

# Isolation of *Legionella pneumophila* from Hospital Cooling Towers in Johor, Malaysia

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Presented by,

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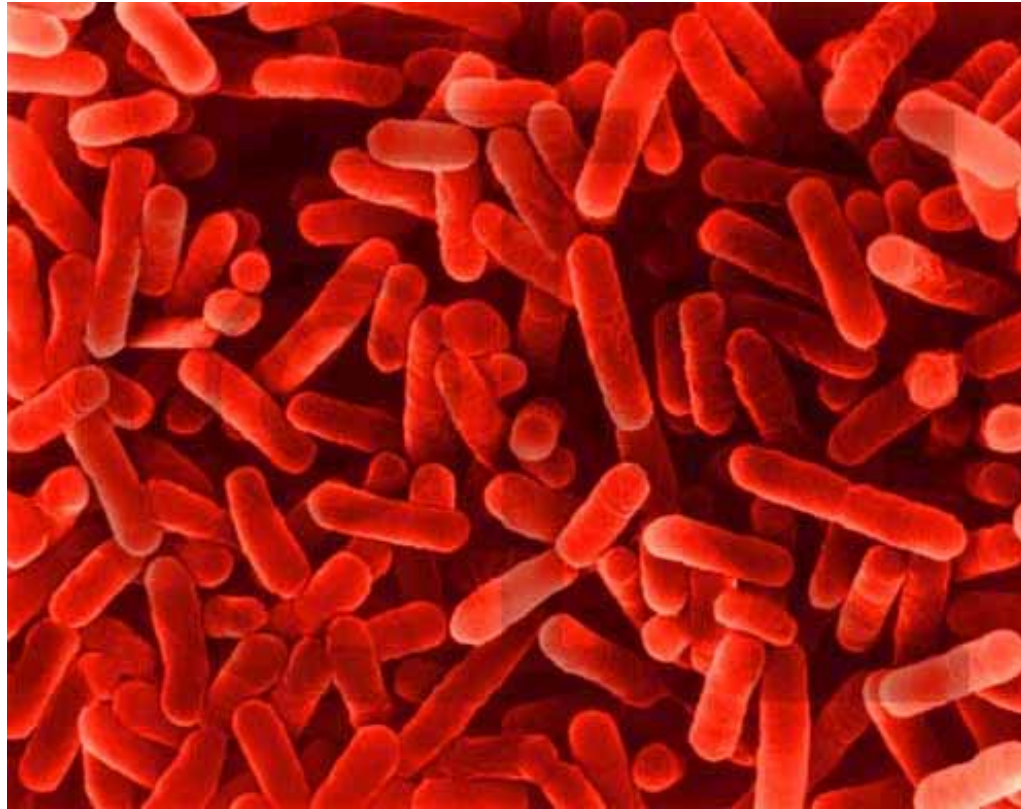
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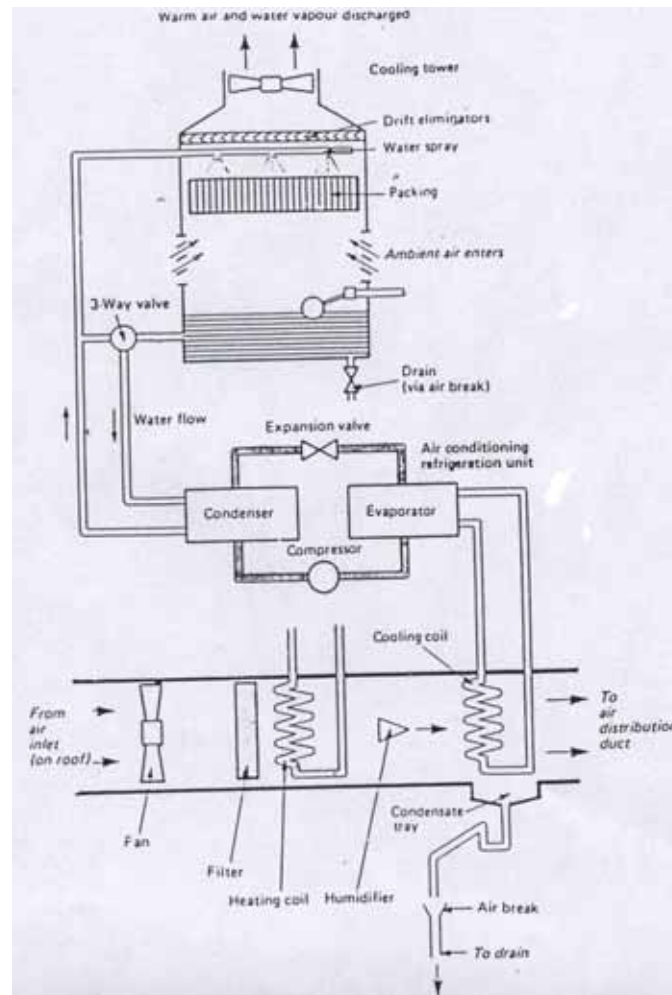
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# The Pathogen

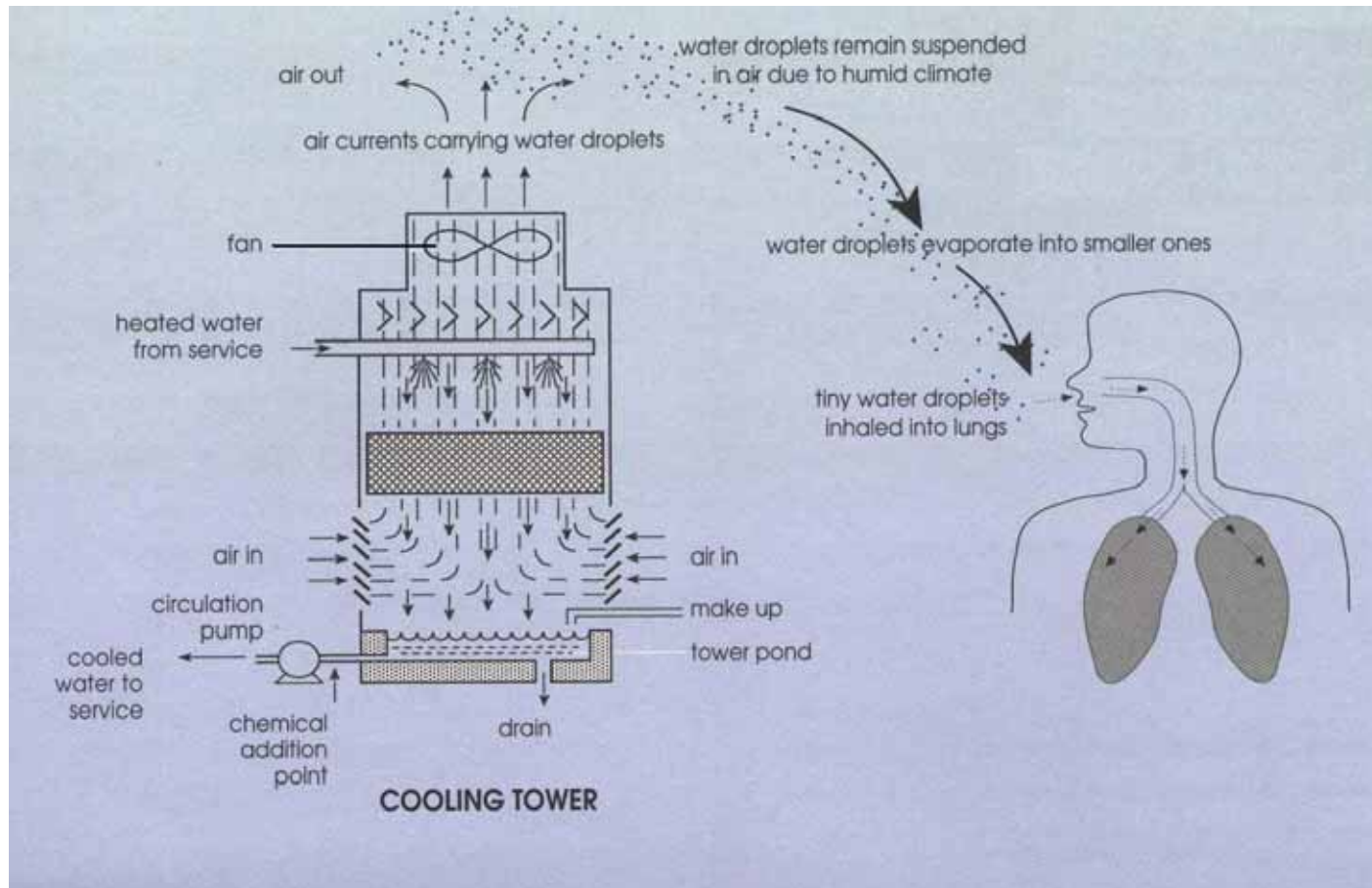


*Legionella pneumophila*

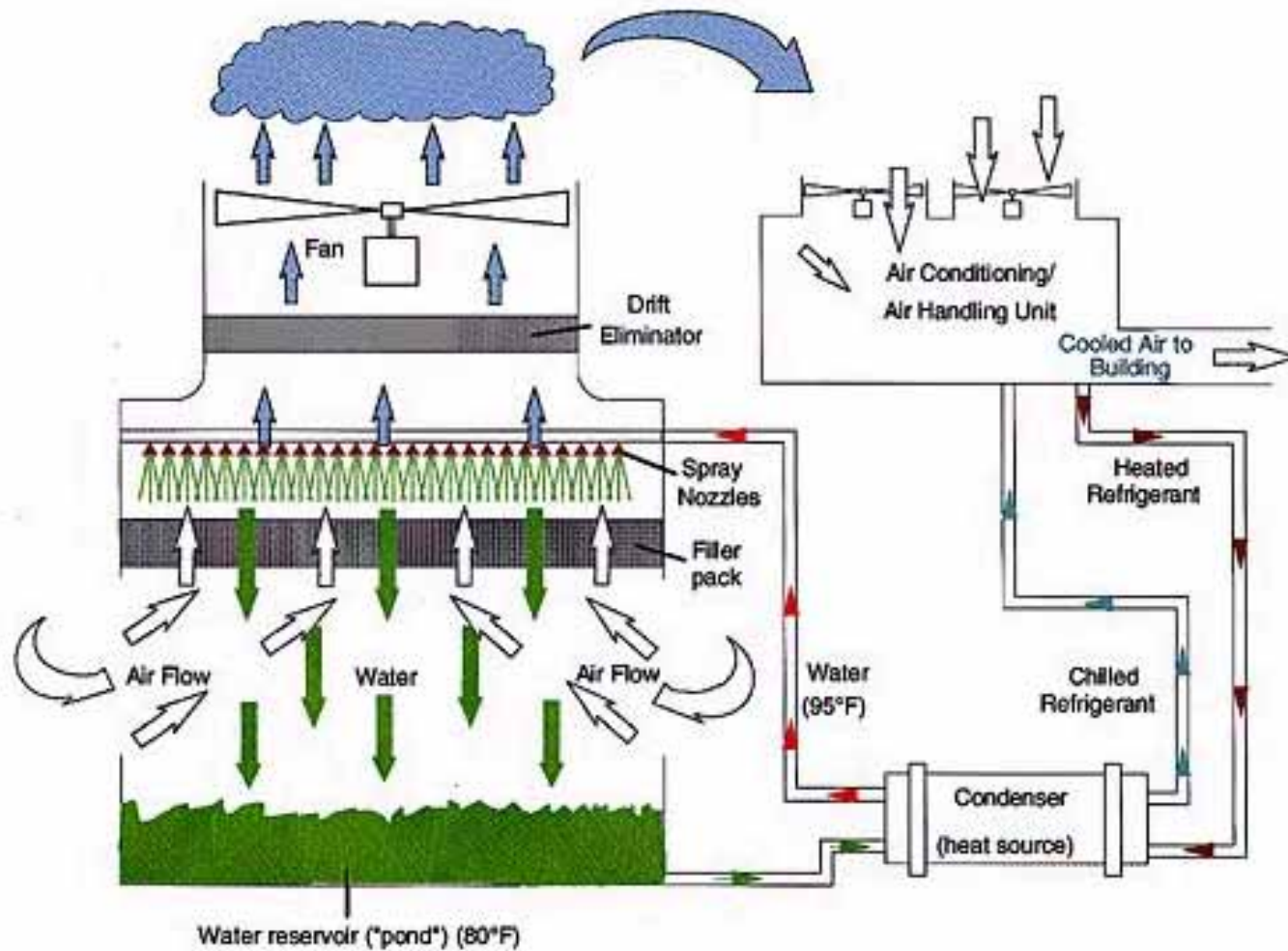
# The Cooling Tower (CT) System



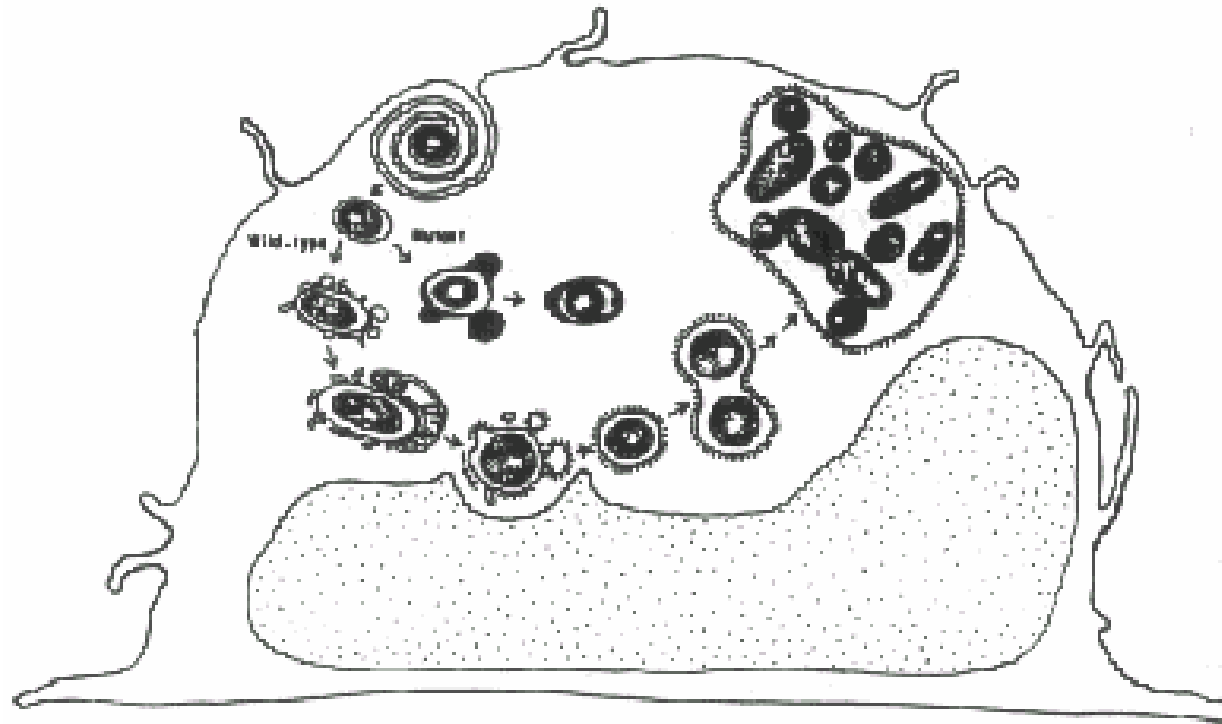
# Mode of Transmission



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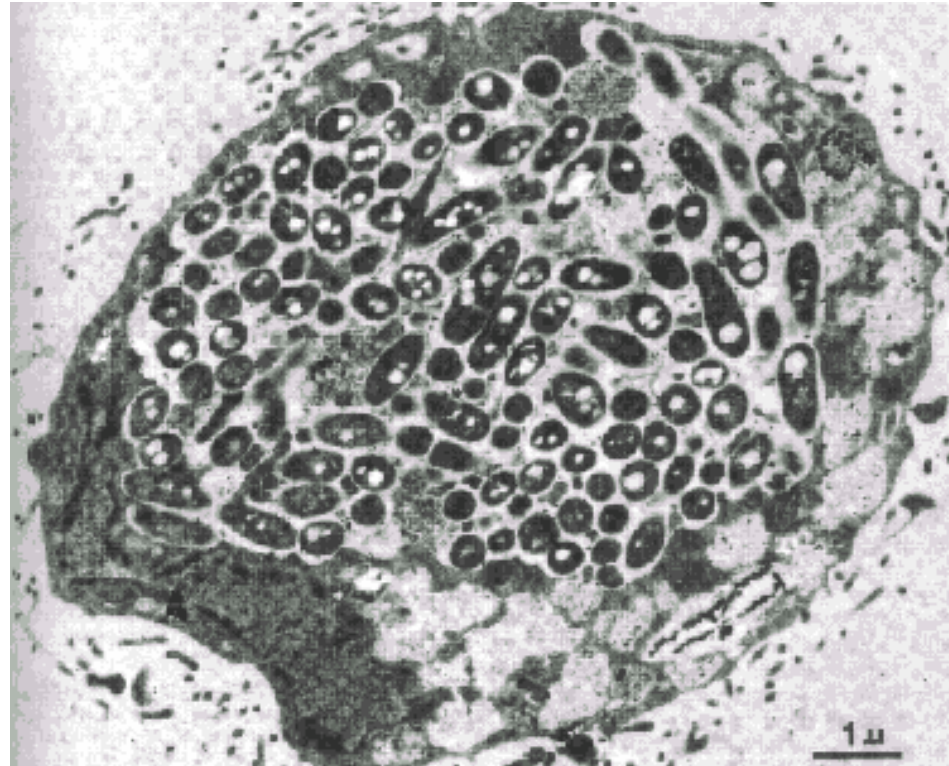


# Pathogenesis



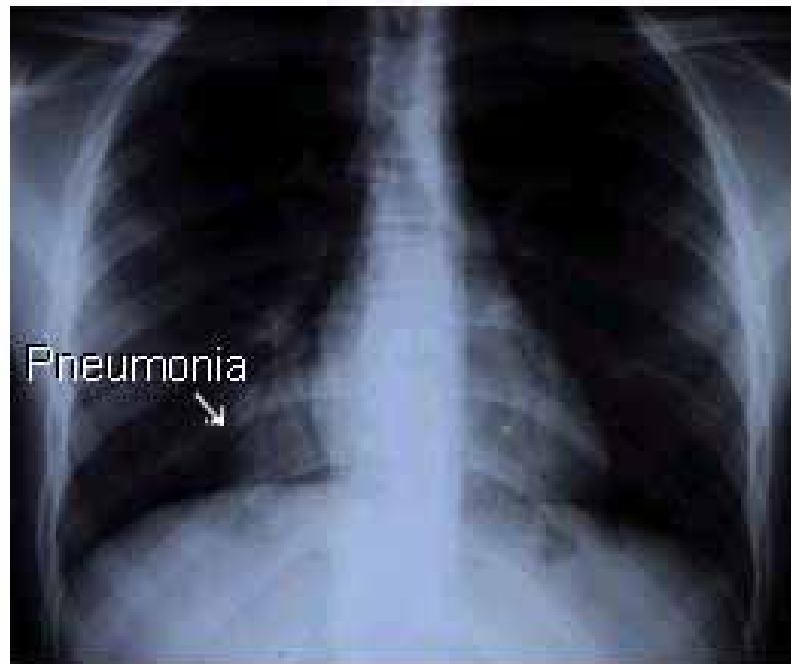
Replicative cycle of *L. pneumophila* within monocytes

# Pathogenesis



Infected alveolar macrophage

# Legionnaires' Disease (LD)



CXR showing legionella pneumonia



# Problem Statement

- Based on findings of *Legionella pneumophila* in building complexes cooling towers (CTs) in Kuala Lumpur <sup>1</sup> and hospital CTs in Singapore,<sup>2</sup> therefore, it is possible that the pathogenic bacteria are also present in hospital CTs in Johor.

1. Ngeow YF, Tan CH, Lim SY. Legionella species isolated from cooling towers in Kuala Lumpur. Med J Malaysia 1992; 47(1) : 15-19.
2. Quarantine and Epidemiology Department. Legionellosis. In : Communicable disease surveillance in Singapore 1999. Singapore : Ministry of Environment, 2000. 6-1 – 6-14.

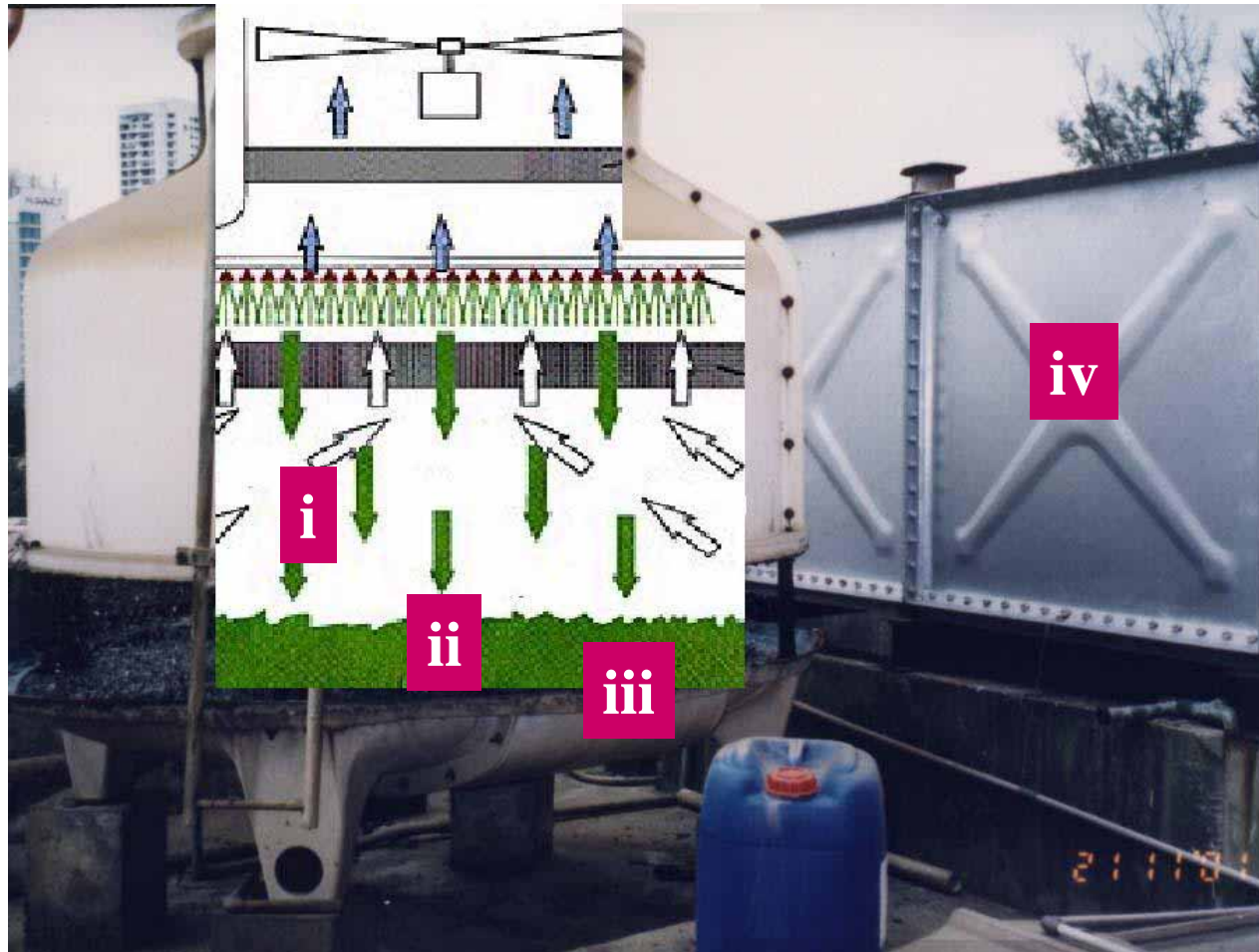
# Objectives

1. To determine the presence of *Legionella* bacteria in the hospital CTs
2. To compare isolation rate of *Legionella* bacteria in the CTs with and without cleaning and/or treatment maintenance programme
3. To associate the isolation rate of *Legionella* bacteria with water parameters like temperature, pH, turbidity, and free chlorine content

# Study Design

- An environmental survey on all water-based CTs
- Convenient sampling at two selected hospitals named as the Hospital A and the Hospital B

# Sampling Sites



# Sampling Site i



# Sampling Sites ii & iii



# Sampling Site iv

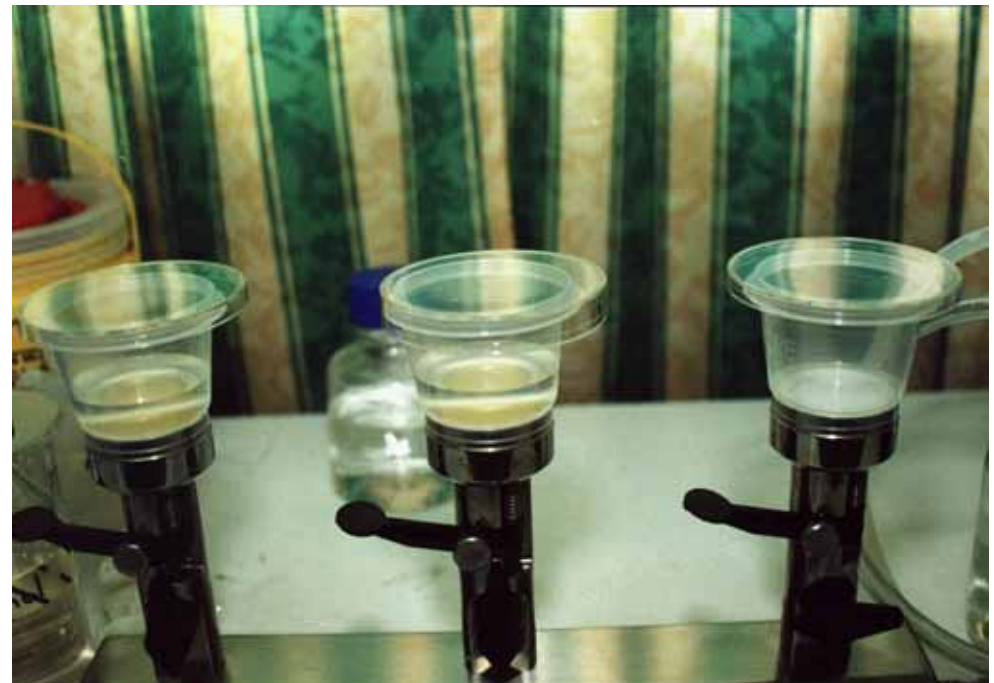


# Water Parameters tested *in situ*





# Laboratory Procedures



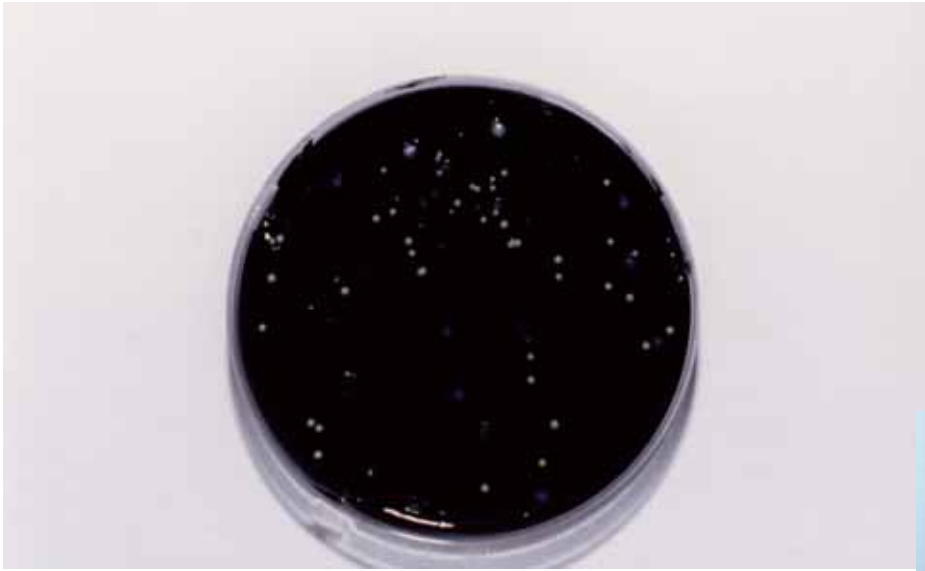
# Laboratory Procedures



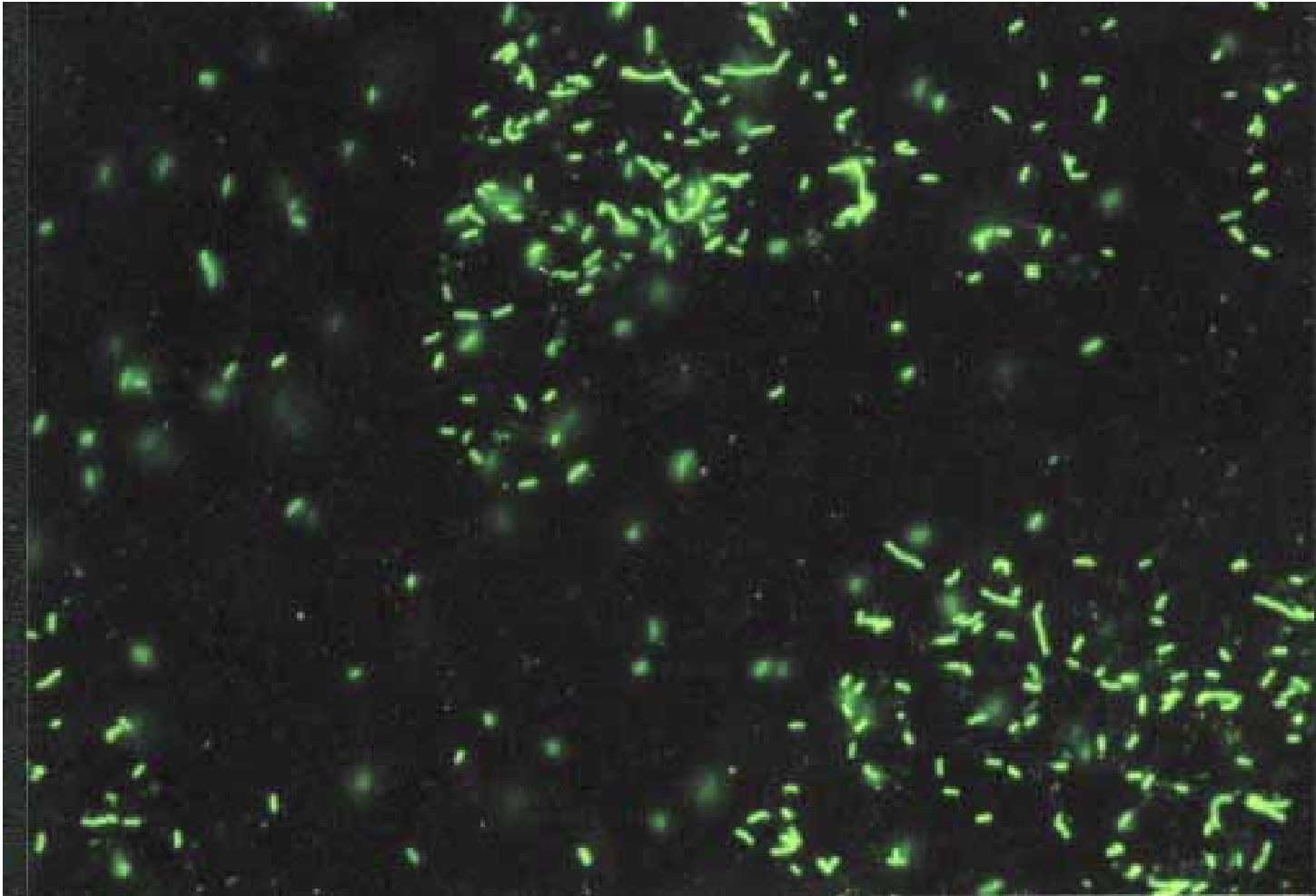
# Control Isolate



# Trial Run



# Direct Fluorescent Antibody Test



# Study Findings

1. *Legionella* isolations in hospital CTs

Table 1. Isolation of *L. pneumophila* from Hospital A and Hospital B cooling towers by different sampling site and treatment method.

Sampling premise.	Sampling site <sup>a</sup>	Treatment method (1 = Detected; 0 = Not detected)			
		Direct Plating	Heat	Acid Buffer	
Hospital A	CT 1	i.	1	1	1
		ii.	1	1	1
		iii.	1	1	1
		iv.	1	1	0
	CT 2	i.	No sample	No sample	No sample
		ii.	1	1	1
		iii.	1	1	1
		iv.	1	1	1
	CT 3	i.	1	1	1
		ii.	1	1	1
		iii.	1	1	1
		iv.	0	0	0
	CT 4	i.	1	1	1
		ii.	1	1	1
		iii.	1	1	1
		iv.	0	0	0
	CT 5	i.	1	1	1
		ii.	1	1	1
		iii.	1	1	1
		iv.	1	1	1
Hospital B	CT 6	i.	No sample	No sample	No sample
		ii.	1	1	1
		iii.	1	1	1
		iv.	No sample	No sample	No sample
	CT 7	i.	0	0	0
		ii.	0	0	0
		iii.	0	0	0
		iv.	0	0	0

CT = Cooling tower

Table 2. Identification of *L. pneumophila* by DFA test grading and serogrouping.

Sampling site		No. of water samples	No. (%) of culture positive	DFA test grading	Serogroup
Hospital A	CT 1	4	4 (100%)	2+	Serogroup 2 - 7
	CT 2	3	3 (100%)	2+	Serogroup 2 - 7
	CT 3	4	3 (75%)	2+ to 3+	Serogroup 2 - 7
	CT4	4	3 (75%)	2+ to 3+	Serogroup 2 - 7
	CT 5	4	4 (100%)	3+ to 4+	Serogroup 1
Hospital B	CT 6	2	2 (100%)	2+	Serogroup 1 - 7
	CT 7	4	0 (0%)	0	0
Total	7 CTs	25	19 (76%)		

CT = Cooling tower

DFA = Direct Fluorescence Antibody



# Study Findings

2. Isolation of *Legionella pneumophila* in the CTs with and without cleaning and treatment maintenance programme

**Table 3. Isolation of *L. pneumophila* and summary of CT maintenance programmes at Hospital A and Hospital B.**

Sampling site		<u>Legionella</u> isolation*	<u>Frequency of treatment &amp; cleaning programme</u>			
			Chemical	<u>Microbiocide I</u>	<u>Microbiocide II</u>	Manual cleaning
Hospital A	CT 1	1	Two weekly	Two weekly	Monthly	None
	CT 2	1	Two weekly	Two weekly	Monthly	None
	CT 3	1	Two weekly	Two weekly	Monthly	None
	CT 4	1	Two weekly	Two weekly	Monthly	None
	CT 5	1	Two weekly	Two weekly	Monthly	None
Hospital B	CT 6**	1	None	None	None	None
	CT 7	0	Weekly	Weekly	Monthly	Weekly

\* 1 = Detected; 0 = Not detected

\*\* CT 6 was used as a backup CT therefore it was not operated at the time of sampling.

It would undergo treatment before putting back on operation.

# Study Findings

## 3. Associations with water parameters

**Table 4. Association between water parameters and number of day intervals between CT treatment and water sampling.**

Model		<u>Unstandardized</u> Coefficients		Standardized	t	Sig.	95% Confidence	
		B	Std. Error	Beta			Lower	Upper
							Bound	Bound
1	(Constant)	8.914	1.304		.000	6.185	6.837	11.643
	pH	-.169	.148	-.051	.269	.479	-1.140	.141
	Temperature	-1.078E-02	.014	-.016	.437	.039	-.794	.018
	Chlorine	-25.703	.977	-.957	.000	27.748	-26.304	-23.657
	Turbidity	-.114	.067	-.065	.105	.253	-1.704	.026

Dependent Variable: Number of day intervals between CT treatment and water sampling

# Limitations

- Sampling Method and the Sampling Size
- Sampling Day
- Quantitative Method

# Conclusions

- *L. pneumophila* were prevalent in both hospitals with the Hospital A has a potential LD outbreak
- High pH and free chlorine content would eliminate *Legionella* bacteria but may lead to scale and fouling formations
- Isolation of *L. pneumophila* in the CT water supply is equally alarming
- The Hospital B had better engineering practice than the Hospital A

# Recommendations

1. Good Engineering Practice
2. Intervention Measure and Follow-up
3. CT Survey at Other High Risk Public Places
4. *Legionella* Isolation at Other Man-made Devices
5. An Environmental Surveillance
6. Molecular Identification of *Legionella* Strains

# Recommendations

7. A Clinical Surveillance  
(Legionellosis Notification)
8. Clinical Diagnostic Kits and Markers
9. Awareness Programme
10. Law and Regulations
11. Further Research



# Acknowledgements

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**Thank You**