Secondary attack rates and determinants of Sars-CoV-2 household transmission in Pakistan

A case-ascertained prospective, longitudinal study

IDM Annual Symposium 2023

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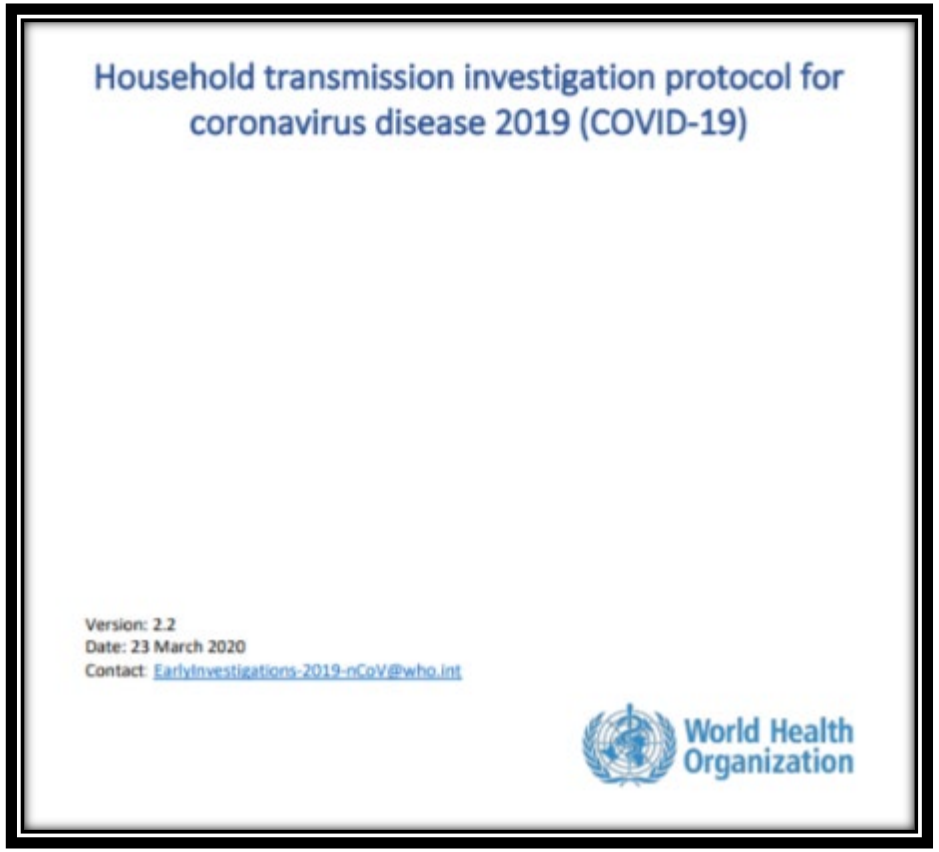
Introduction

- Aim: To study SARS-CoV-2 household transmission in the background of increasing seroprevalence due to multiple COVID-19 waves.

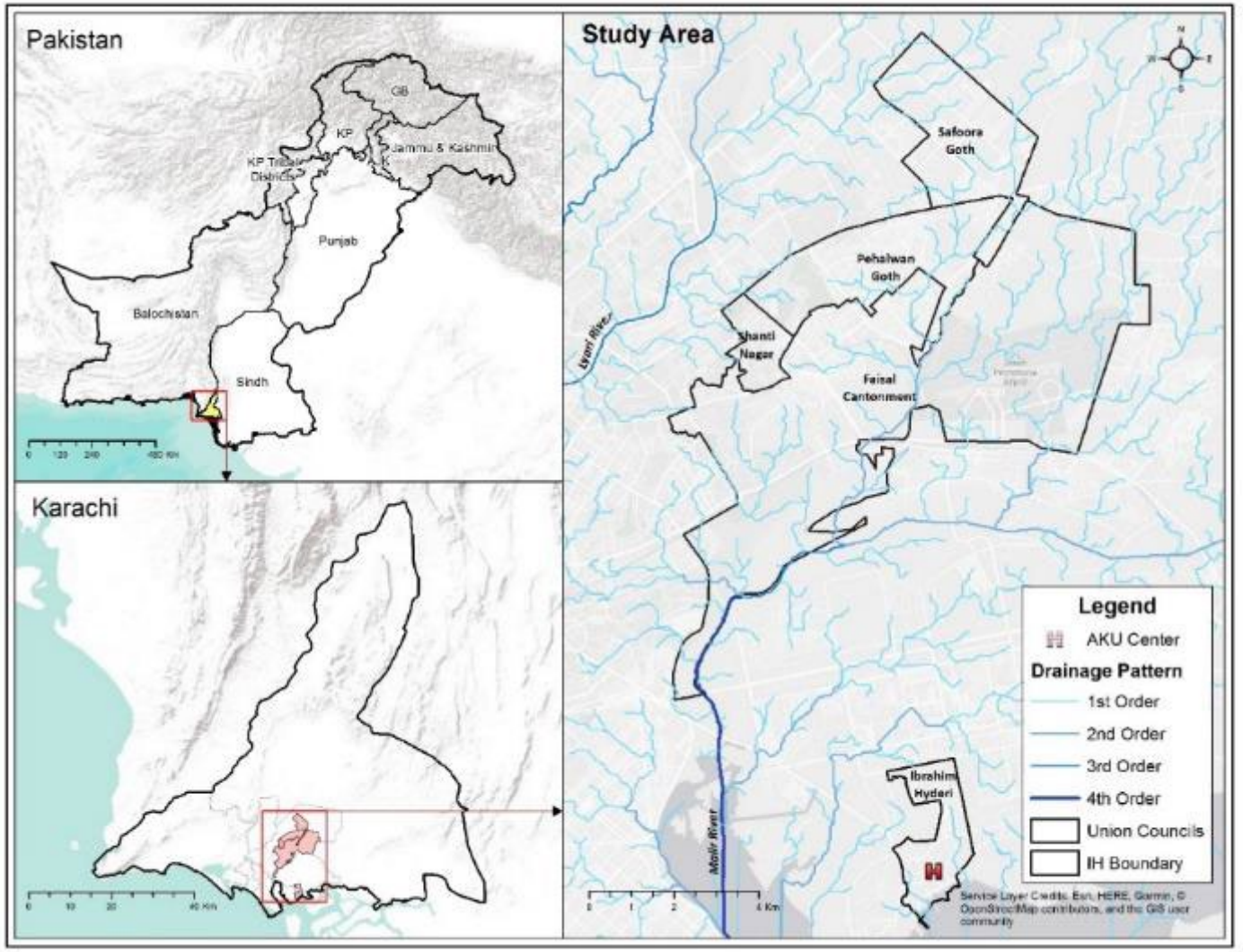
- Rationale: Disease ‘Clustering’ among household with spread starting even before the appearance of symptoms. Urban dwellings serve as an ideal setting for infectious disease transmission.



Methods

- Timeline: October 2020 to January 2021, during the second wave of the pandemic

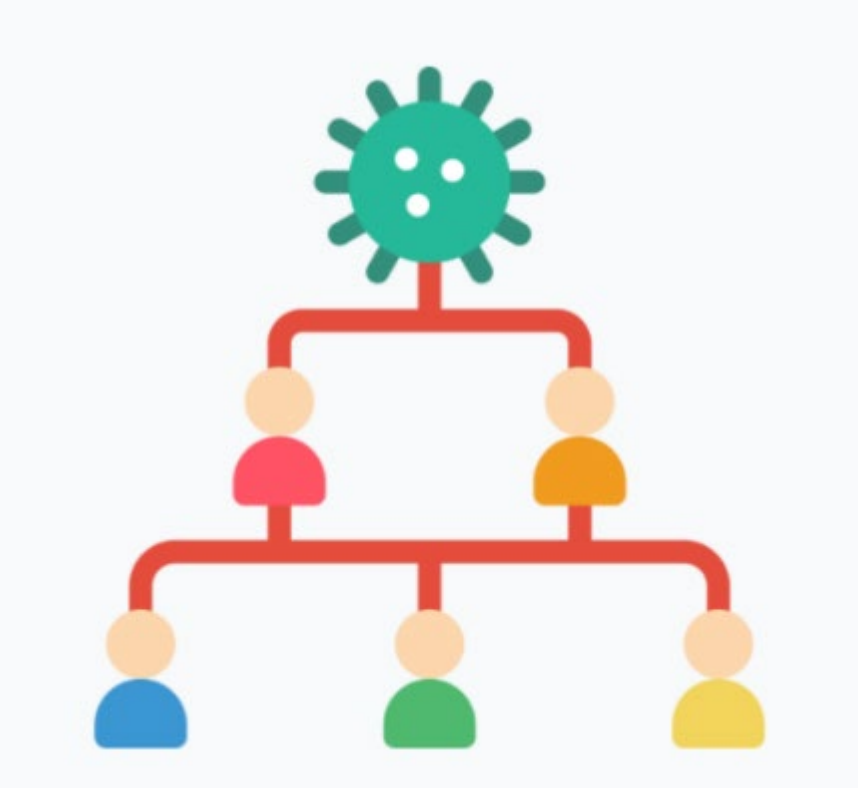
- Setting: District East of Karachi, Pakistan which has a population of 2.9 million people residing in 509,647 households.



Case & Contact Identification

- Cases: Identified through government's database (those with a positive RT-PCR for SARS-CoV-2) within last 72 hours.

- Contact: Any individual who came in the proximity of less than 2 meters of a confirmed case during their symptomatic period or 4 days prior to first onset of symptoms for a minimum of 15 minutes. We enrolled households with ≥2 eligible members (sharing ≥2 meals in the same residence per week).



Days	1	7	14	28
Home visit and data collection	✓	✓	✓	✓
Respiratory Sample	✓	✓	✓	✓
Serum sample	✓	✓	✓	✓

Data Collection

- Four household visits
- Daily symptom recording on telephone

Data Analyses

- $$\boldsymbol{SAR} = \frac{\text{total number of secondary cases identified}}{\text{total number of susceptible contacts}} X\ 100$$

- $$\boldsymbol{Re} = \frac{\text{total number of secondary cases across all household's}}{\text{total number of households}}$$

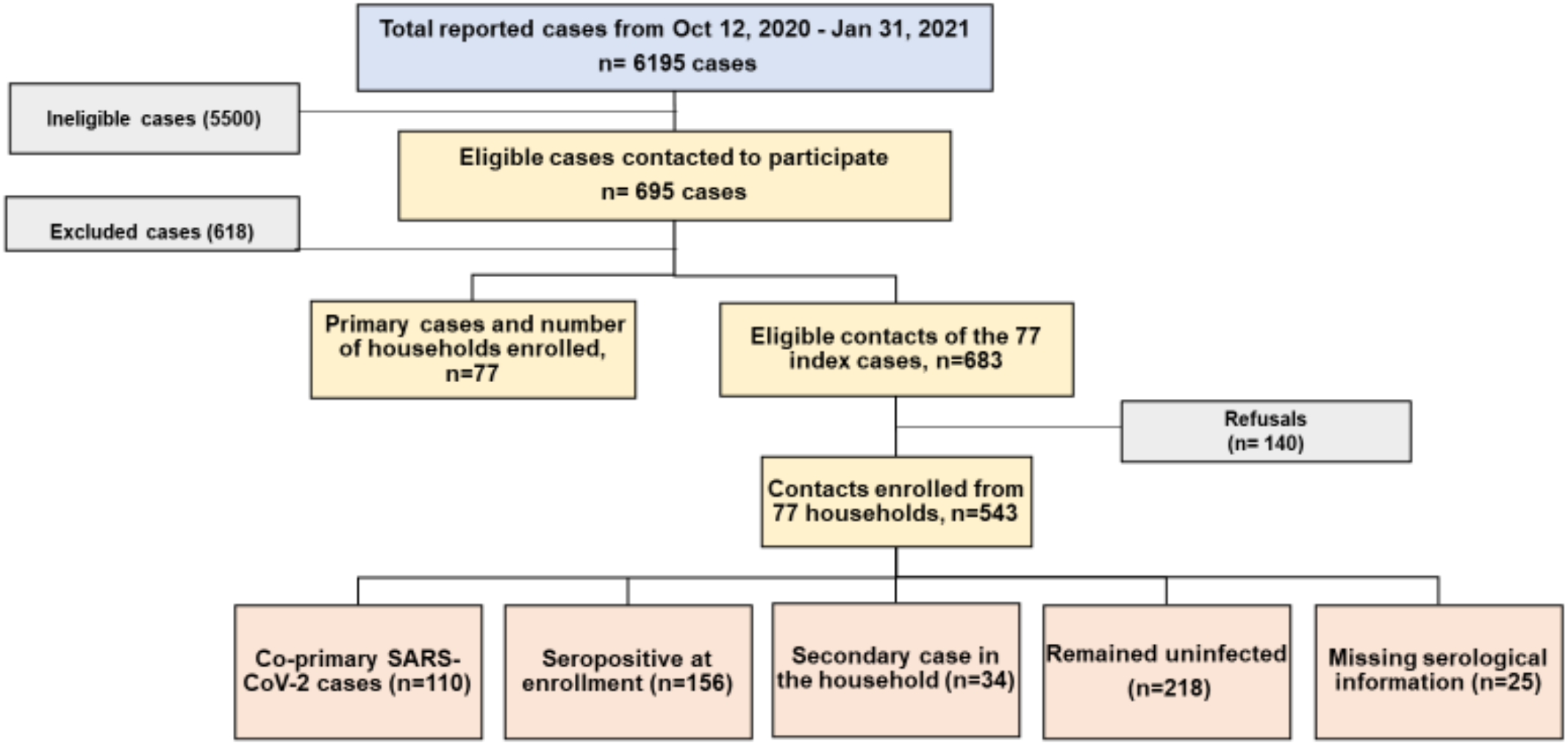
Lab Analyses

- Nasal swabs were analyzed through RT-PCR using the SARS-CoV-2 Cobas 6800 Roche assay at the AKUH Clinical laboratories.
- Serum samples were analyzed using Roche Elecsys Anti SARS-CoV-2 antibody test.

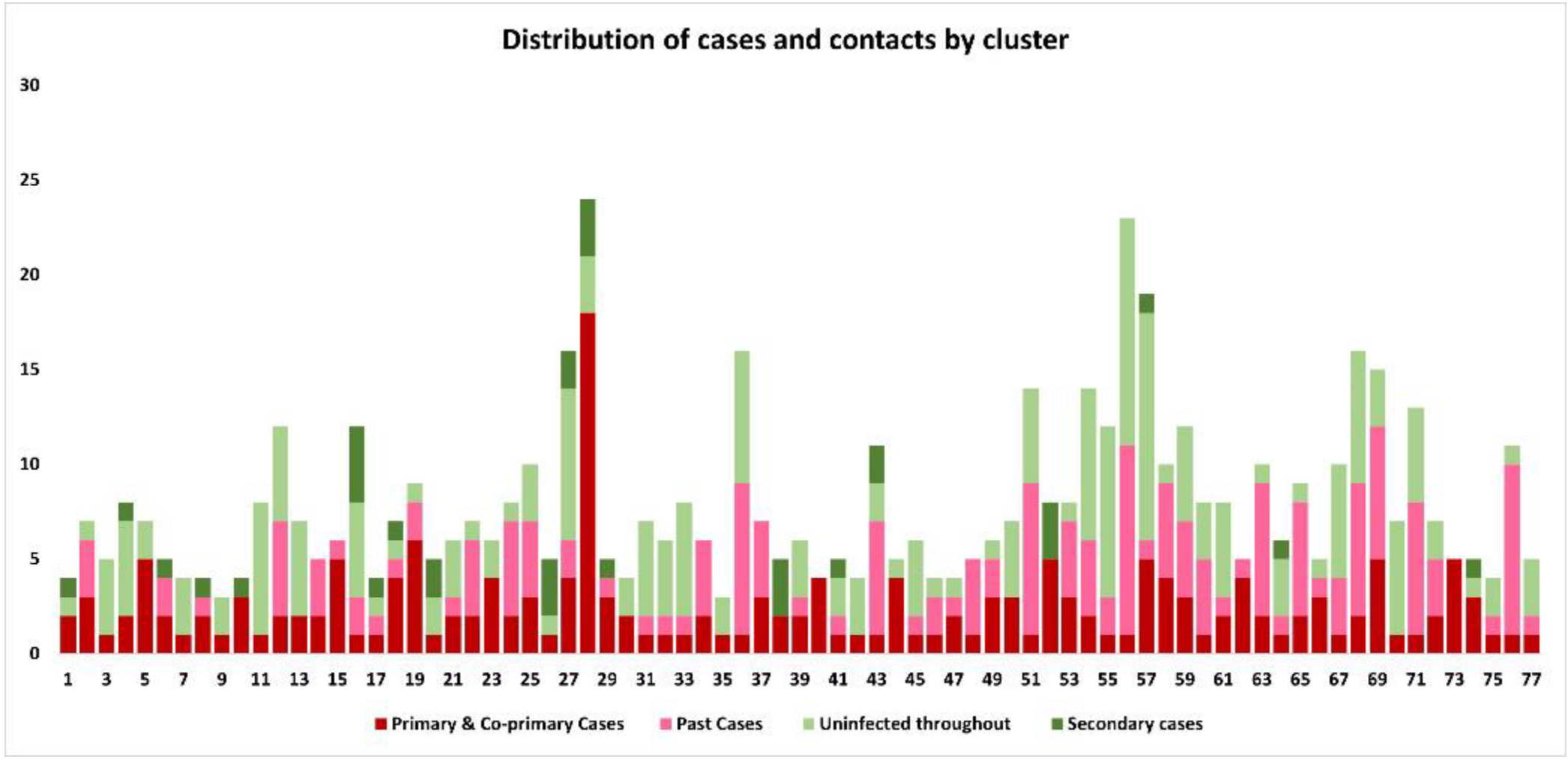
Definitions

- **A secondary case** was defined as any SARS-CoV-2 infection in a household contact (not the index case) with a negative RT-PCR at day 1 and positive RT-PCR test during follow-up visits, regardless of symptom onset OR, SARS-CoV-2 negative serology at enrollment and positive serology at end of follow-up (seroconversion).
- **A co-primary case** was defined as any SARS-CoV-2 infection in a household member (not the index case) with positive RT-PCR test at enrollment (day 1) OR positive serology at enrollment and a history of recent (< 2 weeks before enrollment) respiratory symptoms.
- **A susceptible contact** was defined as any household contact with a negative RT-PCR test and a negative serology at enrollment (day 1).
- **An uninfected contact** was defined as any household contact who remained RT-PCR negative and serology negative from day 1 till day 28.

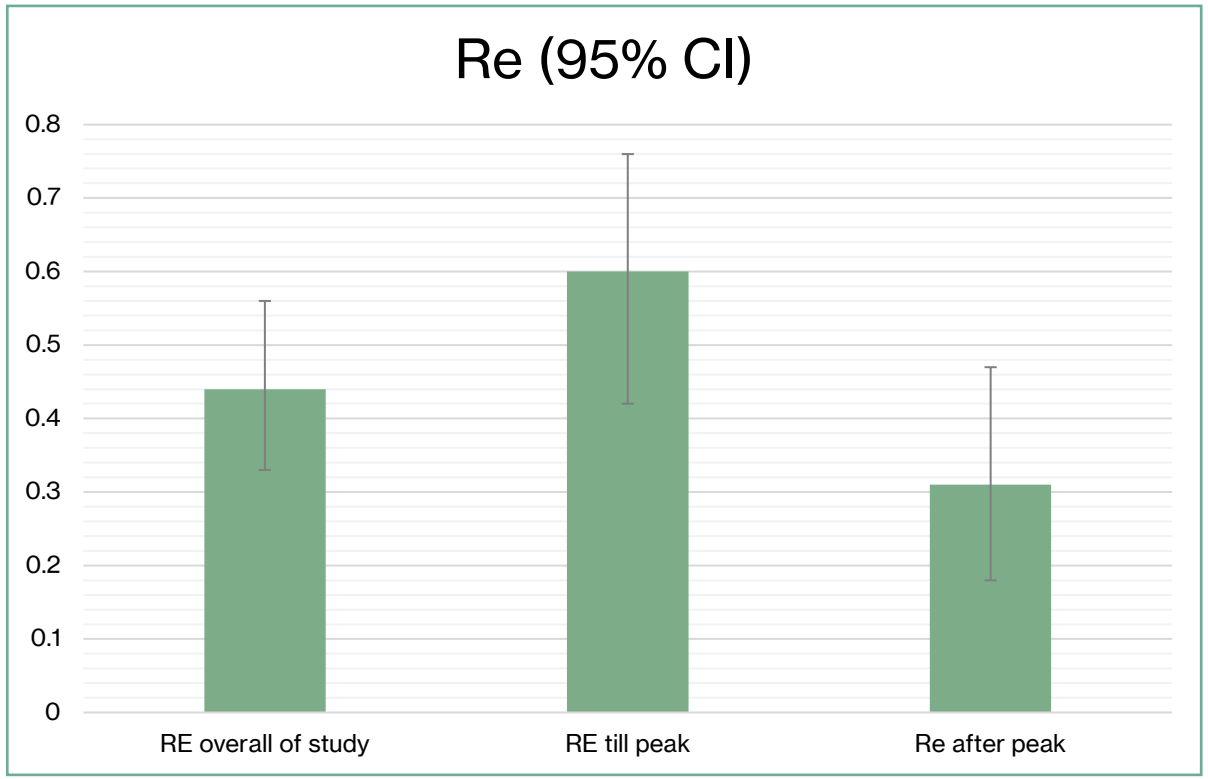
RESULTS

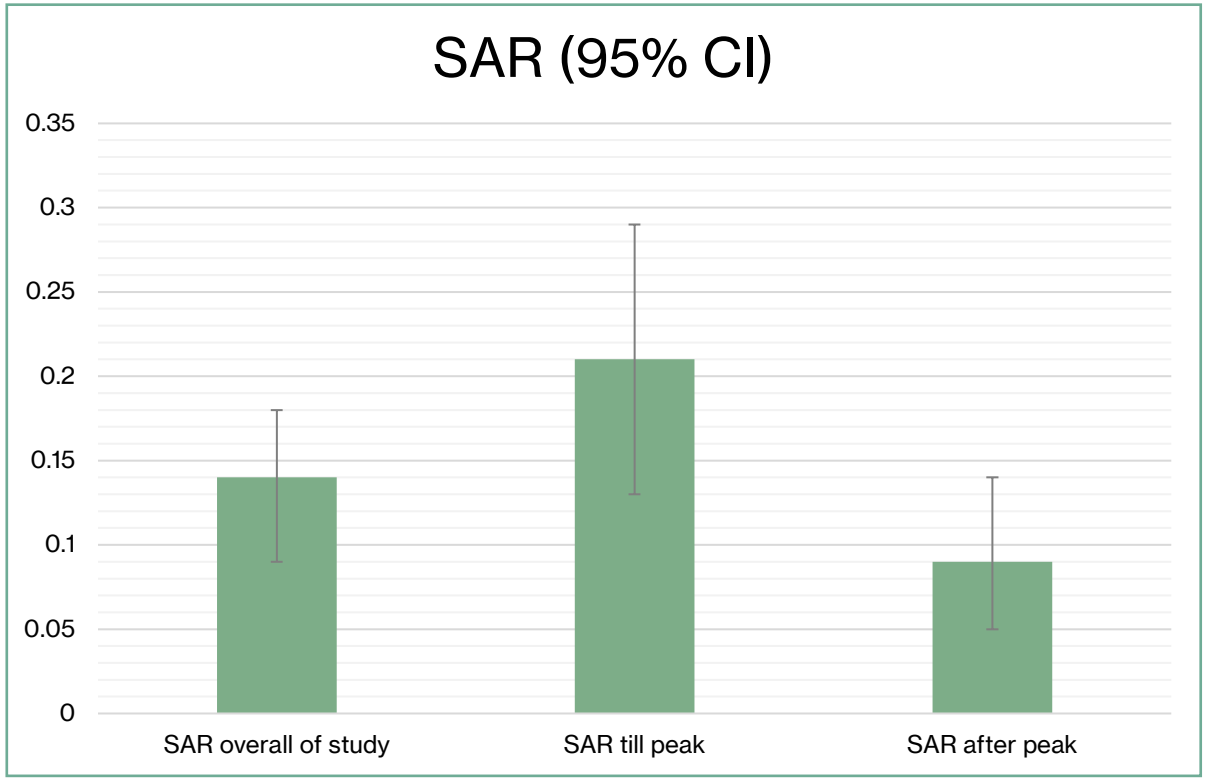

Total reported cases from Oct 12, 2020 - Jan 31, 2021
n= 6195 cases
Ineligible cases (5500)
Eligible cases contacted to participate
n= 695 cases
Excluded cases (618)
Primary cases and number of households enrolled, n=77
Eligible contacts of the 77 index cases, n=683
Refusals (n= 140)
Contacts enrolled from 77 households, n=543
Co-primary SARS-CoV-2 cases (n=110)
Seropositive at enrollment (n=156)
Secondary case in the household (n=34)
Remained uninfected (n=218)
Missing serological information (n=25)

Results


Distribution of cases and contacts by cluster
30
25
20
15
10
5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77
Primary & Co-primary Cases
Past Cases
Uninfected throughout
Secondary cases

Results


Re (95% CI)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
RE overall of study
RE till peak
Re after peak


SAR (95% CI)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
SAR overall of study
SAR till peak
SAR after peak

Results

Characteristics	Non-cases	Secondary cases	OR(CI)
	N=218	N=34	
Age, years, (mean ± SD)	30.62±19.92	35.30±19.67	1.01(0.99,1.03)
0-10 Years	40 (18.35%)	2 (5.88%)	Ref
11-20 Years	35 (16.06%)	6 (17.65%)	3.43(0.65,18.09)
21-30 Years	41 (18.81%)	10 (29.41%)	4.88(1.01,23.67)
31-40 Years	40 (18.35%)	4 (11.76%)	2(0.35,11.54)
41-50 Years	18 (8.26%)	3 (8.82%)	3.33(0.51,21.71)
51-60 Years	15 (6.88%)	3 (8.82%)	4(0.61,26.35)
>60 Years	29 (13.30%)	6 (17.65%)	4.14(0.78,21.99)
Gender			
Male	109 (50.00%)	15 (44.12%)	Ref
Female	109 (50.00%)	19 (55.88%)	1.27(0.61,2.62)

Results

Characteristics	Non-cases	Secondary cases	OR(CI)	aOR(CI)	P-value
	N=218	N=34			
Symptoms					
Fever	23 (10.55%)	12 (35.29%)	4.62(2.03,10.56)		
Sore throat	30 (13.76%)	12 (35.29%)	3.42(1.53,7.62)		
Congestion or runny nose	43 (19.72%)	13 (38.24%)	2.52(1.17,5.43)		
Cough	39 (17.89%)	12 (35.29%)	2.5(1.14,5.48)		
Shortness of Breath	9 (4.13%)	3 (8.82%)	2.25(0.58,8.76)		
Nausea or Vomiting	3 (1.38%)	3 (8.82%)	6.94(1.34,35.9)	7.89(1.37,45.53)	0.021
Diarrhea	5 (2.29%)	0 (0.00%)	-		
Headache	19 (8.72%)	11 (32.35%)	5.01(2.12,11.82)		
Muscle/Body ache	17 (7.80%)	12 (35.29%)	6.45(2.73,15.24)		
Loss of smell	17 (7.80%)	12 (35.29%)	6.45(2.73,15.24)		
Loss of taste	5 (2.29%)	8 (23.53%)	13.11(3.99,43.05)		
Fatigue	14 (6.42%)	13 (38.24%)	9.02(3.75,21.71)	9.31(3.81,22.78)	<0.001
Other symptoms	3 (1.38%)	3 (8.82%)	6.94(1.34,35.9)		
Comorbidities	22 (10.09%)	5 (14.71%)	1.54(0.54,4.37)		

Study Limitations

At enrollment, (110/543) 20.8% contacts tested positive for the virus and majority of these were asymptomatic.

- They had been infected concurrently or before the index cases.
- Acquired the infection from the community.
- Survivor bias as only cases who had mild to moderate disease were enrolled.
- None of the cases in our study were hospitalized before or during the study period. Milder cases of the disease may not have a sufficient viral load to spread the infection efficiently resulting in the lower SAR estimate.

Conclusion

- We observed low SARS-CoV-2 transmission in the backdrop of high seroprevalence among households in Karachi, Pakistan in the early months of the pandemic. High proportion of asymptomatic cases and low diagnostic testing is likely to be attributable to the gap between seroprevalence and reported cases.

Acknowledgements

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