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Bacteriological Analysis of Pharmaceutical Waste Water and Surrounding Environmental Waste Samples in South India

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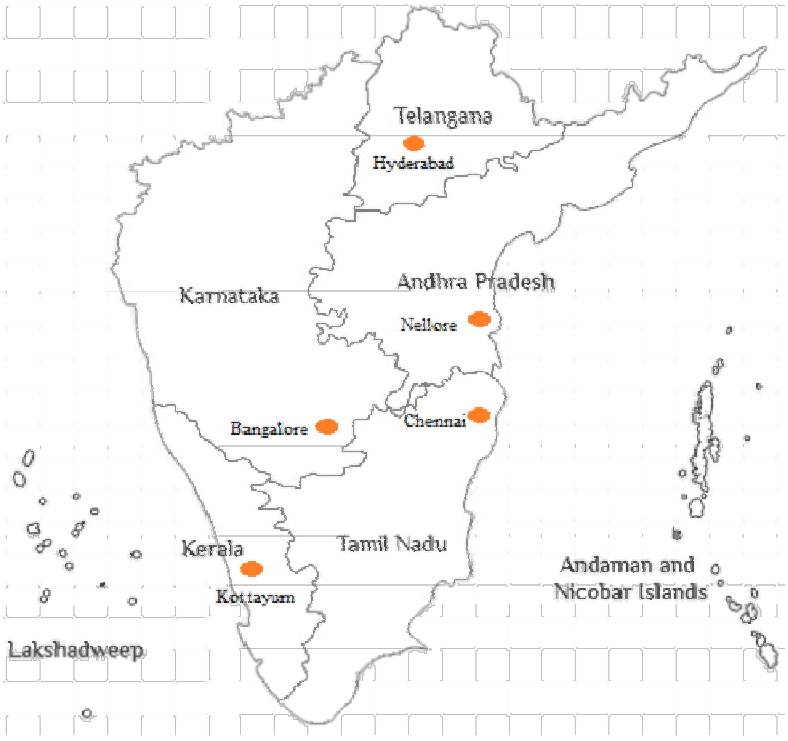
Supplementary Data



Supplementary Fig. 1: Map of the South India and locations of the various sampling sites in Pharmaceutical Industries and surrounding environment

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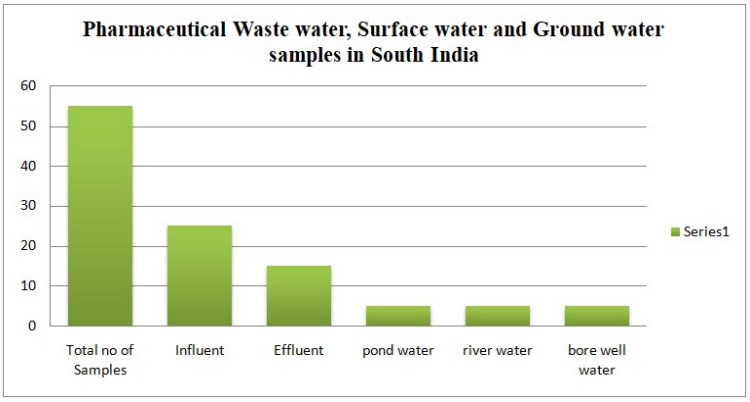

Supplementary Fig. 2:

Supplementary Table 1: Details of isolation and identification of bacteria from the waste water, surface water and ground water samples collected from pharmaceutical industries in South India

Sample ID/Year	Gram staining	Biochemical test										Identification of microorganism
		Oxidase	Catalase	Urease	TSI			Citrate	Indole	Manitol	Coagulase	
					S/B	Gas	H_2S Gas					
1:TN/I/2020	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas aeruginosa*
2:AP/GW/2020	G –ve Bacilli	- -	+ +	+ -	A/A			+ +	- -	- +		*Klebsiella pneumonia & Enterobacter aerogenes*
3:TS/GW/2020	G –ve Bacilli	- -	+ +	+ -	A/A			+ +	- -	- +		*Klebsiella pneumonia & Enterobacter aerogenes*
5:TS/I/2020	G +ve Bacilli	-	+	-								*Corynebacterium*
7:TS/I/2020	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas aeruginosa*
8:KA/I/2020	G –ve Bacilli	-	+	-	-	-	-	-	-	-		*Acinetobacter*
9:TS/GW/2020	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas Aeruginosa*
10:TS/I/2020	G –ve Bacilli	-	+	-	-	-	-	-	-	-		*Acinetobacter*
11:TS/I/2020	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas aeruginosa*

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12:TS/I/2021	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas aeruginosa*
15:KA/I/2021	G –ve Bacilli	+ -	+ +	- -	A/A		-	+ +	+ -	+ +		*Aeromonas Punctate & Enterobacter aerogenes*
16:KA/I/2021	G –ve Bacilli	- +	+ +	+ -	A/A		-	+ +	- +	- +		*Klebsiella pneumonia & Aeromonas Punctate*
17:KA/GW/2021	G –ve Bacilli	-	+	+	A/A			+	-	-		*Klebsiella pneumonia*
18:KA/E/2021	G -ve Bacilli	-	+	-	A/A			+	-	+		*Enterobacter aerogenes*
26:AP/GW/2021	G -ve Bacilli	+	+	+			+		-	-		*Ralstonia picketti*
27:TN/GW/2021	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
29:KL/I/2021	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
30:KL/I/2021	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
31:KL/I/2021	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
32:KL/I/2021	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
33:KL/GW//2021	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
34:KL/GW/2021	G –ve Bacilli G +ve Cocci	+ +	+ +	- +	K/K			+	-	- +	+	*Pseudomonas aeruginosa & Staphylococcus aureus*
35:TS/GW/2021	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas aeruginosa*
36:TS/I/2021	G –ve Bacilli G +ve Cocci	- +	+ +	- +	A/A			+	-	+ +	+	*Enterobacter aerogenes & Staphylococcus aureus*

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37:TS/I/2021	G –ve Bacilli	-	+	+	A/A		+	+	-	+		*Citrobacter freundii*
38:KA/I/2021	G –ve Bacilli	- -	+ +	- +	A/A		+	+ +	- -	+ +		*Enterobacter aerogenes* & *Citrobacter freundii*
41:TS/I/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
42:TS/GW/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
43:KA/GW/2022	G –ve Bacilli	-	-	-			-	+	-	-		*Stenotrophomonas maltophillia*
44:KA/I/2022	G –ve Bacilli	- +	- +	- -	K/K		-	+ +	- -	- -		*Stenotrophomonas maltophillia* & *Pseudomonas aeruginosa*
45:KA/I/2022	G –ve Bacilli G +ve Cocci	- +	+ +	+ +	A/A			+	-	- +	+	*Klebsiella pneumonia* & *Staphylococcus aureus*
46:KA/GW/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
47:KA/I/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
48:KA/GW/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
49:KL/I/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
50:KL/I/2022	G +ve Cocci	+	+	+						+	+	*Staphylococcus aureus*
51:AP/I/2022	G –ve Bacilli	-	+	+	A/A			+	-	-		*Klebsiella pneumonia*
52:AP/I/2022	G –ve Bacilli	-	+	+	A/A			+	-	-		*Klebsiella pneumonia*
53:TN/GW/2022	G –ve Bacilli	+	+	-	K/K			+	-	-		*Pseudomonas aeruginosa*
Note: 54:AP/I/2022, 55:TN/E/2022, 4:TN/E/2020, 6:TS/E/2020, 13:TN/E/2021, 14:TN/E/2021, 19:TS/E/2021, 20:TS/I/2021, 21:KA/E/2021, 22:KA/E/2021, 23:KA/E/2021, 24:AP/E/2021, 25:AP/E/2021, 28:KL/E/2021, 39:KL/E/2022, 40:TS/GW/2022. All these effluent samples were negative for isolation of any bacteria.												

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Supplementary Table 2: Number of samples and bacterial isolates obtained per monitoring sites in South India

	STATES															
	TN			AP			TS			KA			KL			
Organisms	GW	I	E	GW	I	E	GW	I	E	GW	I	E	GW	I	E	Total
Klebsiella pneumonia	-	-	-	1	2	-	1	-	-	1	2	-	-	-	-	7
Pseudomonas aeruginosa	1	1	-	-	-	-	2	3	-	-	1	-	1	-	-	9
Citrobacter freundii	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2
Enterobacter	-	-	-	1	-	-	1	1	-	-	2	-	-	-	1	6
Ralstonia picketti	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Acinetobacter	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2
Aeromonas Punctate	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
Stenotrophomonas maltophillia	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	2
Corynebacterium	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Staphylococcus aureus	1	-	-	-	-	-	1	2	-	2	2	-	2	6	-	16
Total	2	1		3	2		5	9		4	12		3	6	1	48

Supplementary Table 3: Percentage (%) of bacterial isolates obtained from surface water, ground water and waste water samples of Pharmaceutical industries in South India

Bacterial isolates	Percentage (%)
Gram Negative Bacilli	
Stenotrophomonas maltophillia *Klebsiella pneumonia* *Pseudomonas aeruginosa* *Citrobacter freundii* *Enterobacter aerogenes* *Ralstonia picketti* *Acinetobacter sp.* *Aeromonas punctate*	3 19 22 4 12 2 5 3
Gram Positive Cocci	
Staphylococcus aureus	28
Gram Positive Bacilli or Club shaped	
Corynebacterium sp.	2