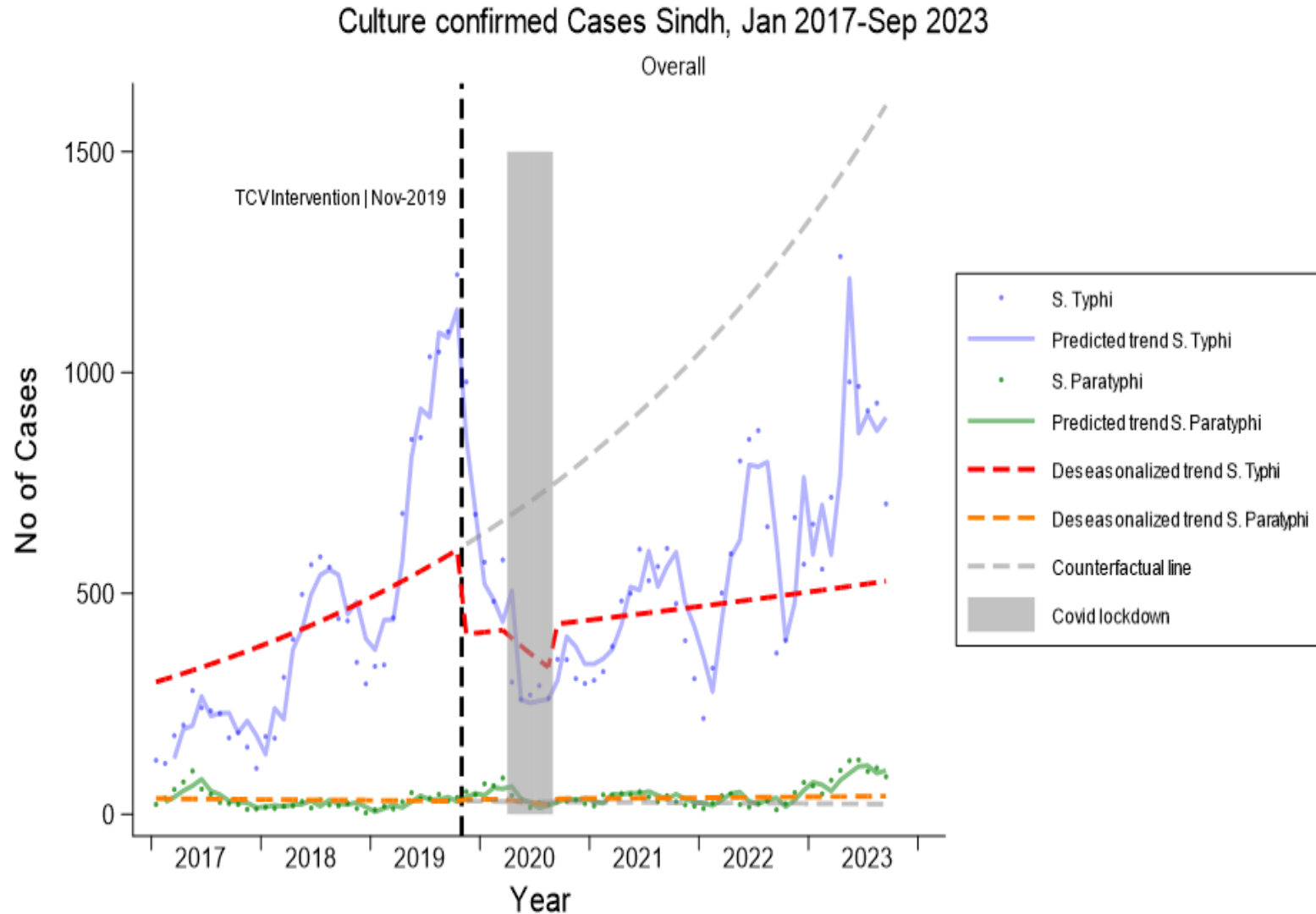
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Interrupted Time Series Regression measuring impact of TCV in Sindh (2017- 2023)



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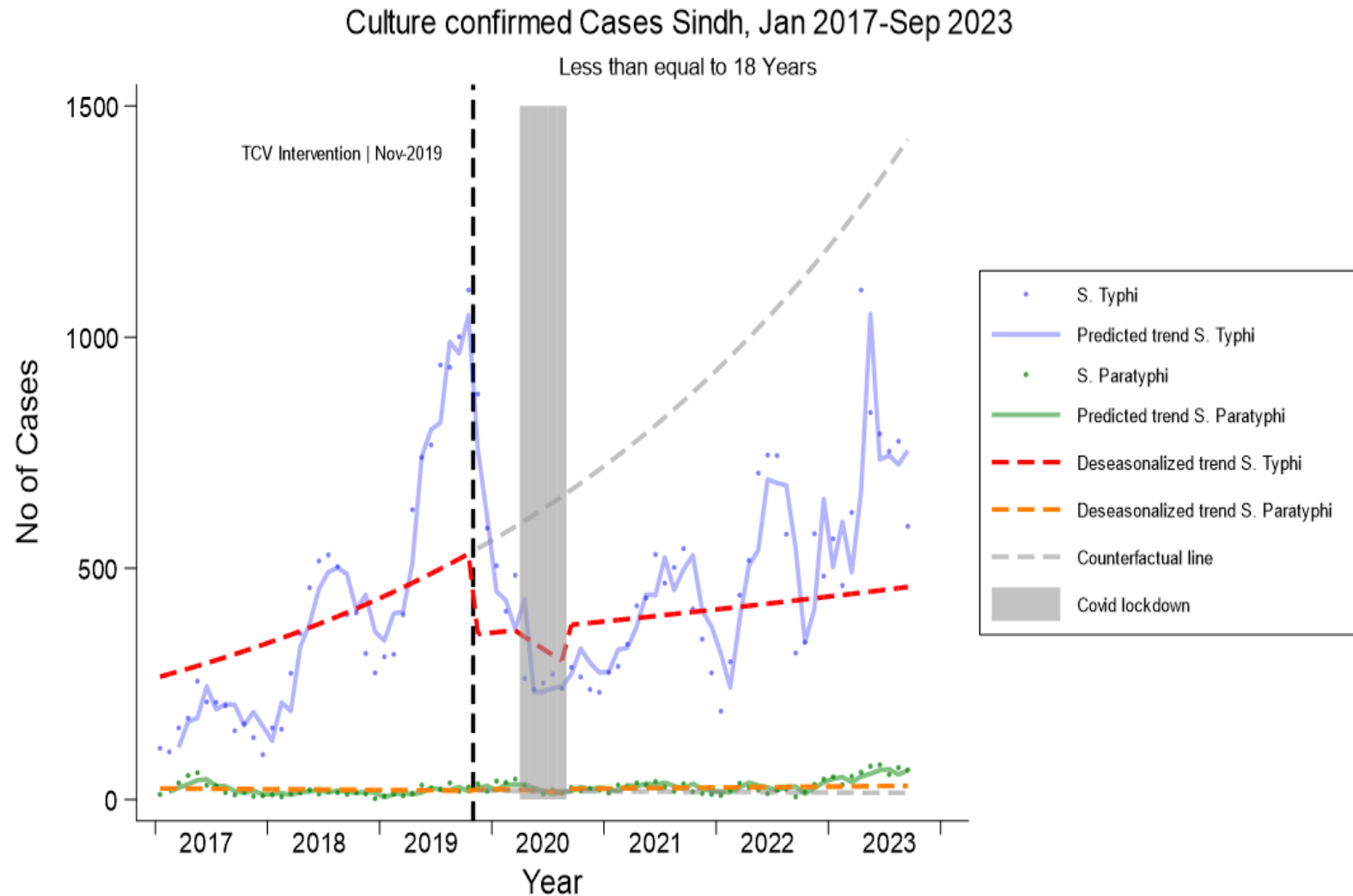


- **32% reduction in incidence level
(IRR 0.68; 95% CI: 0.55, 0.83)**
- **2% reduction in overall trend
(IRR 0.98; 95% CI: 0.97, 0.99)**
- **COVID 19 related lockdown had
transient effect**

Interrupted Time Series Regression measuring impact of TCV in age ≤ 18 years in Sindh (2017- 2023)



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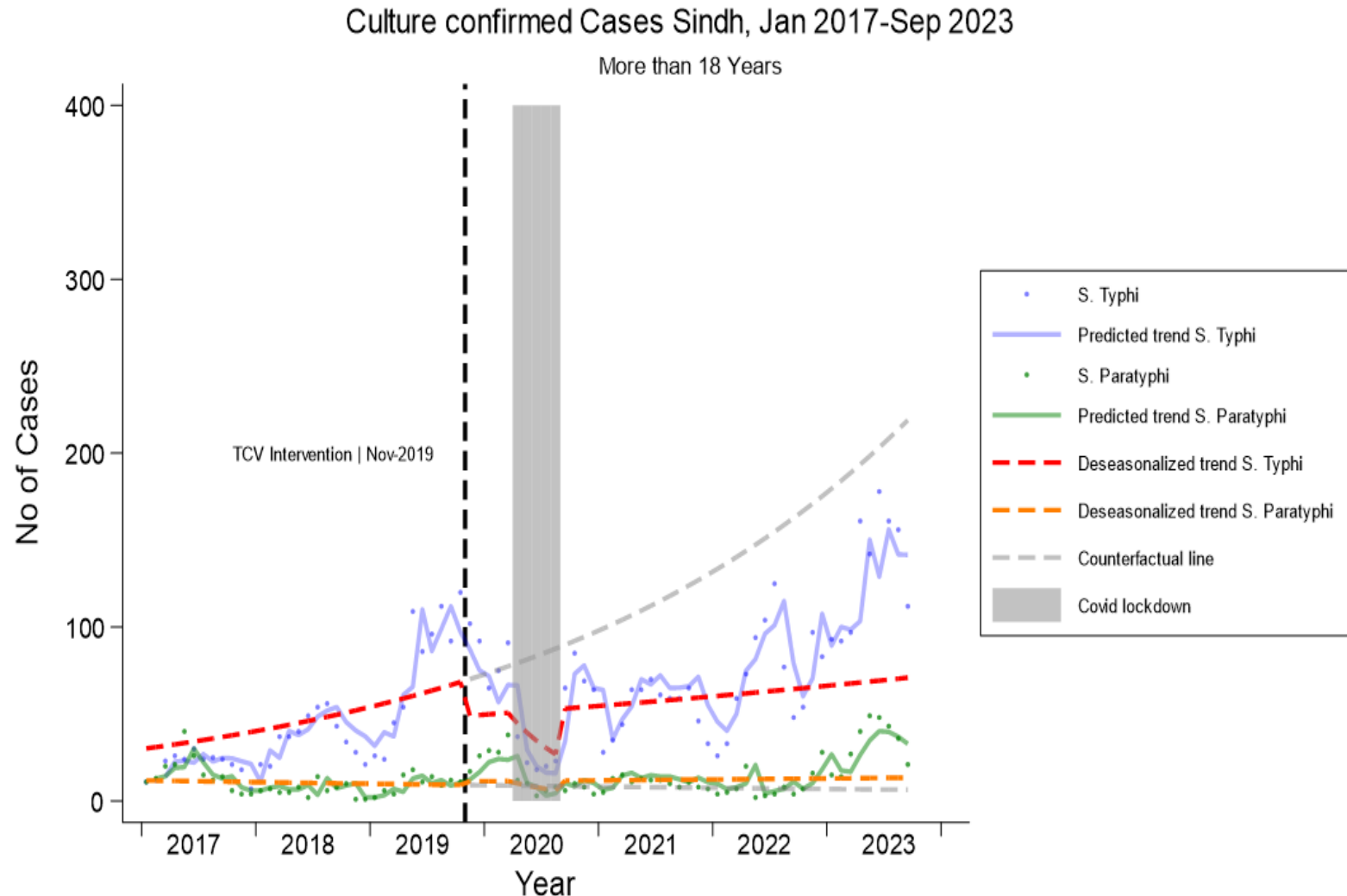


- **33% reduction in incidence level**
(IRR 0.67; 95% CI: 0.55, 0.82)
- **2% reduction in overall trend**
(IRR 0.98; 95% CI: 0.97, 0.99)
- **COVID 19 related lockdown had transient effect**

Interrupted Time Series Regression measuring impact of TCV in age > 18 years in Sindh (2017-2023)



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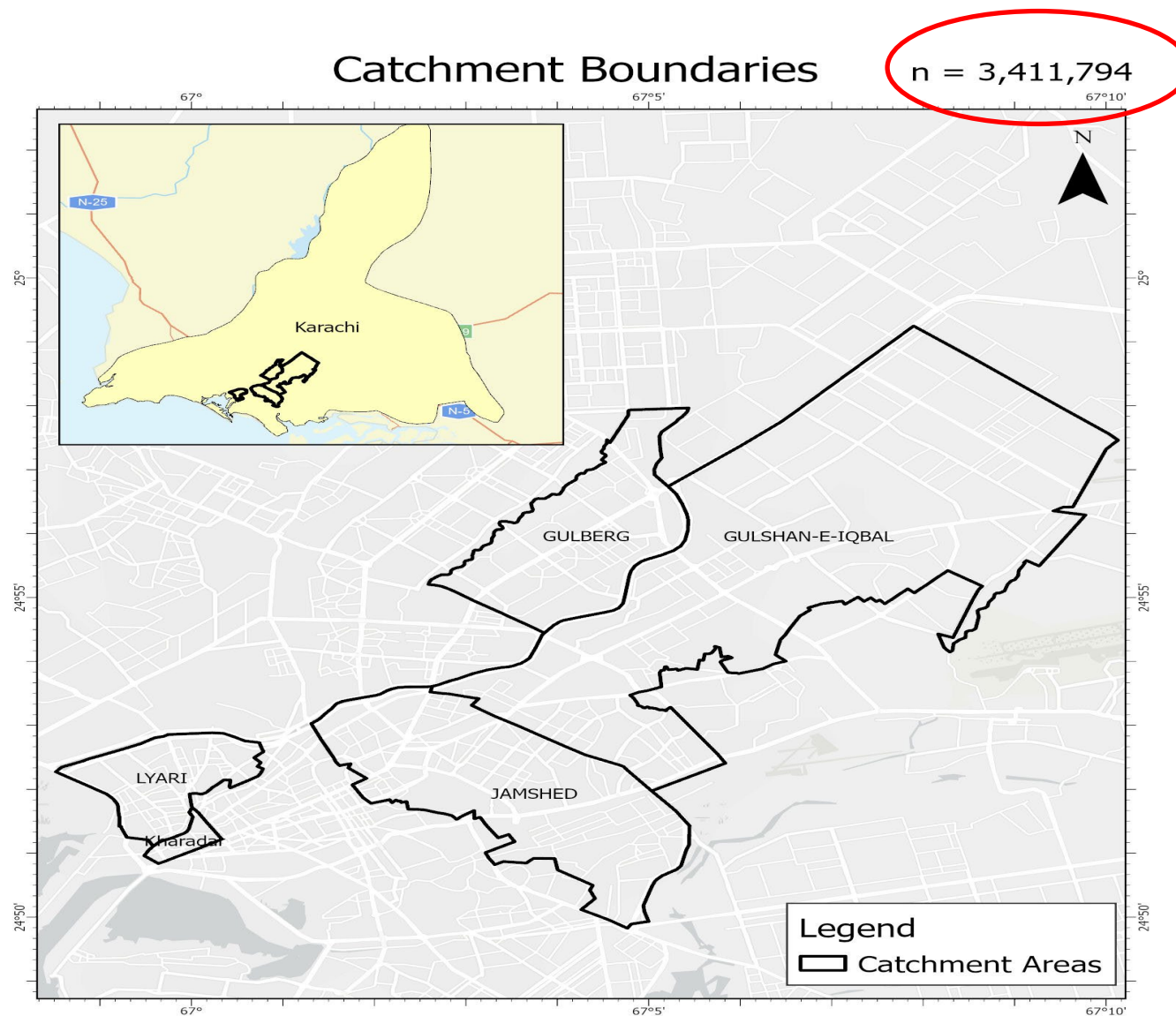


- **29% reduction in incidence level**
(IRR 0.71; 95% CI: 0.55, 0.92)
- **2% reduction in overall trend**
(IRR 0.98; 95% CI: 0.97, 0.99)
- **COVID 19 related lockdown had transient effect**

Hospital surveillance catchment in Karachi



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Incidence rate ratios of typhoid before and after TCV introduction in Karachi (Oct 2017 to Sep 2023)



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| Age (years) | Pre vaccine period (2017 – 2019) | | | Post vaccine period (2020 – 2023) | | | IRR (95% CI) |
|-------------|----------------------------------|------------|------------|-----------------------------------|------------|-----------|-------------------|
| | Cases | Population | Incidence* | Cases | Population | Incidence | |
| < 2 | 157 | 201433 | 77.9 | 103 | 201433 | 51.1 | 0.38 (0.28, 0.50) |
| 2 - 4 | 351 | 402865 | 87.1 | 151 | 402865 | 37.5 | 0.42 (0.34, 0.51) |
| 5 - 18 | 533 | 1724026 | 30.9 | 103 | 1724026 | 6.0 | 0.27 (0.21, 0.35) |
| 19 - 25 | 77 | 782033 | 9.8 | 51 | 1364954 | 3.7 | 0.38 (0.27, 0.54) |
| > 25 | 81 | 2808208 | 2.9 | 49 | 4901426 | 1.0 | 0.35 (0.24, 0.49) |

1/3rd reduction in health seeking among age group ≥ 18 yrs post TCV time as compared pre-TCV period – resulting in 1/3 decrease in typhoid cases

*unadjusted incidence per 100,000

Incidence rate ratios of paratyphoid before and after TCV introduction in Karachi (Oct 2017 to Sep 2023)



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| Age (years) | Pre vaccine period (2017 – 2019) | | | Post vaccine period (2020 – 2023) | | | IRR (95% CI) |
|-------------|----------------------------------|------------|------------|-----------------------------------|------------|-----------|--------------------|
| | Cases | Population | Incidence* | Cases | Population | Incidence | |
| < 2 | 2 | 201433 | 1.0 | 6 | 351579 | 1.7 | 1.72 (0.35, 8.57) |
| 2 - 4 | 2 | 402865 | 0.5 | 18 | 703158 | 2.6 | 5.16 (1.20, 22.22) |
| 5 - 18 | 12 | 1724026 | 0.7 | 29 | 3009103 | 1.0 | 1.38 (0.71, 2.71) |
| 19 - 25 | 8 | 782033 | 1.0 | 7 | 1364954 | 0.5 | 0.50 (0.17, 1.50) |
| > 25 | 7 | 2808208 | 0.2 | 12 | 4901426 | 0.2 | 0.57 (0.06, 5.84) |

*unadjusted incidence per 100,000



Incidence rate ratios of typhoid at OPD before and after TCV introduction in Karachi (Oct 2017 to Sep 2023)

| Age (years) | Pre vaccine period (2017 – 2019) | | | Post vaccine period (2020 – 2023) | | | IRR (95% CI) |
|-------------|----------------------------------|------------|------------|-----------------------------------|------------|-----------|-------------------|
| | Cases | Population | Incidence* | Cases | Population | Incidence | |
| < 2 | 82 | 201433 | 40.7 | 54 | 351579 | 15.4 | 0.38 (0.27, 0.53) |
| 2 - 4 | 181 | 402865 | 44.9 | 153 | 703158 | 21.8 | 0.48 (0.39, 0.60) |
| 5 - 18 | 232 | 1724026 | 13.5 | 163 | 3009103 | 5.4 | 0.40 (0.29, 0.57) |
| 18 - 25 | 36 | 782033 | 4.6 | 24 | 1364954 | 1.8 | 0.38 (0.23, 0.64) |
| > 25 | 28 | 2808208 | 1.0 | 30 | 4901426 | 0.6 | 0.61 (0.37, 1.03) |

*unadjusted incidence per 100,000

Incidence rate ratios of typhoid in hospitalized cases after TCV introduction in Karachi (Oct 2017 to Sep 2023)



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| Age (years) | Pre vaccine period (2017 – 2019) | | | Post vaccine period (2020 – 2023) | | | IRR (95% CI) |
|----------------|----------------------------------|------------|------------|-----------------------------------|------------|-----------|-------------------|
| | Cases | Population | Incidence* | Cases | Population | Incidence | |
| < 2 | 75 | 201433 | 37.2 | 49 | 351579 | 13.9 | 0.40 (0.21, 0.77) |
| 2 - 4 | 170 | 402865 | 42.2 | 101 | 703158 | 14.4 | 0.35 (0.23, 0.53) |
| 5 - 18 | 301 | 1724026 | 17.5 | 89 | 3009103 | 3.0 | 0.16 (0.08, 0.31) |
| 16 - 25 | 41 | 782033 | 5.2 | 27 | 1364954 | 2.0 | 0.38 (0.23, 0.61) |
| > 25 | 53 | 2808208 | 1.9 | 19 | 4901426 | 0.4 | 0.21 (0.12, 0.35) |

*unadjusted incidence per 100,000



Conclusion

- TCV has a 60% to 85% impact against culture confirmed typhoid in Karachi
- Impact in ≥ 18 years is attributed to $1/3^{\text{rd}}$ reduction in healthcare seeking post TCV introduction
- TCV leads to overall decline in culture confirmed cases irrespective of severity
- Further analysis with adjustment for healthcare seeking is needed
- Strengthening of routine immunization coverage is a key



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THANK YOU

