

Supplementary appendix

This appendix is part of the report “Statistics and Stories: A multidimensional risk dashboard for COVID-19”. It provides a detail of the secondary data and micronarratives data used in the production of the report.

Appendix 1: Choice of Indicators

Appendix 2: Ward level data and risk scores

Appendix 3: Background of survey participants

Appendix 4: Background of doctors interviewed for micronarratives

Appendix 1: Choice of indicators

A disaster risk framework was adopted to understand the ward level risk in Pune city. In disaster risk studies, the risk is represented as the $(\text{Hazard} * \text{Vulnerability}) / \text{Capacity}$. We used 15 indicators to capture the Hazard, Vulnerability and Capacity.

1. Hazard

Rationale: COVID-19 is a biological hazard caused by SARS-CoV-2 and a source of harm and adverse health effects on lives and livelihoods.

Indicators: Indicators on total cases, growth rate of cases, active cases and recoveries were used at a ward level. While deaths is a crucial indicator, Pune city has not released ward wise deaths in the last 4 months. Hence, at the time of writing this report, we were unable to use deaths as a ward level indicator of the hazard. Additionally, the number of tests and the test positivity rate is important to understand if the hazard is being under reported or not.

Sources: Pune Municipal Cooperation (PMC) COVID War Room reports and twitter updates. Data for available indicators updated daily.

2. Capacity

Rationale: Capacity refers to the ability of a system to plan and build the necessary infrastructure and services to deal with the hazard. Here, we consider the capacity of the healthcare systems and hospitals in Pune city. In our interactions with government officials in the city, we learned that hospital beds in Pune are allocated in a centralized manner. While patients are mostly admitted to the hospital nearest to their homes, they could be sent to other hospitals if beds are not available or if the load has to be distributed. Hence, a ward level assessment of the healthcare capacity is not relevant for the city. However, during a pandemic, the capacity of the health care system is the most important resource for providing care and minimizing the number of preventable deaths and was hence chosen.

Indicators: 3 indicators were used to understand the city level capacity to manage the COVID risk. The Case Fatality Rate captures the proportion of deaths among the total diagnosed individuals. A lower CFR would indicate that preventable deaths are minimized because of access to healthcare. Second, we consider the capacity and occupancy of oxygen beds, ICU beds and ventilator beds. This shows the strength and capacity of the health care system. The final indicator chosen is the criticality rate. This indicates the proportion of active patients who require intensive care treatment and ventilator support. A high criticality rate is indicative of an older population, higher number of comorbidities or late admission. We choose this indicator because it allows us to estimate the number of hospital beds that the city requires. Indicators that capture the affordability and quality of the healthcare facilities are also needed but weren't included because of limited data.

Sources: Pune Municipal Cooperation COVID War Room reports, Pune division COVID Care software [dashboard](#). The war room report is released every two weeks and the COVID care dashboard is updated several times every day.

3. Vulnerabilities

Rationale: Vulnerabilities refers to the predisposition, susceptibilities, fragilities, weaknesses, deficiencies, or lack of capacities that results in adverse effects on the elements exposed to a hazard. We measure vulnerability at a ward level. In our study, we identify three types of vulnerabilities- spatial, water sanitation and hygiene (WASH) and health. Research shows that the living conditions and health of individuals impacts their vulnerability to the hazard. We have explained the rationale for choosing these indicators in detail in the report.

Indicators: Data on vulnerabilities especially at the ward level is very limited. We select 6 indicators to measure the vulnerability of the wards. The spatial vulnerability is measured by the population density in wards and the slum population density in the slums in each ward. The WASH vulnerabilities in slum settlements is measured by two indicators, the number of people sharing a toilet seat and the number of people sharing a public tap. The health vulnerabilities are measured by the number of comorbid people in each ward and the number of pregnant women in each ward.

Sources:

- Ward population in 2017- [Pune Municipal Corporation](#)
- Ward areas calculated from shapefiles
- Pune slum shapefiles and locations in 2019- [Mundhe \(2019\)](#)
- Pune slum census with population and WASH infrastructure in 2011- [Census 2011 for Pune district DCHB Part A](#)
- Comorbidities and pregnant women- Pune Municipal Cooperation COVID War Room reports. The comorbidities survey for Pune was conducted on 9th July 2020.

The data on slums at the ward level was compiled by mapping the Census data to the slum locations. This was done with a maximum error of 14.2%. The details of the methodology and the data can be found in this [link](#).

The prabhag and ward shapefiles used in this exercise were sourced from [Datameet](#).

References

1. "Biological Hazard" defined by UN Integrated Research on Disaster Risk (IRDR) program of the International Council for Science (ICSU). UN-ICSU, Integrated Research on Disaster Risk. "Peril Classification and Hazard Glossary". IRDR DATA Publication No. 1. 2012..
2. Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh. "Determinants of risk: exposure and vulnerability". In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). 2012. Cambridge University Press,

Cambridge, UK, and New York, NY, USA, pp. 65-108. Accessed from:

https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

3. Muggah, R., Florida, R. "COVID-19 will hit the developing world's cities hardest. Here's why". May 27, 2020. World Economic Forum. Accessed from:
<https://www.weforum.org/agenda/2020/05/covid-19-will-hit-the-developing-worlds-cities-hardest-heres-why/>
4. Acharya, Rajib et al. "A vulnerability index for the management of and response to the COVID-19 epidemic in India: an ecological study", The Lancet Global Health, Volume 8, Issue 9, e1142 - e1151. July 16, 2020. Accessed from: [https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(20\)30300-4/fulltext#seccestitle190](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30300-4/fulltext#seccestitle190)
5. Mark A. Pelling, King's College, Lecture Notes: Disaster Vulnerability and Resilience, MIT Open Courseware. Accessed from: https://ocw.mit.edu/courses/urban-studies-and-planning/11-941-disaster-vulnerability-and-resilience-spring-2005/lecture-notes/pelling_lect2.pdf
6. Flanagan B., Gregory, E., Hallisey, E., Heitgerd, J., & Lewis, B., "A_Social_Vulnerability_Index_for_Disaster_Management", Journal of Homeland Security and Emergency Management 8(1). 2011. Accessed from:
<https://www.researchgate.net/publication/274439003>

Appendix 2: Ward level data and risk indices

Table 1: Ward wise spatial vulnerability

Ward Office Name	population density	slum population density	Spatial vulnerability
Dhole Patil Road	12324.11	188528.01	0.394
Bhawani Peth	70702.82	165301.84	0.768
Yerawada-Kalas-Dhanori	10597.15	106268.44	0.144
Kasba - Vishrambaugwada	36753.59	197013.31	0.603
Shivajinagar-Ghole Road	10284.3	171911.85	0.33
Bibwewadi	21709.6	245059.23	0.628
Wanawadi - Ramtekadi	14148.26	117130.61	0.202
Dhankawadi - Sahakarnagar	22325.45	244442.57	0.63
Nagar Road - Vadgaonsheri	7138.22	117682.22	0.15
Hadapsar - Mundhwa	10676.09	80676.81	0.071
Kondhwa - Yewalewadi	7909	245796.16	0.525
Sinhagad Road	14454.55	72211.5	0.075
Warje - Karvenagar	15310.46	99088.09	0.159
Kothrud - Bawdhan	13319.95	87280.87	0.11
Aundh - Baner	4558.41	98213.43	0.075

Table 2: Ward wise WASH vulnerability

Ward Office Name	toilets per capita in slums	public taps per capita in slums	WASH vulnerability
Dhole Patil Road	52.516	20.647	0.776
Bhawani Peth	51.488	18.057	0.679
Yerawada-Kalas-Dhanori	47.91	6.039	0.245
Kasba - Vishrambaugwada	55.011	10.784	0.475
Shivajinagar-Ghole Road	69.733	10.251	0.607
Bibwewadi	43.033	5.548	0.179
Wanawadi - Ramtekadi	36.965	18.653	0.551
Dhankawadi - Sahakarnagar	31.113	6.644	0.093
Nagar Road - Vadgaonsheri	40.328	11.925	0.362
Hadapsar - Mundhwa	35.93	13.893	0.382
Kondhwa - Yewalewadi	39.183	9.477	0.269
Sinhagad Road	62.156	6.225	0.397
Warje - Karvenagar	25.544	5.966	0.014
Kothrud - Bawdhan	34.296	20.637	0.589
Aundh - Baner	74.468	9	0.614

Table 1: Ward wise health vulnerability

Ward Office Name	number of comorbid people	number of pregnant women	Health vulnerability
Dhole Patil Road	2381	159	0.05
Bhawani Peth	3078	378	0.136
Yerawada-Kalas-Dhanori	11757	143	0.192
Kasba - Vishrambaugwada	1934	1500	0.505
Shivajinagar-Ghole Road	5150	157	0.093
Bibwewadi	2583	50	0.015
Wanawadi - Ramtekadi	7765	63	0.101
Dhankawadi - Sahakarnagar	8857	556	0.289
Nagar Road - Vadgaonsheri	1616	116	0.023
Hadapsar - Mundhwa	26365	648	0.596
Kondhwa - Yewalewadi	8060	117	0.125
Sinhagad Road	6264	138	0.104
Warje - Karvenagar	33362	143	0.532
Kothrud - Bawdhan	4102	137	0.069
Aundh - Baner	2510	233	0.077

Table 1: Ward wise calculation of Hazard, Vulnerability and risk index

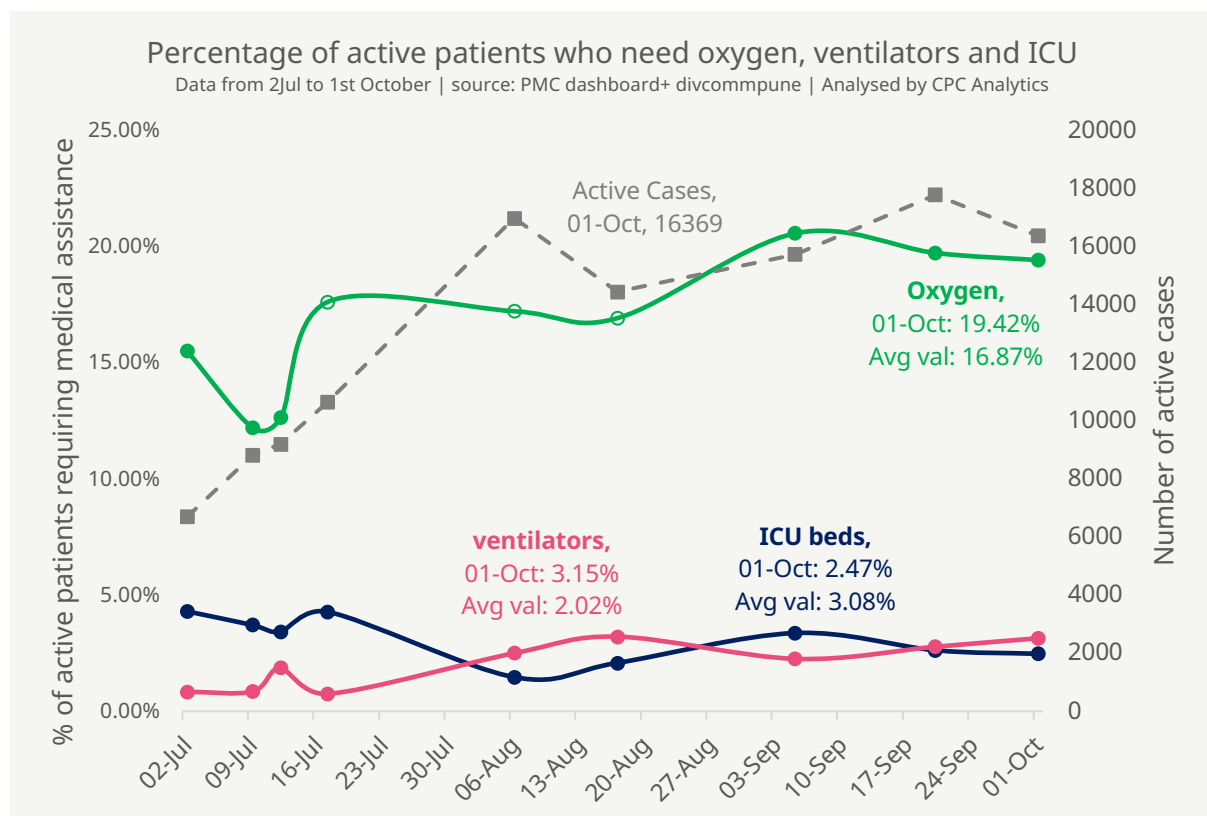
Ward Office Name	Hazard Index	Vulnerability Index	Risk Index
Dhole Patil Road	0.103	0.406	0.254
Bhawani Peth	0.224	0.528	0.376
Yerawada-Kalas-Dhanori	0.471	0.193	0.332
Kasba - Vishrambaugwada	0.473	0.527	0.5
Shivajinagar-Ghole Road	0.462	0.343	0.403
Bibwewadi	0.6	0.274	0.437
Wanawadi - Ramtekadi	0.235	0.285	0.26
Dhankawadi - Sahakarnagar	0.979	0.337	0.658
Nagar Road - Vadgaonsheri	0.777	0.178	0.478
Hadapsar - Mundhwa	0.528	0.35	0.439
Kondhwa - Yewalewadi	0.427	0.306	0.367
Sinhagad Road	0.727	0.192	0.459
Warje - Karvenagar	0.851	0.235	0.543
Kothrud - Bawdhan	0.464	0.256	0.36
Aundh - Baner	0.517	0.255	0.386

Table 1: Active cases, criticality rate and hospital bed (Oxygen, ICU and ventilator) capacity and occupancy for Pune city

Date	Active Cases	Type of hospital bed	Bed capacity	Beds Occupied	% of active patients on assistance
2020-04-17	501	O2_beds	1223	289	57.68%
2020-04-24	980	O2_beds	1230	156	15.92%
2020-05-21	1698	O2_beds	2122	255	15.02%
2020-05-26	2279	O2_beds	2122	350	15.36%
2020-05-28	2294	O2_beds	2030	356	15.19%
2020-06-08	2486	O2_beds	2513	379	15.24%
2020-06-12	2582	O2_beds	2513	531	20.57%
2020-07-02	6695	O2_beds	2513	1038	15.5%
2020-07-09	8809	O2_beds	2513	1075	12.2%
2020-07-12	9203	O2_beds	2513	1163	12.63%
2020-07-17	10644	O2_beds	1861	1875	17.62%
2020-08-06	16975	O2_beds	2688	2923	17.22%
2020-08-17	14442	O2_beds	2999	2444	16.92%
2020-09-05	15730	O2_beds	3324	3236	20.57%
2020-09-20	17781	O2_beds	3648	3508	19.73%
2020-10-01	16369	O2_beds	3969	3179	19.42%
2020-04-17	501	ICU beds	146	10	1.99%
2020-04-24	980	ICU beds	151	41	4.18%
2020-05-21	1698	ICU beds	271	119	7%
2020-05-26	2279	ICU beds	271	132	5.79%
2020-05-28	2294	ICU beds	325	101	4.40%
2020-06-08	2486	ICU beds	580	161	6.47%
2020-06-12	2582	ICU beds	580	183	7.08%
2020-07-02	6695	ICU beds	580	288	4.30%
2020-07-09	8809	ICU beds	580	327	3.71%
2020-07-12	9203	ICU beds	580	315	3.42%
2020-07-17	10644	ICU beds	400	456	4.28%
2020-08-06	16975	ICU beds	278	249	1.46%
2020-08-17	14442	ICU beds	332	301	2.08%
2020-09-05	15730	ICU beds	399	530	3.37%
2020-09-20	17781	ICU beds	465	467	2.62%
2020-10-01	16369	ICU beds	475	405	2.47%
2020-04-17	501	Ventilator beds	NA	NA	NA
2020-04-24	980	Ventilator beds	NA	NA	NA
2020-05-21	1698	Ventilator beds	137	44	2.59%
2020-05-26	2279	Ventilator beds	137	44	1.93%

2020-05-28	2294	Ventilator beds	210	49	2.14%
2020-06-08	2486	Ventilator beds	288	43	1.73%
2020-06-12	2582	Ventilator beds	288	84	3.25%
2020-07-02	6695	Ventilator beds	288	56	0.84%
2020-07-09	8809	Ventilator beds	288	75	0.85%
2020-07-12	9203	Ventilator beds	288	172	1.87%
2020-07-17	10644	Ventilator beds	231	80	0.75%
2020-08-06	16975	Ventilator beds	437	425	2.50%
2020-08-17	14442	Ventilator beds	469	464	3.21%
2020-09-05	15730	Ventilator beds	476	355	2.25%
2020-09-20	17781	Ventilator beds	482	494	2.78%
2020-10-01	16369	Ventilator beds	546	515	3.15%

* Numbers in *italics* indicate that average values were taken. There is a data gap particularly in the number of oxygen beds as PMC did not release the occupied beds in the start. Therefore, it was calculated by taking the average of the data available on the percentage of people needing oxygen.



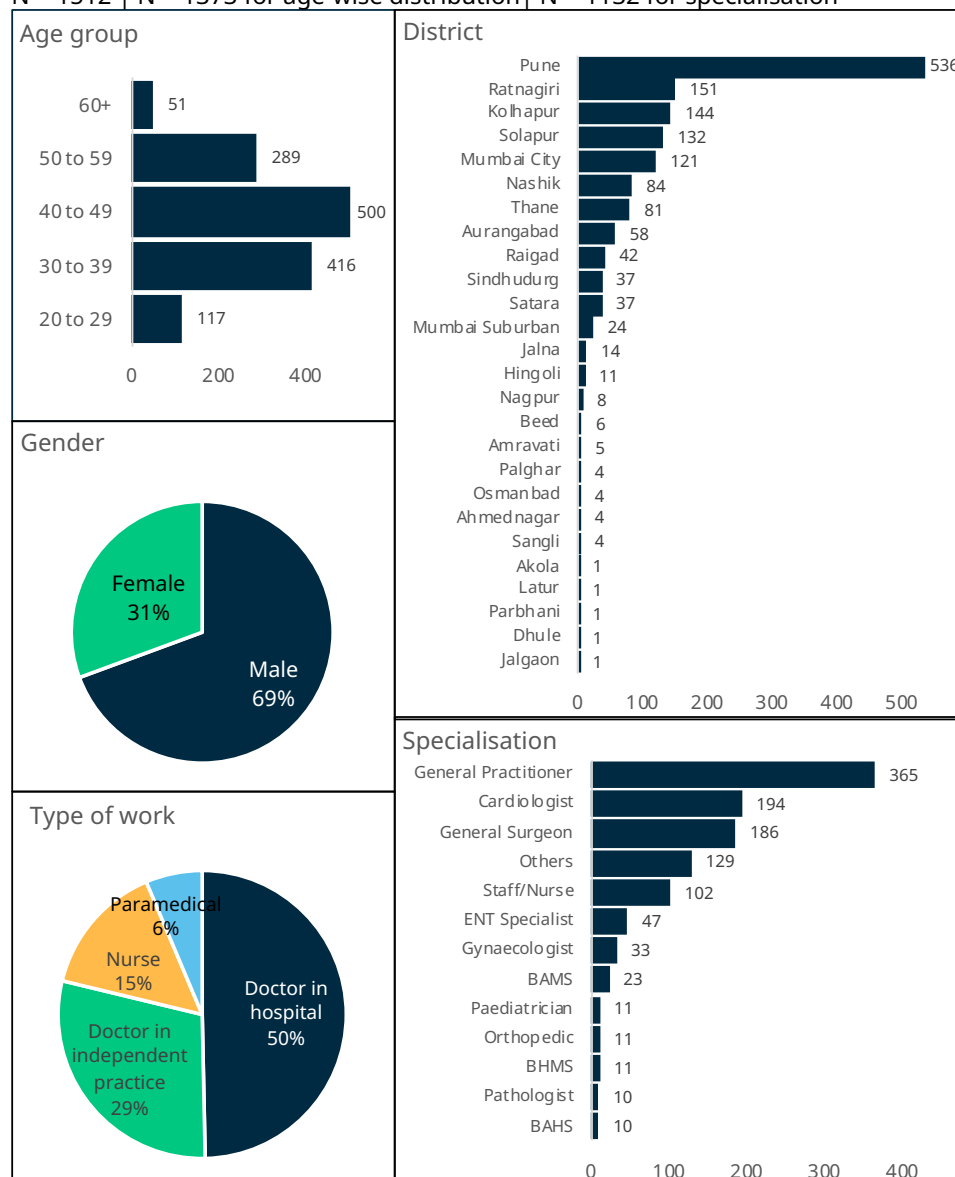
Appendix 3: Background of survey participants

A survey of healthcare workers and COVID survivors was conducted by Pudhari Newspaper (a Marathi daily) and analysed by CPC Analytics. This included 1512 healthcare workers and 2282 people who tested positive for COVID and recovered, across cities in Maharashtra.

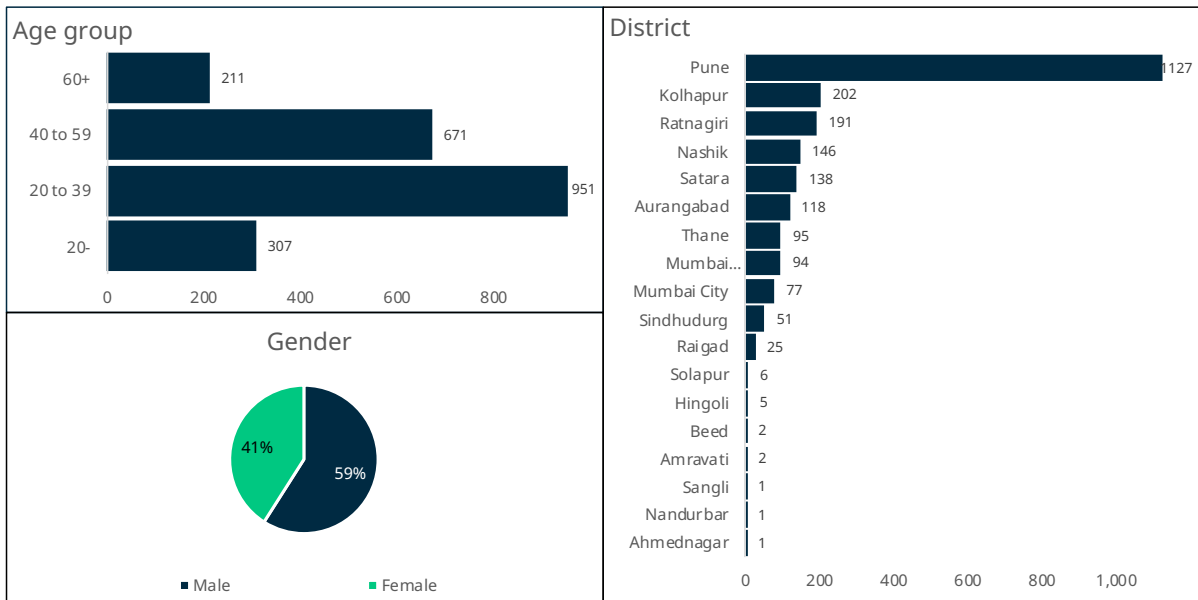
On 19 August 2020, the newspaper published the results of the survey. The article (in Marathi) can be found in this [link](#).

Background of Healthcare workers surveyed

N = 1512 | N = 1373 for age-wise distribution | N = 1132 for specialisation



Background of 2282 COVID survivors



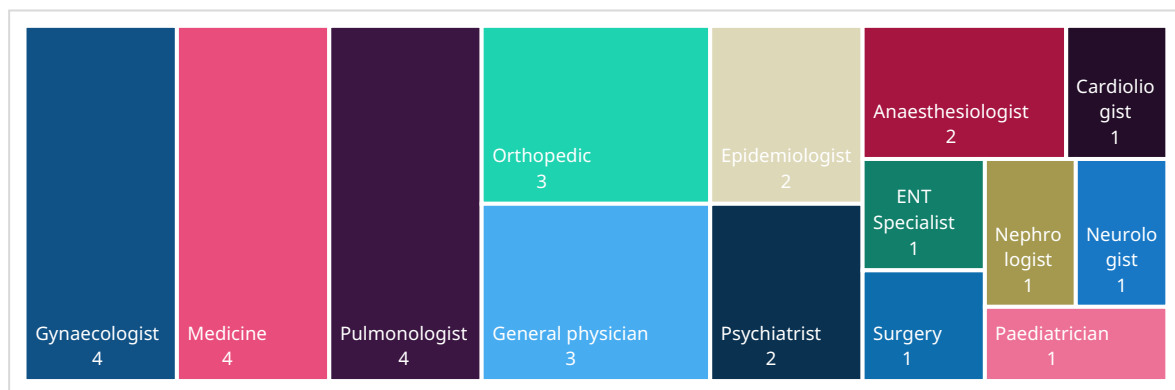
Appendix 4: Selection and background of doctors interviewed for micronarratives

Selection of doctors for detailed interviews

We first contacted and interviewed COVID and non-COVID doctors that we were acquainted with. We then asked these doctors if they knew other doctors working with COVID patients, who were then contacted. This snowball sampling resulted in 48 doctors were contacted, of which 32 were interviewed. All of them completed the interview. Almost all of the interviews were conducted on an audio call using Zoom Application or mobile phone Voice Calls.

The sample of doctors chosen had 11 doctors from Mumbai, 6 from Pune, 2 from Nagpur and 1 each from Thane, Solapur, Akola and Aurangabad. The rest of the doctors (8 doctors) were from outside Maharashtra.

Specialities of the doctors interviewed



Interview Process

Interviewees were sent with the Consent and Ethics Document along with information about the project. This information was repeated on the call before the interview questions as well. Permission was taken to record the call before the questions. Most of them granted permission, few calls could not be recorded. 6 of the 32 doctors requested anonymity. The questions were asked in a serial manner in which we had put them, but the sequence was changed based on the answers from participants. After a few interviews, we assessed the results to add a few questions based on answers we had gotten and remove some to eliminate redundancies. However, broadly the questions remained the same. Effort was taken to ask every doctor all the questions, unless we had a time limit. All the recorded interviews were then transcribed into a word document for analysis. Interviews were conducted in English, Hindi and Marathi, but transcribed and analysed in English.