

Analysis Report

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SAMPLE REPORT - Rafael Data Analysis Portfolio

Overall Results

A chi-square test was performed to analyze the differences in antibiotic response and organism types across three periods: Pre-lockdown, Lockdown, and Post-lockdown. In cases where sample sizes were too small to meet the assumptions of the chi-square test, Fisher's Exact Test was used, which is more appropriate for low-frequency data or smaller subsamples.

For the antibiotic response data, the "I" response (Intermediate) showed a significant increase from 1.6% in the Pre-lockdown period to 4.9% in the Post-lockdown period, with no occurrences during the Lockdown phase. The chi-square value for this response was highly significant ($X^2 = 74.123$, $p < 0.001$), indicating a statistically significant difference across the periods. For the "R" response (Resistance), a decrease was observed during the Lockdown period (6.5%) compared to Pre-lockdown (13.4%), but it increased again to 12.5% in the Post-lockdown phase. The "S" response (Sensitive) showed a decrease from 93.5% during Lockdown to 82.6% in the Post-lockdown phase, compared to 85.0% in the Pre-lockdown period.

Response	Pre-lockdown			Lockdown			Post-lockdown			X^2	p
	N	Total	%	N	Total	%	N	Total	%		
I	46	2941	1.6	0	443	0	63	1273	4.9	74.123	0.000
R	395	2941	13.4	29	443	6.5	159	1273	12.5		
S	2500	2941	85.0	414	443	93.5	1051	1273	82.6		

Regarding organism types, the chi-square test revealed significant differences in the distribution of various organisms over the three periods ($X^2 = 13.552$, $p = 0.035$). Fungal organisms increased slightly from 0.8% in Pre-lockdown to 4.5% during Lockdown but decreased to 2.0% in the Post-lockdown period. Gram-negative bacteria showed a peak during Lockdown (31.3%) compared to 25.2% Pre-lockdown and 20.3% Post-lockdown. Gram-positive bacteria remained relatively stable across the periods, constituting around 72-74% of the total organisms in both Pre-lockdown and Post-lockdown, with a slight decrease during Lockdown (64.2%). Protozoa were not observed during the Lockdown period but increased to 4.0% in Post-lockdown compared to 1.6% in Pre-lockdown.

Organism	Pre-lockdown		Lockdown		Post-lockdown		X^2	p
	N	%	N	%	N	%		
Fungus	3	0.8	3	4.5	4	2.0	13.552	0.035
Gram Negative bacteria	93	25.2	21	31.3	41	20.3		
Gram Positive bacteria	267	72.4	43	64.2	149	73.8		
Protozoa	6	1.6	0.0	0.0	8	4.0		

A Fisher's Exact Test was performed to compare the distribution of antibiotic resistance and sensitivity between the Pre-lockdown and Post-lockdown periods, excluding the Lockdown phase and the "I" (Intermediate) response due to insufficient data. Fisher's Exact Test was chosen due to the smaller sample sizes and the presence of zeros in some categories, which makes it more appropriate than the Chi-square test in these cases.

Antibiotic	Response	Pre-lockdown		Post-lockdown		p
		N	%	N	%	
Amikacin	R	10	5.8	1	2.8	0.694
	S	163	94.2	35	97.2	
Ceftazidime	R	3	5.5	0	0.0	1.000
	S	52	94.5	17	100.0	
Cefuroxime	R	26	23.0	1	3.2	0.010
	S	87	77.0	30	96.8	
Chloramphenicol	R	27	9.1	10	7.0	0.583
	S	271	90.9	132	93.0	
Ciprofloxacin	R	14	4.7	7	7.5	0.296
	S	285	95.3	86	92.5	
Clarithromycin	R	80	36.7	33	37.5	0.897
	S	138	63.3	55	62.5	
Clindamycin	R	47	22.8	23	25.6	0.656
	S	159	77.2	67	74.4	
Cotrimoxazole	R	1	4.8	7	11.5	0.673
	S	20	95.2	54	88.5	
Doxycycline	R	27	14.1	0	0.0	0.000
	S	165	85.9	66	100.0	
Fusidic.Acid	R	105	47.1	59	46.1	0.912
	S	118	52.9	69	53.9	
Gentamicin	R	15	5.0	8	5.0	1.000
	S	284	95.0	152	95.0	
Levofloxacin	R	13	7.6	5	7.0	1.000
	S	158	92.4	66	93.0	
Moxifloxacin	R	0	0.0	2	4.5	1.000
	S	4	100.0	42	95.5	
Mupirocin	R	1	0.7	0	0.0	1.000
	S	138	99.3	14	100.0	
Tobramycin	R	1	2.0	1	6.7	0.406
	S	50	98.0	14	93.3	
Vancomycin	R	1	0.4	0	0.0	1.000
	S	240	99.6	105	100.0	

For **Amikacin**, the "R" (Resistance) response decreased from 5.8% Pre-lockdown to 2.8% Post-lockdown, while the "S" (Sensitive) response increased from 94.2% to 97.2%. However, the test result was not statistically significant ($p = 0.694$), suggesting no significant difference between the two periods.

For **Ceftazidime**, resistance was observed in 5.5% of cases Pre-lockdown but none Post-lockdown. The "S" response remained high across both periods (94.5% Pre-lockdown and 100% Post-lockdown). The difference between the periods was not statistically significant ($p = 1.000$).

Cefuroxime showed a significant difference between periods ($p = 0.010$). The resistance rate dropped from 23.0% Pre-lockdown to 3.2% Post-lockdown, while sensitivity increased from 77.0% to 96.8%.

For **Chloramphenicol**, there was a decrease in resistance from 9.1% Pre-lockdown to 7.0% Post-lockdown, and sensitivity increased from 90.9% to 93.0%. The results were not statistically significant ($p = 0.583$).

For **Ciprofloxacin**, resistance increased slightly from 4.7% Pre-lockdown to 7.5% Post-lockdown, while sensitivity decreased from 95.3% to 92.5%. No significant difference was found ($p = 0.296$).

Clarithromycin and **Clindamycin** showed similar resistance and sensitivity rates across both periods, with no significant differences ($p = 0.897$ for Clarithromycin, $p = 0.656$ for Clindamycin).

Cotrimoxazole showed an increase in resistance from 4.8% Pre-lockdown to 11.5% Post-lockdown, and a decrease in sensitivity from 95.2% to 88.5%, but this difference was not statistically significant ($p = 0.673$).

A statistically significant difference was found for **Doxycycline** ($p < 0.001$), where resistance was observed in 14.1% of Pre-lockdown cases, but no resistance was observed Post-lockdown. Sensitivity increased from 85.9% to 100%.

For **Fusidic Acid**, **Gentamicin**, and **Levofloxacin**, resistance and sensitivity rates remained consistent across the two periods, with no statistically significant differences ($p = 0.912$, $p = 1.000$, and $p = 1.000$, respectively).

For **Moxifloxacin**, no resistance was observed Pre-lockdown, but 4.5% resistance was observed Post-lockdown. Sensitivity remained high across both periods (100% Pre-lockdown and 95.5% Post-lockdown), but this difference was not significant ($p = 1.000$).

For **Mupirocin**, **Tobramycin**, and **Vancomycin**, no significant differences in resistance or sensitivity were observed between Pre-lockdown and Post-lockdown ($p = 1.000$ for Mupirocin and Vancomycin, $p = 0.406$ for Tobramycin).

Overall, the Fisher's Exact Test highlighted that significant differences in resistance and sensitivity rates between Pre-lockdown and Post-lockdown were observed primarily for **Cefuroxime** and **Doxycycline**, while other antibiotics did not show statistically significant changes. These findings suggest potential changes in antibiotic effectiveness for specific antibiotics following the lockdown period.

Gram Positive Bacteria

The same analysis was performed disaggregating by type of organism and the table below shows the results for Gram Positive.

Organism	Antibiotic	Response	Pre-lockdown			Post-lockdown		
			N	%	p	N	%	p
Gram Positive bacteria	Amikacin	R	10	9.6	1.000	1	5.6	1.000
		S	94	90.4	1.000	17	94.4	1.000
	Cefuroxime	R	15	17.9	0.011	0	0.0	0.011
		S	69	82.1	0.011	29	100.0	0.011
	Chloramphenicol	R	11	4.4	1.000	6	4.5	1.000
		S	237	95.6	1.000	126	95.5	1.000
	Ciprofloxacin	R	14	6.4	0.432	7	9.6	0.432
		S	205	93.6	0.432	66	90.4	0.432
	Clarithromycin	R	80	37.9	1.000	33	37.9	1.000
		S	131	62.1	1.000	54	62.1	1.000
	Clindamycin	R	47	22.8	0.656	23	25.6	0.656
		S	159	77.2	0.656	67	74.4	0.656
	Cotrimoxazole	R	1	9.1	1.000	6	10.5	1.000
		S	10	90.9	1.000	51	89.5	1.000
	Doxycycline	R	27	14.7	0.000	0	0.0	0.000
		S	157	85.3	0.000	66	100.0	0.000
	Fusidic.Acid	R	103	47.7	0.736	57	45.2	0.736
		S	113	52.3	0.736	69	54.8	0.736
	Gentamicin	R	14	6.1	1.000	8	6.2	1.000
		S	217	93.9	1.000	121	93.8	1.000
	Levofloxacin	R	9	8.4	1.000	4	7.5	1.000
		S	98	91.6	1.000	49	92.5	1.000
	Moxifloxacin	R	0	0.0	1.000	2	5.3	1.000
		S	4	100.0	1.000	36	94.7	1.000
	Mupirocin	R	1	0.7	1.000	0	0.0	1.000
		S	138	99.3	1.000	14	100.0	1.000
	Vancomycin	R	0	0.0	1.000	0	0.0	1.000
		S	237	100.0	1.000	105	100.0	1.000

For **Cefuroxime** in Gram-positive bacteria, a significant reduction in resistance was observed, dropping from 17.9% Pre-lockdown to 0% Post-lockdown. Sensitivity correspondingly increased from 82.1% to 100% ($p = 0.011$), indicating a notable improvement in sensitivity during the Post-lockdown period.

For **Doxycycline** in Gram-positive bacteria, a significant shift was detected, with resistance declining from 14.7% Pre-lockdown to 0% Post-lockdown. Sensitivity increased from 85.3% to 100% ($p < 0.001$), demonstrating a significant enhancement in antibiotic effectiveness Post-lockdown.

The results for other antibiotics were non-significant.

Gram Negative Bacteria

All antibiotics in Gram-negative bacteria showed no statistically significant differences in resistance or sensitivity between the Pre-lockdown and Post-lockdown periods.

Organism	Antibiotic	Response	Pre-lockdown			Post-lockdown		
			N	%	p	N	%	p
Gram Negative bacteria	Amikacin	R	0	0.0	1.000	0	0.0	1.000
		S	69	100.0	1.000	18	100.0	1.000
	Ceftazidime	R	3	5.5	1.000	0	0.0	1.000
		S	52	94.5	1.000	17	100.0	1.000
	Cefuroxime	R	11	37.9	1.000	1	50.0	1.000
		S	18	62.1	1.000	1	50.0	1.000
	Chloramphenicol	R	16	32.0	0.718	4	40.0	0.718
		S	34	68.0	0.718	6	60.0	0.718
	Ciprofloxacin	R	0	0.0	1.000	0	0.0	1.000
		S	80	100.0	1.000	20	100.0	1.000
	Clarithromycin	R	0	0.0	1.000	0	0.0	1.000
		S	7	100.0	1.000	1	100.0	1.000
	Cotrimoxazole	R	0	0.0	0.286	1	25.0	0.286
		S	10	100.0	0.286	3	75.0	0.286
	Fusidic.Acid	R	2	28.6	0.167	2	100.0	0.167
		S	5	71.4	0.167	0	0.0	0.167
	Gentamicin	R	1	1.5	1.000	0	0.0	1.000
		S	67	98.5	1.000	31	100.0	1.000
	Levofloxacin	R	4	6.3	1.000	1	5.6	1.000
		S	60	93.8	1.000	17	94.4	1.000
	Tobramycin	R	1	2.0	0.406	1	6.7	0.406
		S	50	98.0	0.406	14	93.3	0.406

Additional Analysis

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