



Rijksinstituut voor Volksgezondheid  
en Milieu  
*Ministerie van Volksgezondheid,  
Welzijn en Sport*

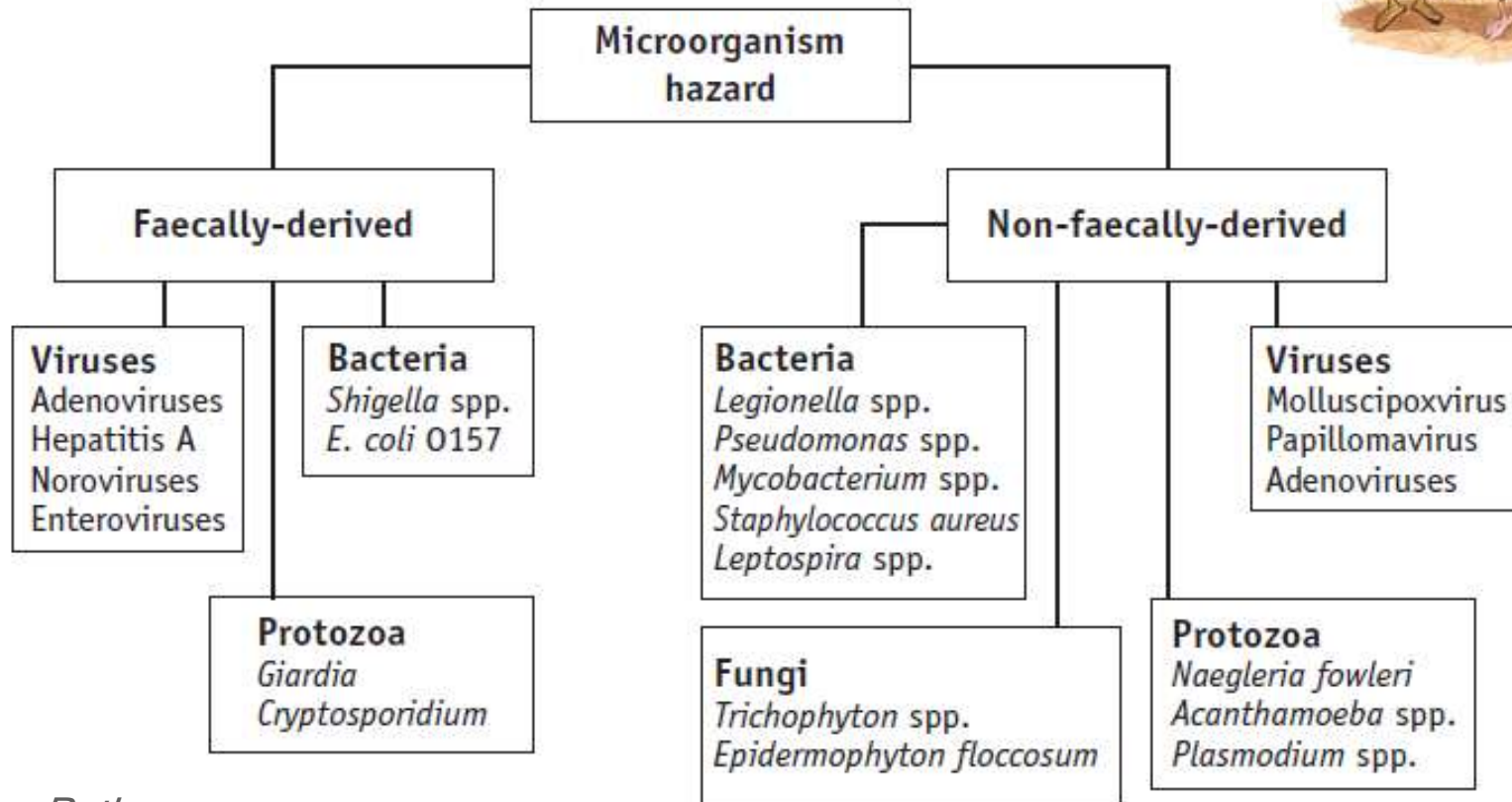
## Delivering Healthy Water ~ waves ahead

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Ciska Schets  
CIb LZO Milieu

26 mei 2011 IRAS



# Recreational water related pathogens



*Pathogen x,y,z*



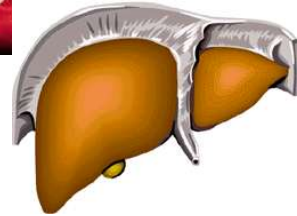
PV



VV



HepV



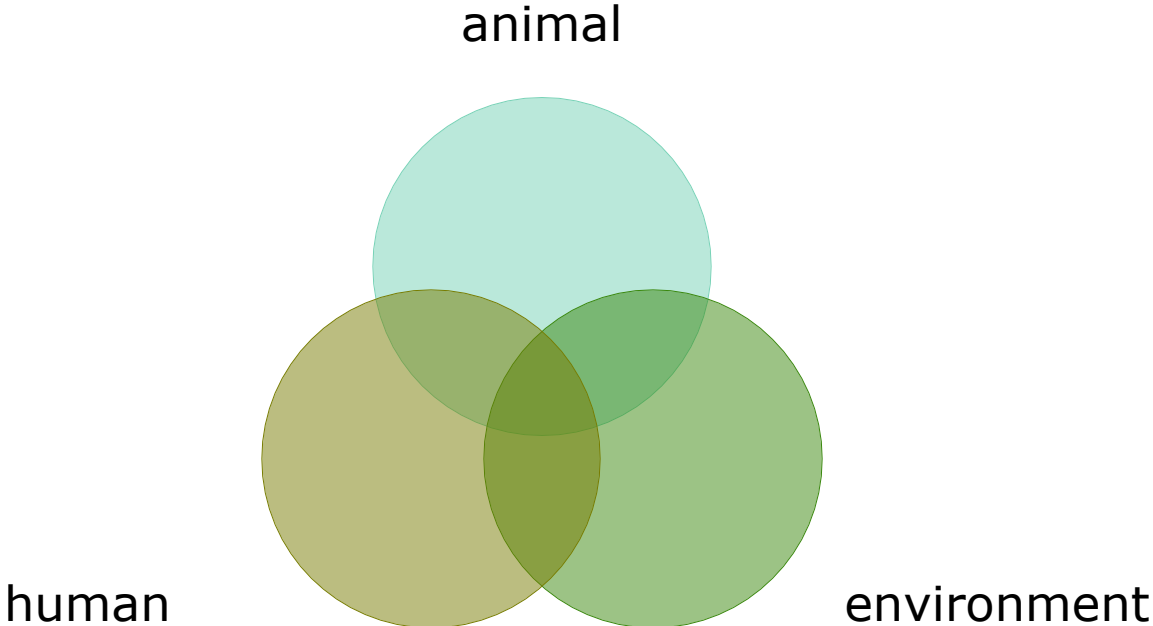
HIV



ReoV



# Pathogen sources



# Excretion and secretion

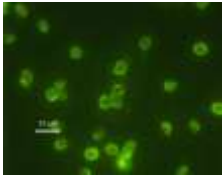
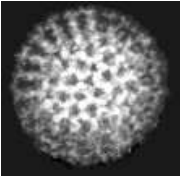
	Faeces	Urine	Saliva	Tears	Sweat	Reference
Adenovirus	+	+	+	+	?	Ramsay et al. 2002; Hatakeyama et al. 2006; Kaye et al. 2005
Aichivirus	+	?	?	?	?	Yamashita et al. 2000
Astrovirus	+	?	?	?	?	Guix et al. 2005
Enterovirus	+	+	+	?	?	Ramsay et al. 2002; Muir et al 1993
Hepatitis A virus	+	?	+	?	?	Mackiewicz et al. 2004
Hepatitis C virus	+	?	+	?	+	Beld et al. 2000; Ortiz-Movilla et al. 2002
Hepatitis E virus	+	?	?	?	?	Singh et al. 1998
Norovirus	+	?	?	?	?	Herrmann et al. 1985
Parvovirus	?	?	+	?	?	Ramsay et al. 2002
Picobirnavirus	+	?	?	?	?	Cascio et al. 1996; Banyai et al. 2003
Polyomavirus	+	+	?	?	?	Hatakeyama et al. 2006; Berger et al. 2006
Reovirus	+	?	?	?	?	Giordano et al. 2002
Rotavirus	+	?	?	?	?	Bowdre 1983
Sapovirus	+	?	?	?	?	Phan et al. 2006
SARS coronavirus	+	+	+	?	+	Wang et al. 2004; Ding et al. 2004
TT virus	+	-	+	+	-	Matsubara et al. 2000

+ studied and confirmed; - studied but not detected;

? no studies included in publications shown by search engine NCBI pubmed



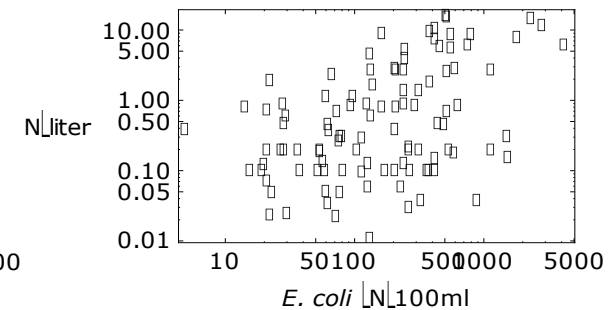
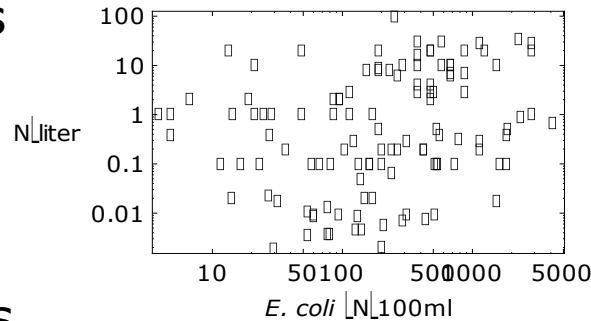
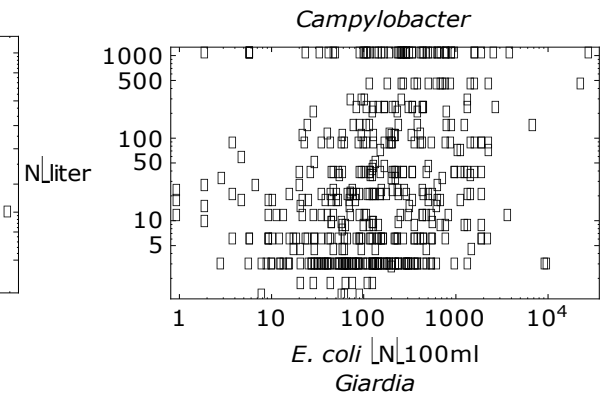
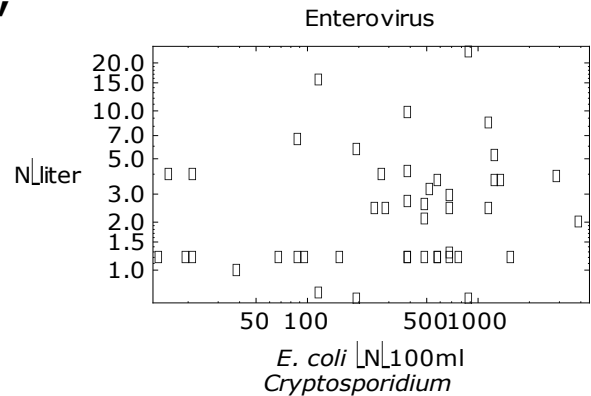
# Persistence in aquatic environment





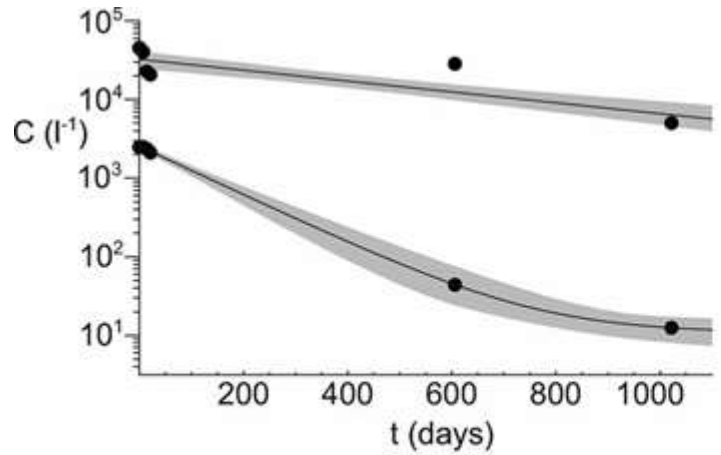
# *E. coli* and enteric pathogens

- Data from Canada, US, Australia, Europe
- In surface water
  - Weak positive relation between presence of *E. coli* and concentrations of enteric pathogens
  - High and low concentrations of enteric pathogens independent from *E. coli*-concentrations

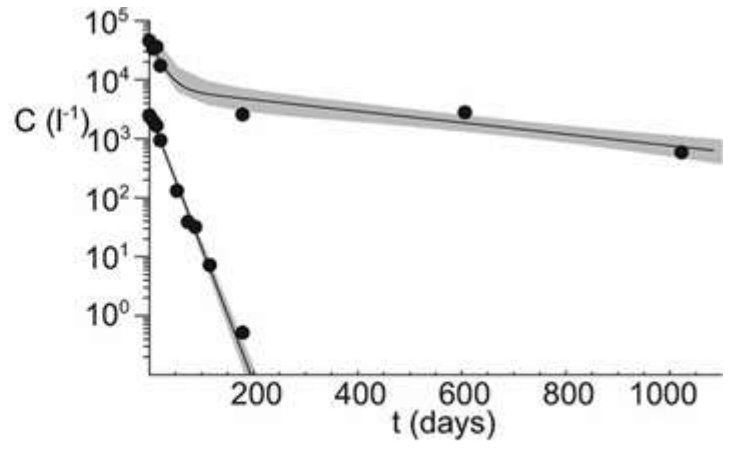




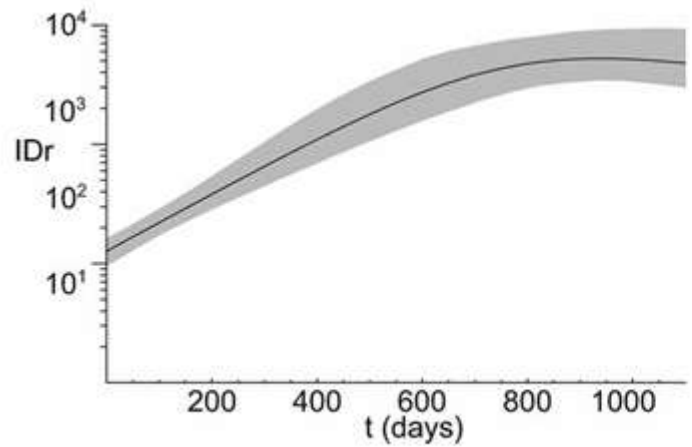
# Inactivation by PCR and cell culture



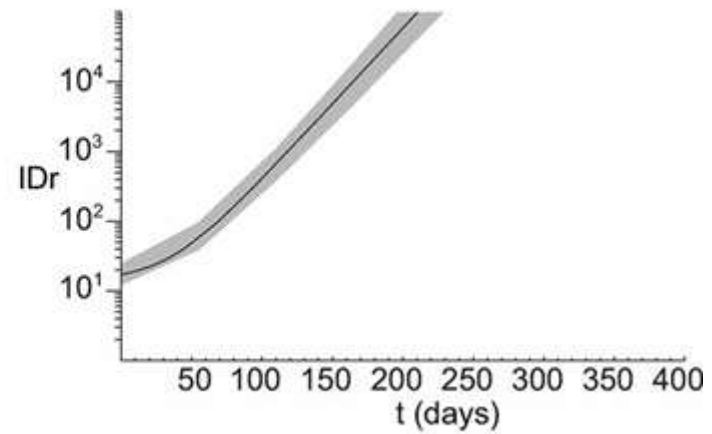
(a) PV1 4°C



(b) PV1 22°C



(c) PV1 4°C



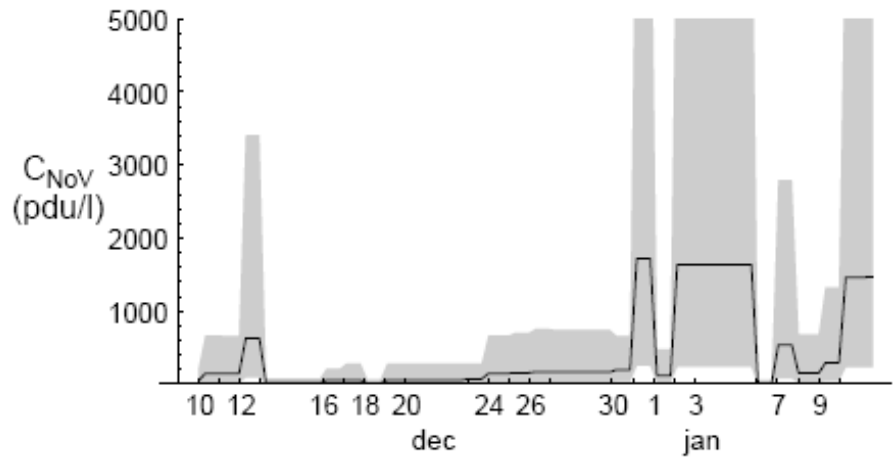
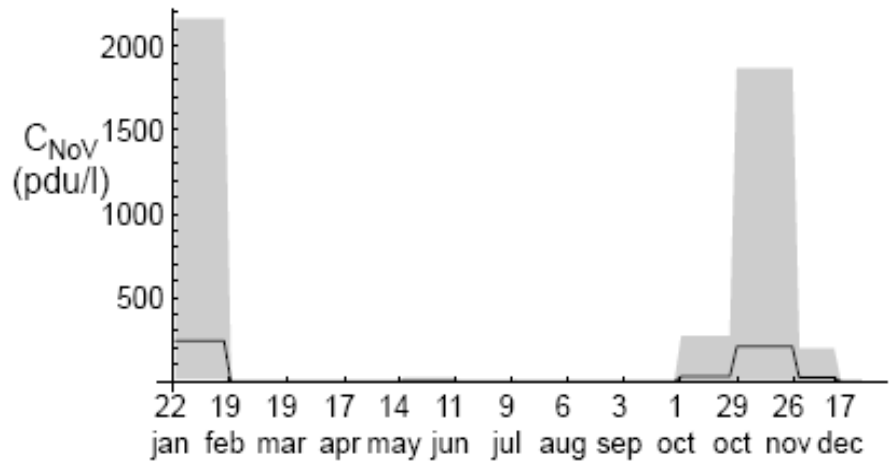
(d) PV1 22°C





# Short term fluctuations in surface waters

- NoV winter peak may consist of many narrow, higher peaks
- Influence on annual infectious risks



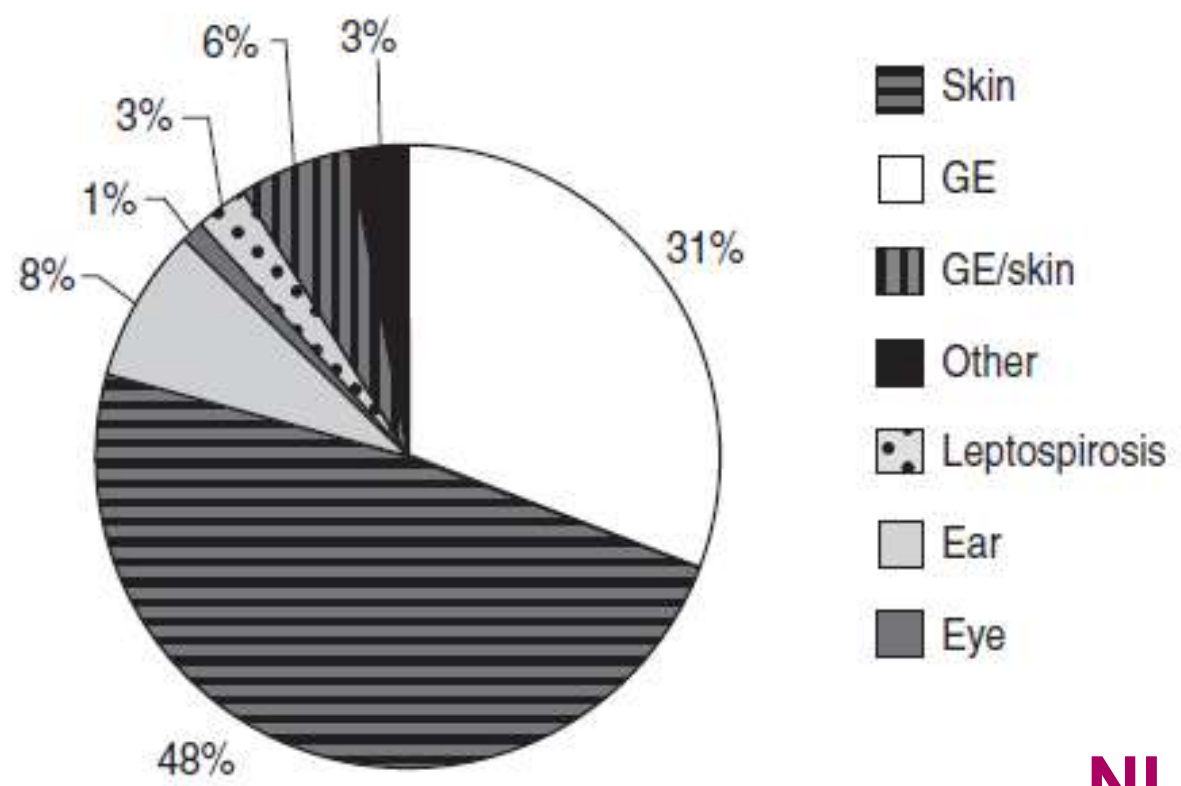


# Recreational water types





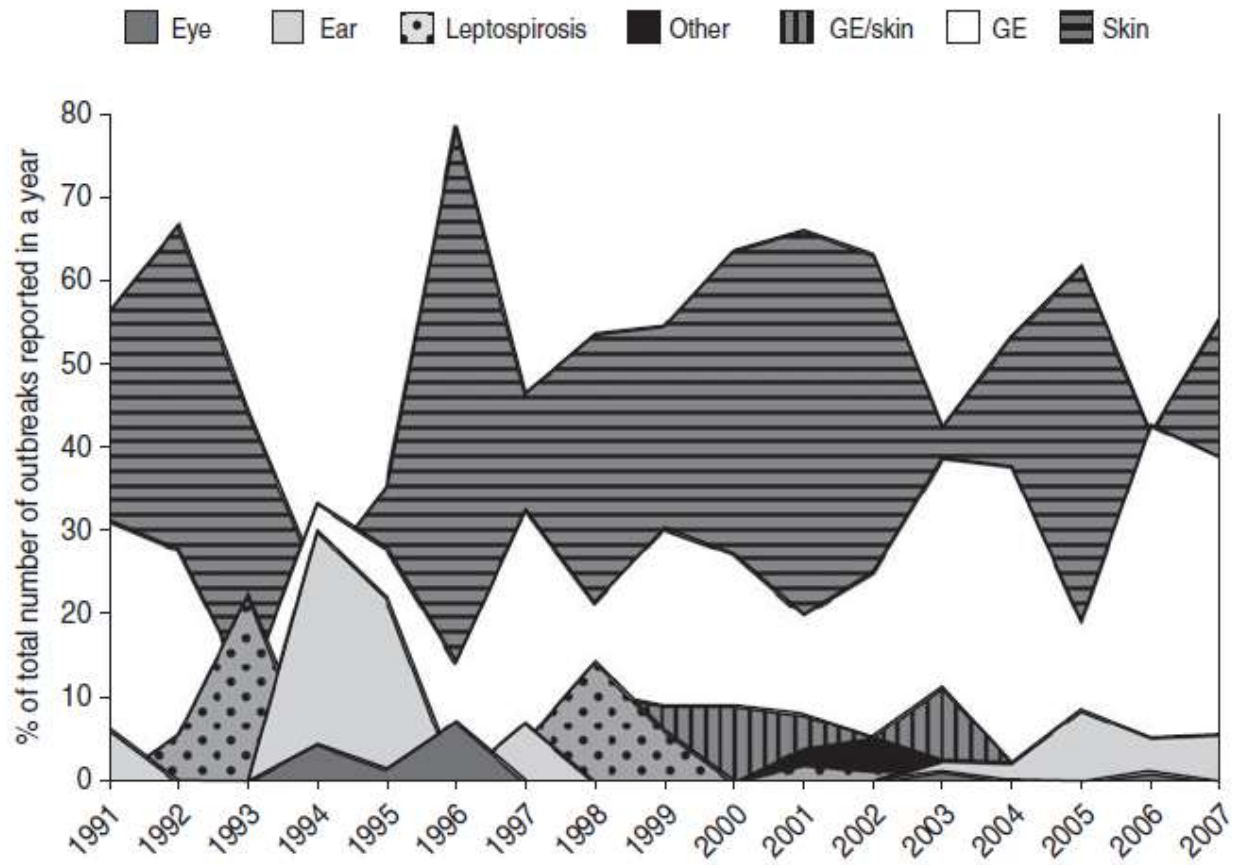
# Recreational water related health complaints



**NL 1991-2007**



# Trends in recreational water related health complaints





# Recreational water exposure

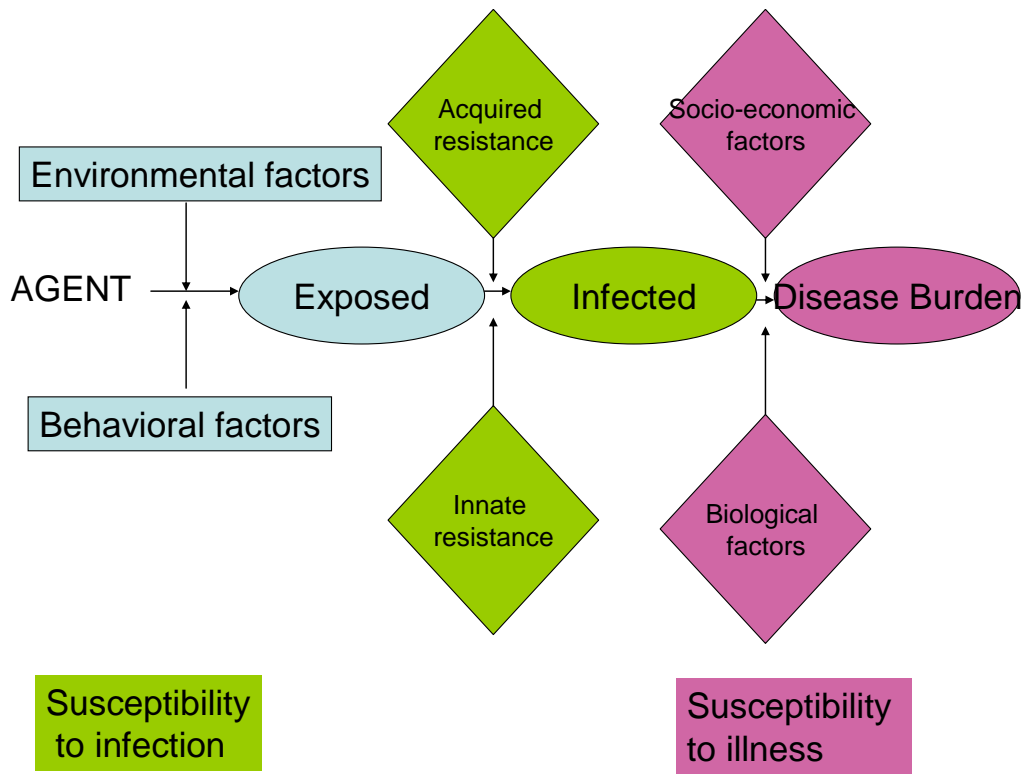
**Table 1.** Number (%) of divers who swallowed the specified volume of water per dive [shown as range (average)].

	Water volume (mL)					Total divers
	None 0 (0)	Few drops 0.5–5 (2.75)	Shot glass 20–30 (25)	Coffee cup 80–120 (100)	Soda glass 170–210 (190)	
<b>Occupational divers in 2002</b>						
Open sea	5 (25)	9 (45)	6 (30)	0 (0)	0 (0)	20
Coastal water, usd < 1 km	4 (50)	1 (13)	3 (38)	0 (0)	0 (0)	8
Coastal water, usd > 1 km	2 (29)	3 (43)	2 (29)	0 (0)	0 (0)	7
Coastal water, usd unknown	5 (18)	8 (29)	4 (14)	1 (3.6)	0 (0)	18
Fresh water, usd < 1 km	4 (33)	6 (50)	2 (17)	0 (0)	0 (0)	12
Fresh water, usd > 1 km	4 (33)	6 (50)	2 (17)	0 (0)	0 (0)	12
Fresh water, no usd	7 (58)	3 (25)	2 (17)	0 (0)	0 (0)	12
Fresh water, usd unknown	11 (44)	9 (36)	5 (20)	0 (0)	0 (0)	25
<b>Sport divers in 2003 wearing an ordinary diving mask</b>						
Open sea	130 (46)	39 (14)	102 (36)	9 (3.2)	0 (0)	280
Coastal water	57 (14)	79 (19)	262 (64)	10 (2.4)	2 (0.49)	410
Fresh recreational water	35 (8.3)	110 (26)	255 (61)	20 (6.8)	1 (0.24)	421
Canals and rivers	126 (63)	13 (6.5)	59 (30)	2 (1.0)	0 (0)	200
City canals	130 (75)	8 (4.6)	33 (19)	2 (1.1)	0 (0)	173
Swimming pools	47 (14)	91 (28)	154 (47)	28 (8.6)	6 (1.8)	326
<b>Sport divers in 2003 wearing a full face mask</b>						
Open sea	27 (84)	5 (16)	0 (0)	0 (0)	0 (0)	32
Coastal water	25 (96)	0 (0)	1 (4.0)	0 (0)	0 (0)	26
Fresh recreational water	27 (96)	0 (0)	1 (4.0)	0 (0)	0 (0)	28
Canals and rivers	24 (83)	5 (17)	0 (0)	0 (0)	0 (0)	29
City canals	24 (89)	3 (10)	0 (0)	0 (0)	0 (0)	27
Swimming pools	23 (74)	0 (0)	5 (16)	2 (6.5)	1 (3.2)	31

usd, upstream sewage discharge.

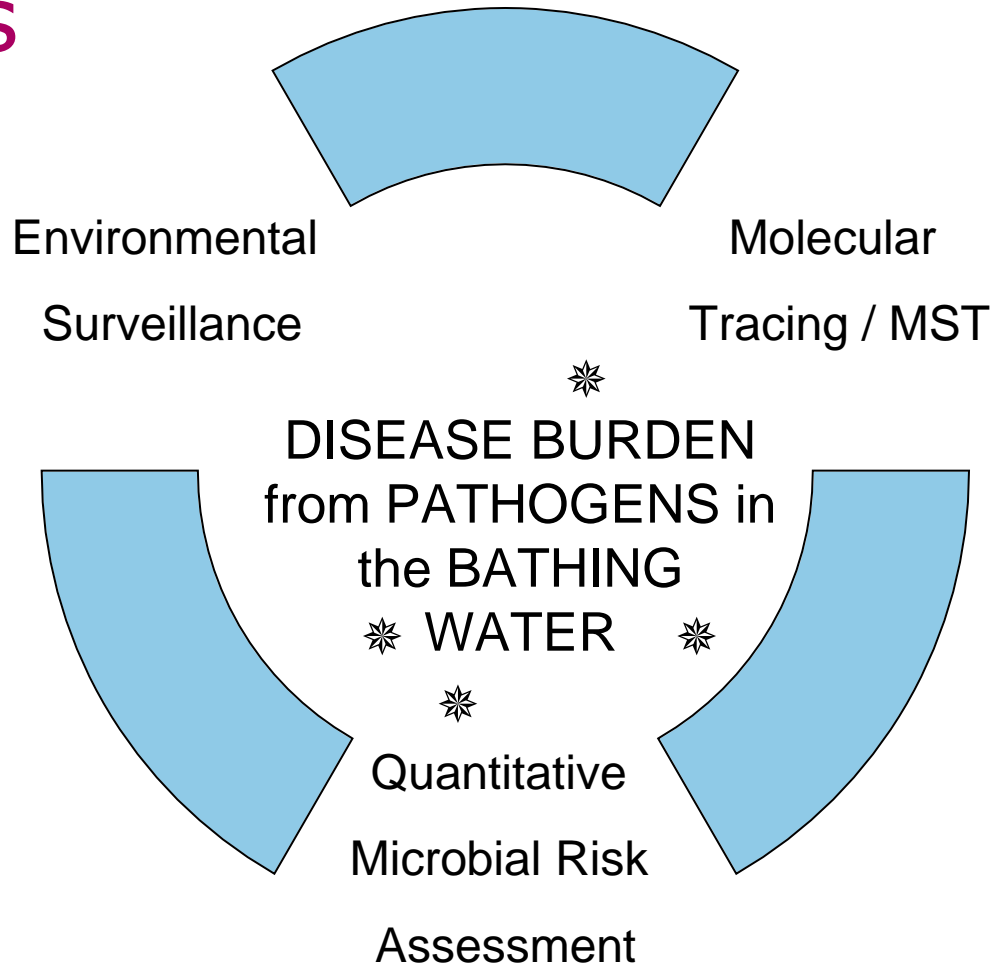


# Susceptible subpopulations





# The tools





# Current status of EU bathing water legislation

	Excellent quality	Good quality	sufficient	method
Inland waters				
Intestinal enterococci	200 (*)	400 (*)	330 (**)	ISO 7899-1 (microtiter MPN) ISO 7899-2 (membrane filtration)
E. coli	500 (*)	1000 (*)	900 (**)	ISO 9308-3 (microtiter MPN) ISO 9308-1 (membrane filtration)
Coastal waters				
Intestinal enterococci	100 (*)	200 (*)	185 (**)	ISO 7899-1 (microtiter MPN) ISO 7899-2 (membrane filtration)
E. coli	250 (*)	500 (*)	500 (**)	ISO 9308-3 (microtiter MPN) ISO 9308-1 (membrane filtration)

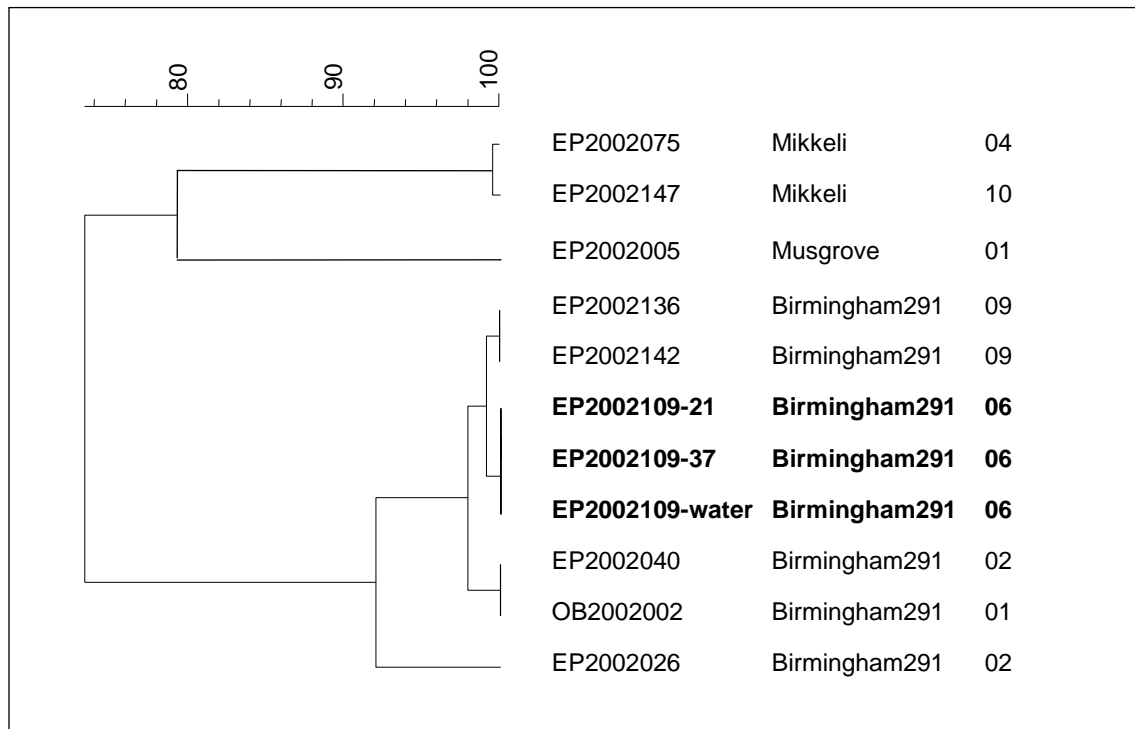
(\*) based upon a 95-percentile evaluation; (\*\*) based upon a 90-percentile evaluation

- At least 4 samples per bathing season
- Evaluation based upon at least 16 samples (4 bathing seasons)



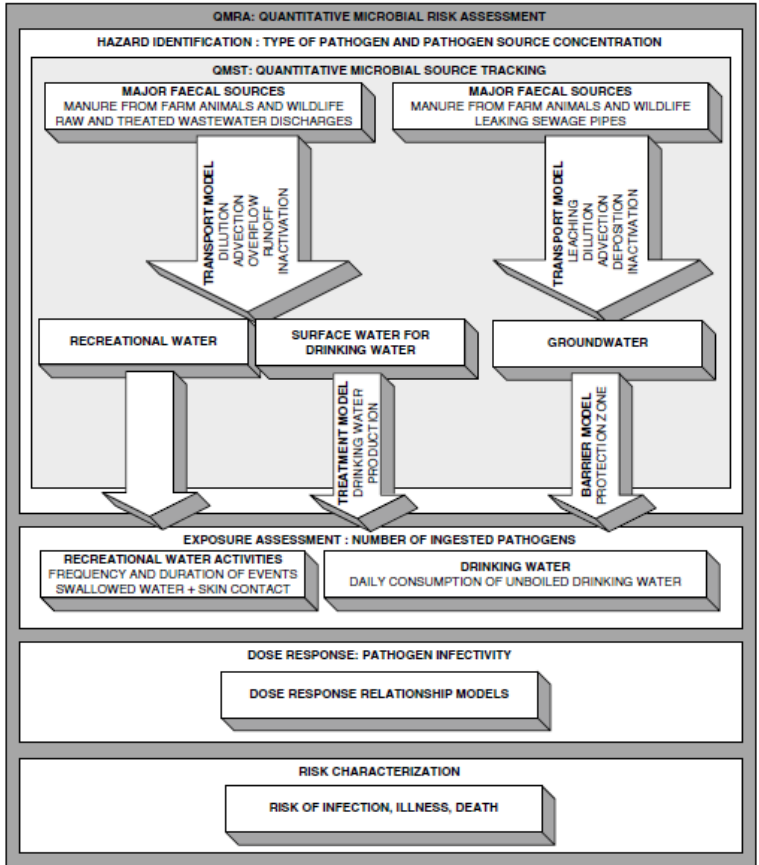


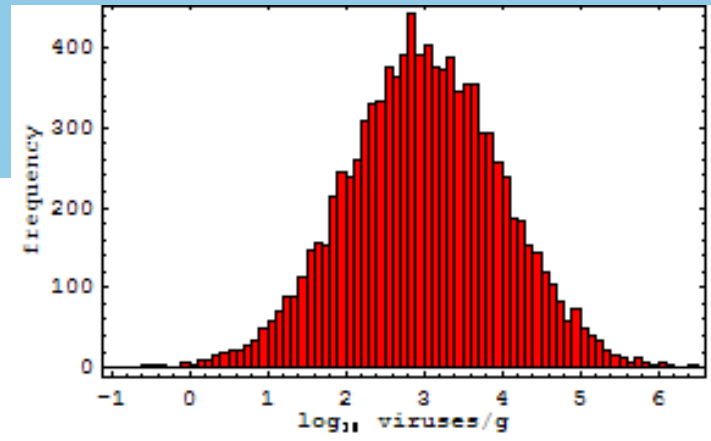
# Molecular tracing



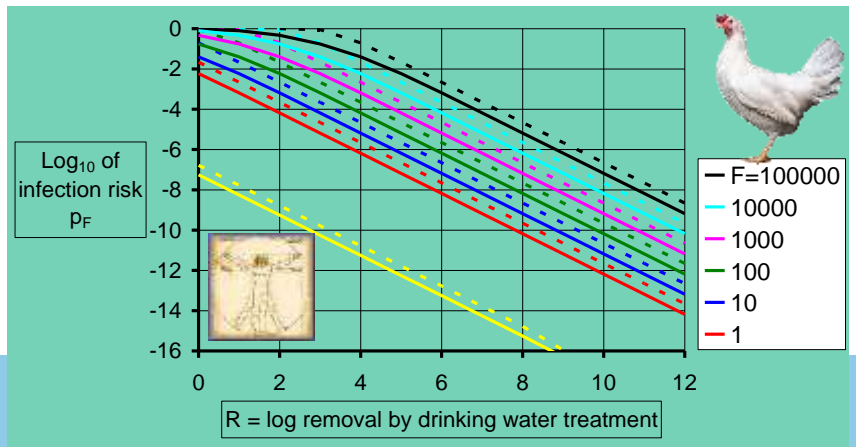
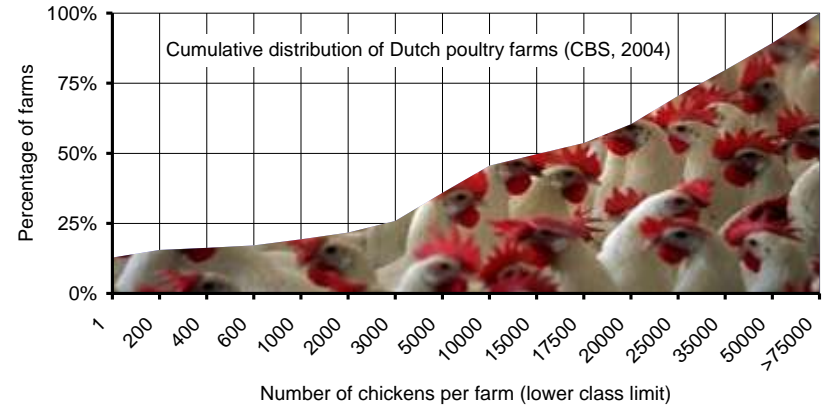
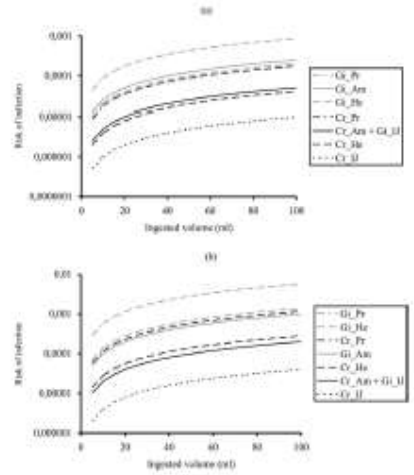


# Microbial Source Tracking



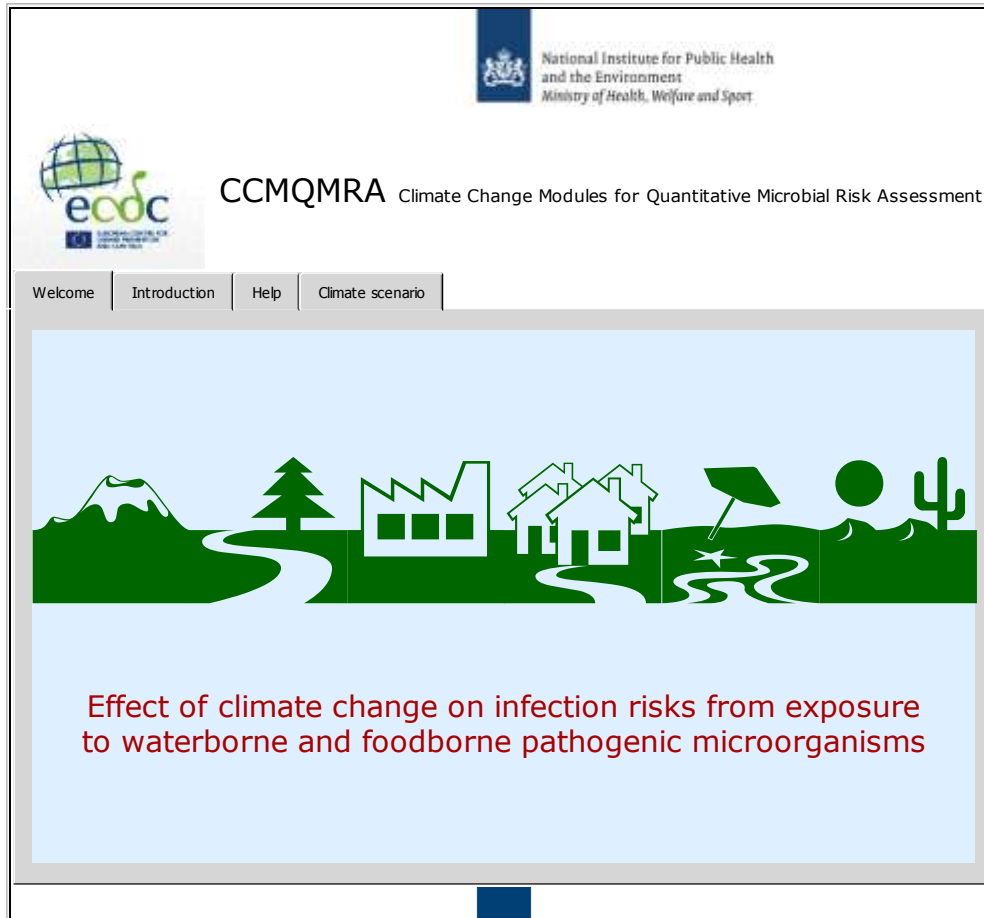


# Risk assessment





# QMRA for Climate Change



The screenshot shows the homepage of the CCMQMRA (Climate Change Modules for Quantitative Microbial Risk Assessment) website. At the top right, it features the logo of the National Institute for Public Health and the Environment, Ministry of Health, Welfare and Sport. On the left is the ecdc logo. The main title 'CCMQMRA Climate Change Modules for Quantitative Microbial Risk Assessment' is centered. Below the title is a navigation menu with 'Welcome', 'Introduction', 'Help', and 'Climate scenario' tabs. The central graphic is a green silhouette of a landscape with a river, a factory, houses, a satellite dish, a sun, and a cactus. Below the graphic, the text reads: 'Effect of climate change on infection risks from exposure to waterborne and foodborne pathogenic microorganisms'.



## qPCR and bathing waters: what if .... Implemented tomorrow, in 5 years, in 10 years

1. Methodological approach depends on beach management challenge
2. Toolbox
  1. Bathing water profile
  2. Water quality monitoring/ surveillance
  3. QMRA
  4. Molecular tracing/ MST