



# Evaluating Emerging Technologies for Management & Control of Microbial Pollution at Bathing Waters

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# Background

Revised Bathing Waters Directive

Parallel debates over suitability of enumeration methods

Culture (plate counts): slow (24hrs)

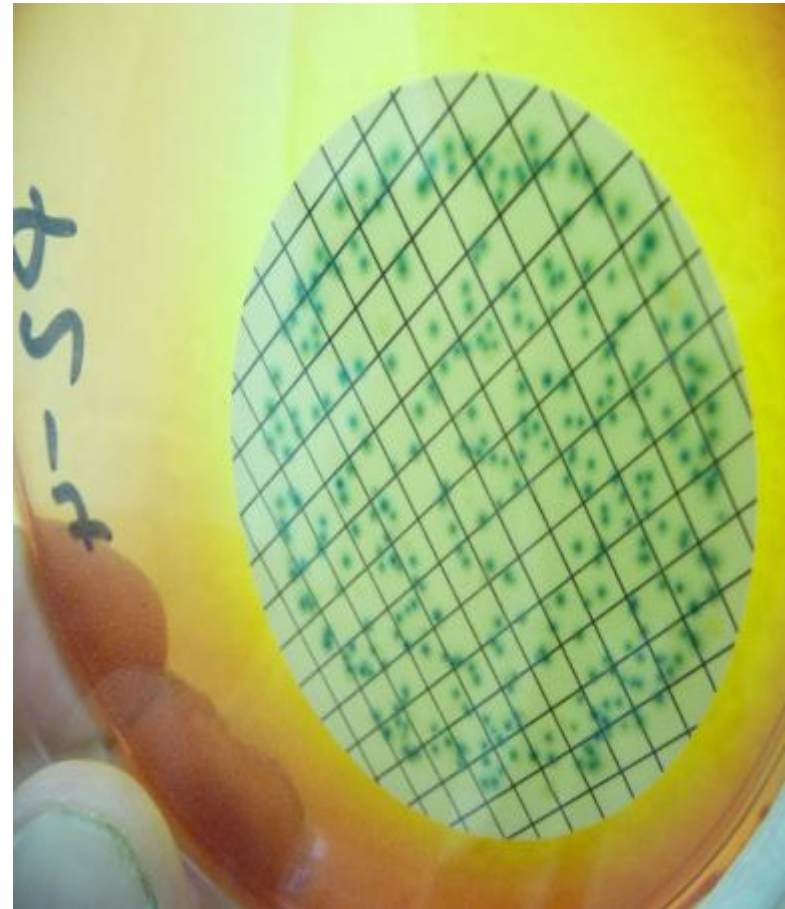
Molecular (qPCR): fast (~2hrs)



Photo courtesy of Andy Cummins

# Rationale

- US has begun to consider molecular-based enumeration as alternative to 'tried & tested' culturing
- With emergence of new approaches come difficult decisions
- How best to translate technological innovation into up-to-date regulation?



# The Problem of Delayed Test Results?



Courtesy of Julie Hewitt, USEPA



# Overarching aim

To ensure the managed flow of knowledge among researchers, policy makers, regulators and interested bodies with the aim of promoting long-term water security in bathing waters.

**How? .....** Through shared understanding of the science evidence-base underpinning current and emerging microbial quantification techniques.

# Key to this process:

. . . .a series of workshops centred on emerging pressures and shifts in microbial quantification techniques for regulatory monitoring . . . . .

1. Regulatory, policy & stakeholder needs
2. How science providers can align with these needs
3. Immediate & wider economic impacts



# Summary of debate from International Workshops

***‘What are the biggest challenges facing regulators in moving towards using molecular methods in the regulation of bathing waters?’***

**Science users**

To support risk management with timely answers

Can new technologies deliver high confidence in outcomes of health significance?

Regulation dictated by legislation: qPCR not a standard method in rBWD

**Science providers**

Inter and intra lab variability in recovery of organisms?

Cost

Too little funding for technology development

Education of regulators/ management over advantages and disadvantages of molecular data



***‘What, if any, are the institutional barriers that would hamper implementation of molecular techniques by regulators?’***

Resistance to change

How to make comparisons with older data sets

Co-ordinating change across agencies

Interpretation and communication to interested parties

Why devote more £'s / \$'s to “additional” test methods

***‘How realistic is the development of rapid testing in terms of the fit with regulatory needs?’***

- Could provide a more meaningful statement of risk
- Only useful if used regularly – no point knowing in hours if only sampling once a week
- High costs for rapid testing
- Little appetite for it in the UK

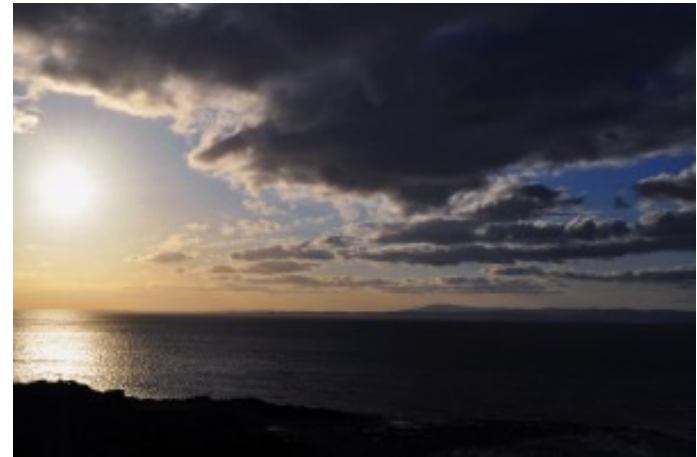
# Perceived advantages of molecular tools

- Rapidity
- Access to information otherwise unavailable
- Information saved for later use



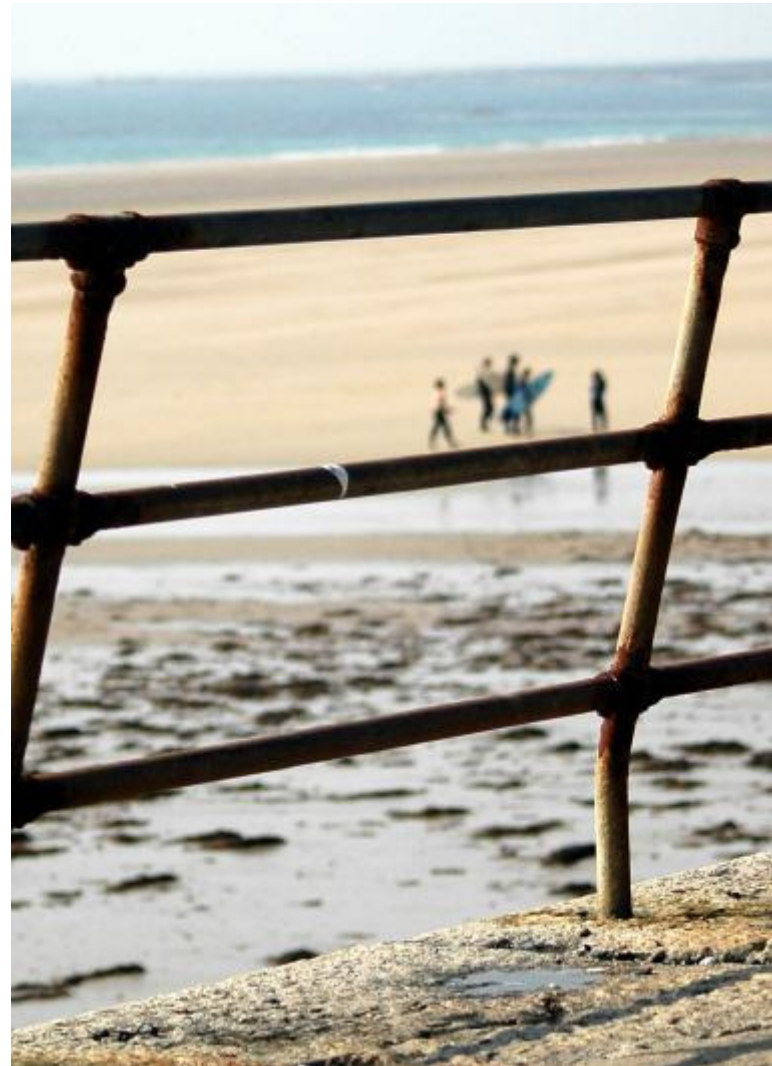
# Arguments against change?

- Absence of a convincing driver for change
- Concerns over accuracy and precision
- A lack of consensus over what would replace current methods

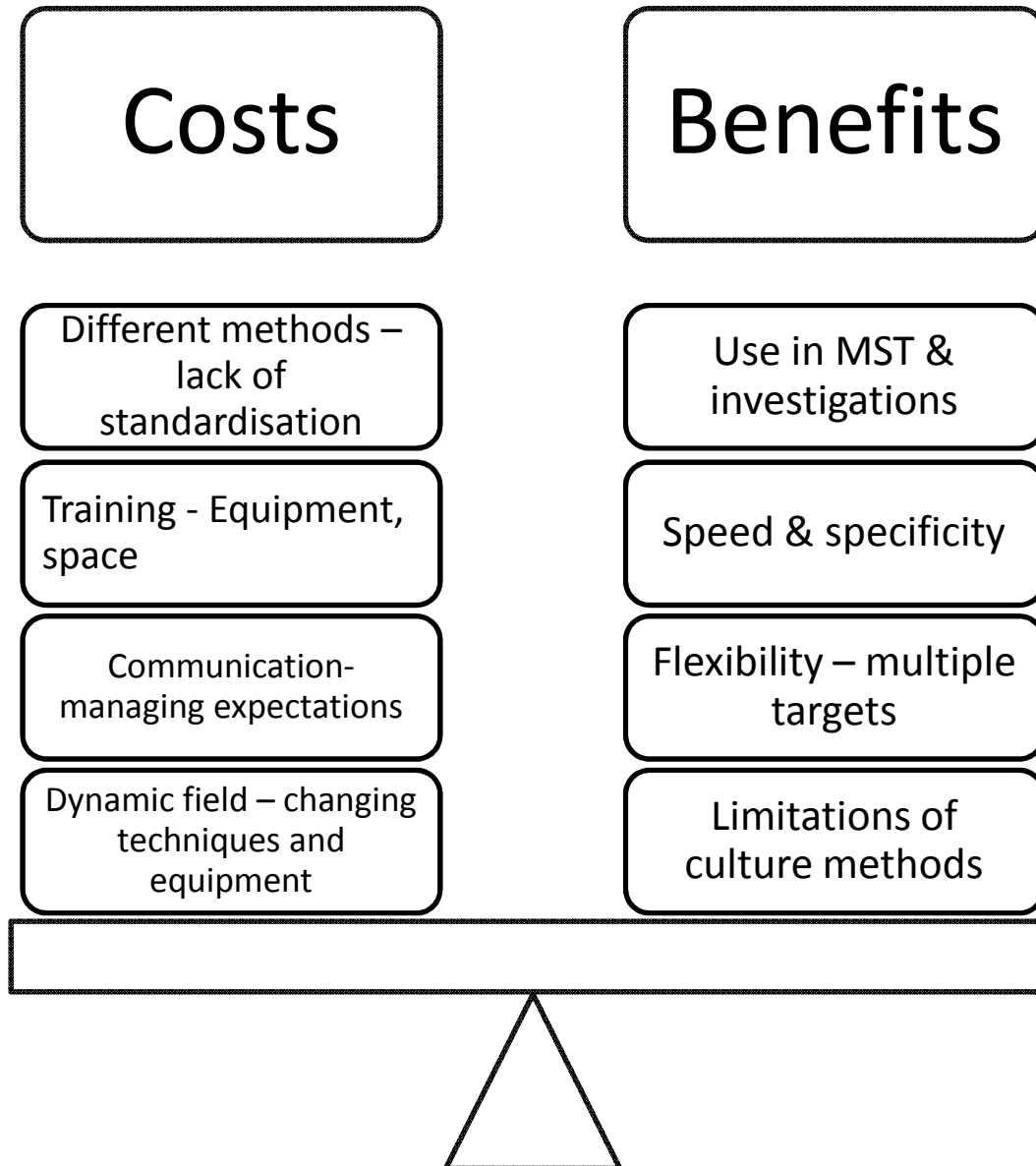


# Gaps & future research?

- Epidemiological evidence
- Rapidity & logistics
- Markers and targets
- Precision & reproducibility



# What are the costs and benefits of molecular technologies?



# **Economic debates: direct & indirect cost implications**

Valuing coastal recreation linked to changes in water quality - the value of a day at the beach;

Valuing changes in health risk relating to bathing water quality;

The value of risk information.

# Research priorities linked to economics

Type of information	How to measure success	How to measure and communicate risk	How to value a day at the beach and the cost of illness	Beachgoing habits	Methods and logistics
What quantity and type of information would beach users prefer to get? How quickly would they like to receive it and how would they like to access it?	What are the measures by which we can (and want to) evaluate beach management success?	What are the risks to children and how best can we communicate effectively with their care givers?	We need holistic regulatory approaches to avoid unintended outcomes. System-wide methods of assessment in order to understand the totality of benefits / trade-offs for valuations.	What drives demand for beach use, how heterogeneous is it, and what role does water quality play in it? How do people perceive substitutes and make those decisions?	What would be the optimal location frequency of labs to facilitate qPCR?
Does the preference for a certain type of information or the way in which it is accessed differ between different user groups and if so how?	What are the additional (\$) benefits in terms of enhanced ecosystem services from actions to reduce health risks in bathing waters?	How can uncertainty regarding health risk be better incorporated into valuation scenarios of bathing water quality?	Do we know enough about the vulnerability /WTP of different user groups with regard to health risks?	How do we distinguish the effects of changes in water quality compared to the effects of signs?	Uncertainties in the scientific evidence base hindering economic valuations need to be addressed
As a recreational water user would you value information on water quality before exposing yourself to pollutants?	How would changes to the beach take shape (frequency/activities/ indirect and direct economic impacts) should water quality information be improved?	What information should be given to the public to allow more informed and better decisions about risk? Timing of information delivery?	What are the economic impacts of illness as a result of exposure to polluted waters?	Which groups of recreationists would be most affected by 1) signs, 2) water quality changes? Would some recreational users benefit from poorer water quality? (Savings from not testing?)	What infrastructure and costs are needed to maximise the benefits of rapid methods?
What information would people respond to, to change the behaviour or continue to go to the same bathing waters?	How do we capture the benefits to new users who do not currently use a beach due to poor water quality?	Does prediction of water quality have more value to beach users than "real" water quality data?	Balancing the costs of improvements and benefits in light of other national priorities	What are the regional differences in attitudes and preferences regarding the impact of new regulations?	Would predictive monitoring have more merit than using other methods?
What are the differential impacts of the same information presented in different ways?		What is the best way to present risk information ie risk of getting a GI infection as compared with risk of having an accident driving to the beach	Would the use of new methods lead to more beach failures? If so how would this change the value of a day at the beach? What would be the economic costs?		How should investment be distributed between risk management (beach monitoring) and prevention (catchment management)?

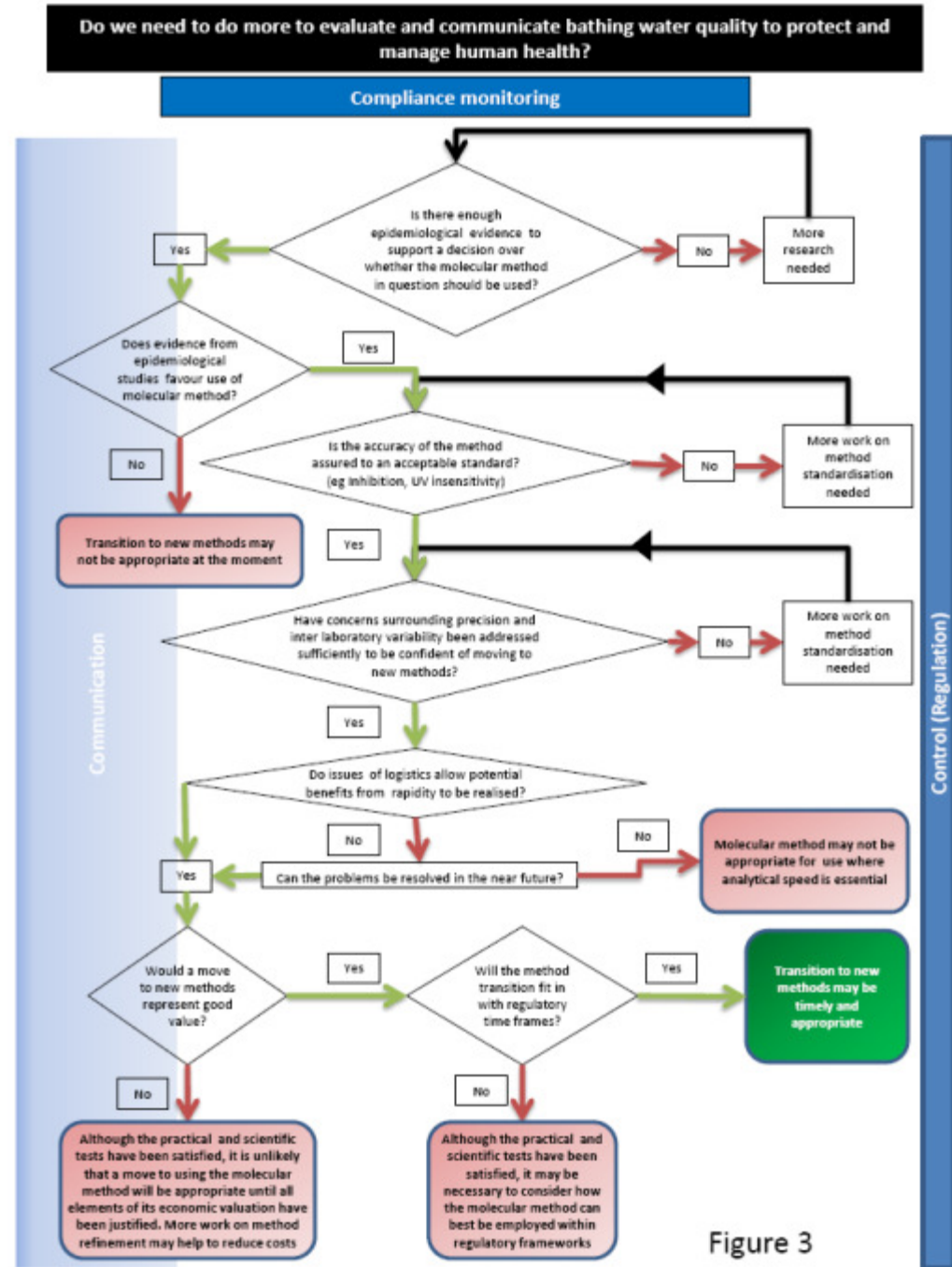


# Economic research priorities identified by the Working Group

- How would changes to the beach take shape (frequency/activities/ indirect and direct economic impacts) should water quality information be improved?
- What information do people require, how quickly do they need it and how is it best distributed?
- Would the use of new methods lead to more beach failures?
- Does prediction of water quality have more value to beach users than “real” water quality data

# Towards a Decision-Making Framework

Scenario	Epidemiological evidence	Accuracy	Precision	Rapidity and logistics	Cost	Time frame	Action
1	3	1-3	1-3	1-3	1-3	1-3	A
2	2	3	2-3	1-3	1-3	1-3	A
3	2	1-2	1-2	1-2	1-2	1-2	B
4	1	3	3	1-3	1-3	1-3	B
5	1	1-2	1-2	3	3	3	B
6	1	1-2	1-2	1-2	1-2	1-2	C
7	1	1	1	1	1	1	D



# Conclusions

- UK regulators lack any appetite for qPCR/molecular tools (for monitoring)
- Government/ policy makers are concerned about the cost of transition
- No push from the EU (yet) to change
- Yet the science community (particularly US) is convinced that the transition from culture to molecular will happen
- DHW project highlighted that much uncertainty remains with qPCR as operational tool for bathing water quality assessment

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