

Moving DPR Forward: Research Efforts and Real World Experience

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California's Big Question



Is it feasible to do potable reuse without an environmental buffer (DPR)?

Division of Drinking Water
(DDW)

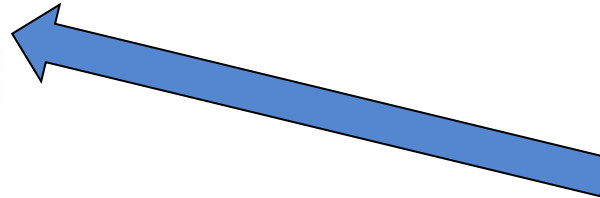


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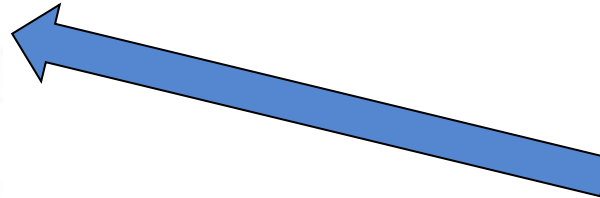


California's Big Question



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Is it feasible to do potable reuse without an environmental buffer (DPR)?



KEY  **QUESTION**
Can we do DPR safely?



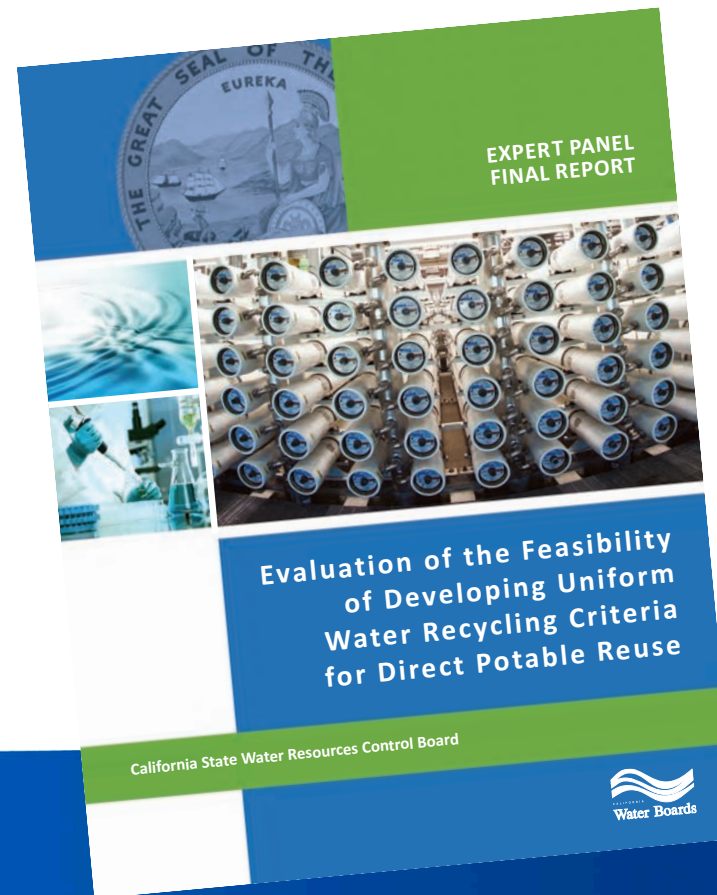
California Direct Potable Reuse Initiative

- Began in 2012 and raised more than \$6M for research to develop information for the State Expert Panel
- WRRF 14-12 (DPR Demonstration Project) was a \$2M project funded by CA DWR



DPR Conclusions

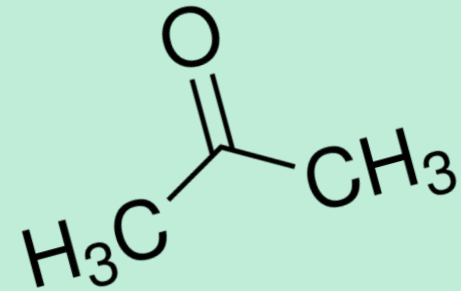
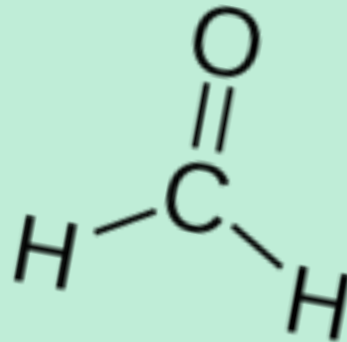
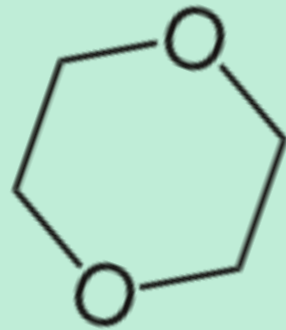
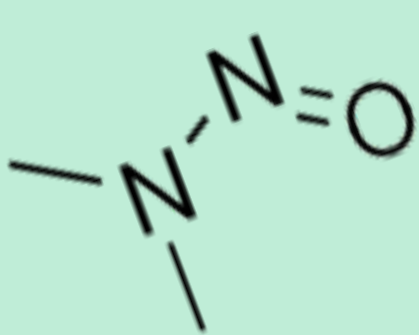
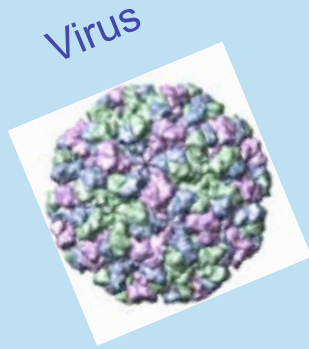
- CA State Expert Panel conducted DPR feasibility assessment using WRRF 14-12 data; concluded it is feasible to create uniform regulations for DPR
- Expert Panel recommended 6 topics for further research



Research Topics Relate to Public Health

Protection

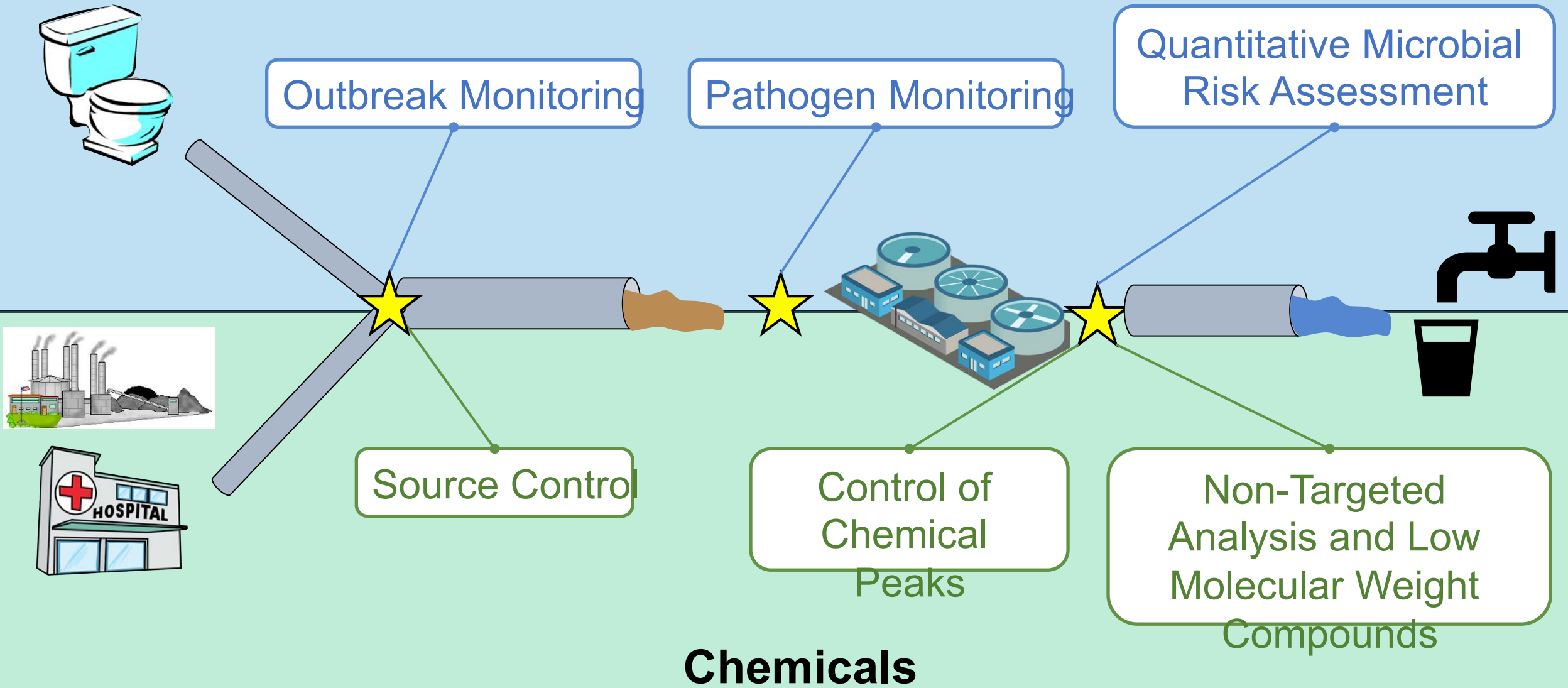
Pathogens



Chemicals

Research Topics Relate to Public Health

Protection Pathogens



Pathogen and Outbreak Monitoring

Pathogens

Outbreak Monitoring

Pathogen Monitoring

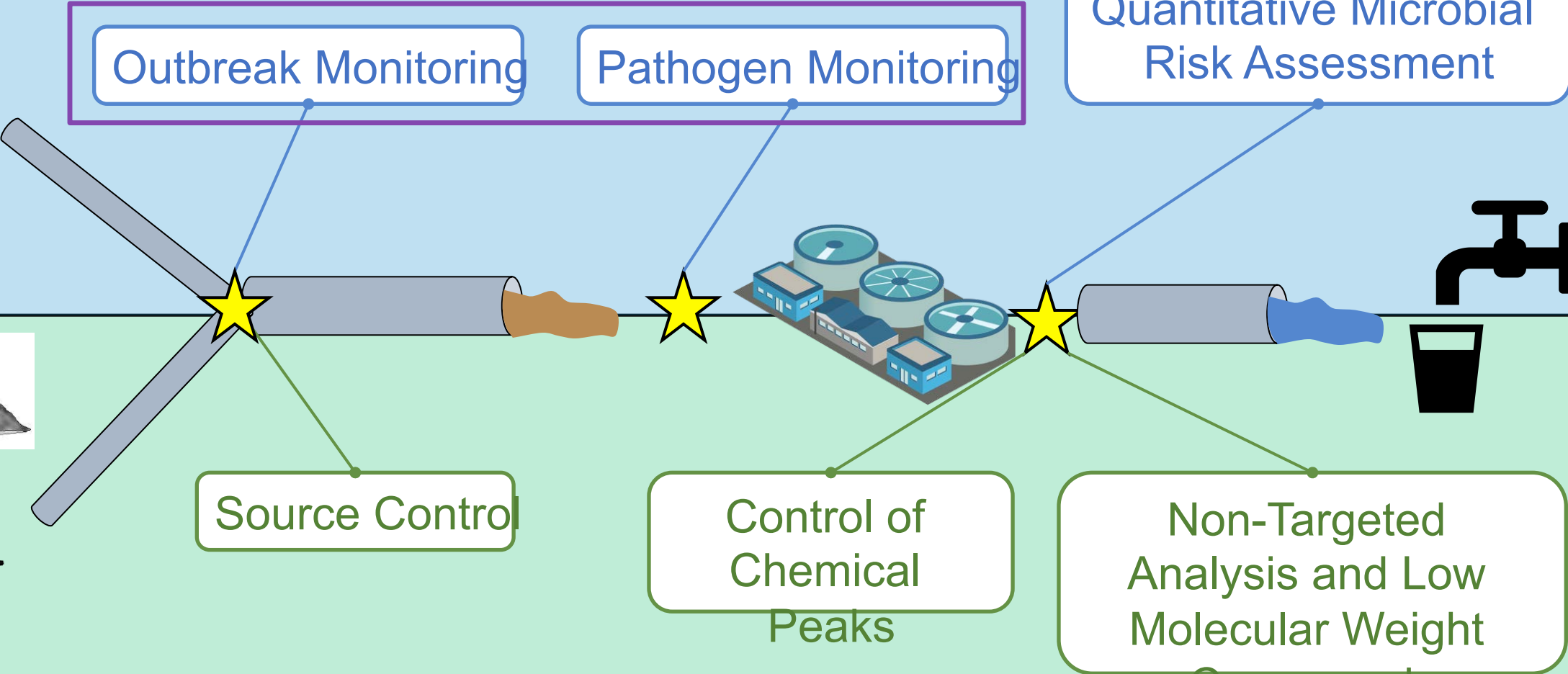
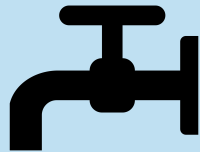
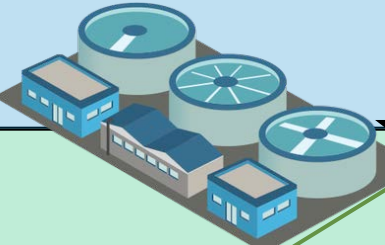
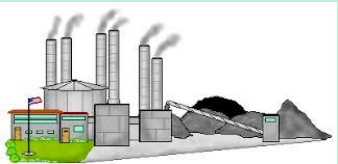
Quantitative Microbial Risk Assessment

Source Control

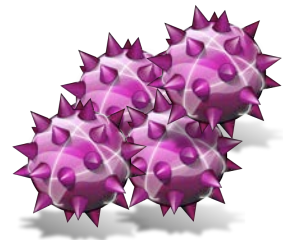
Control of Chemical Peaks

Non-Targeted Analysis and Low Molecular Weight Compounds

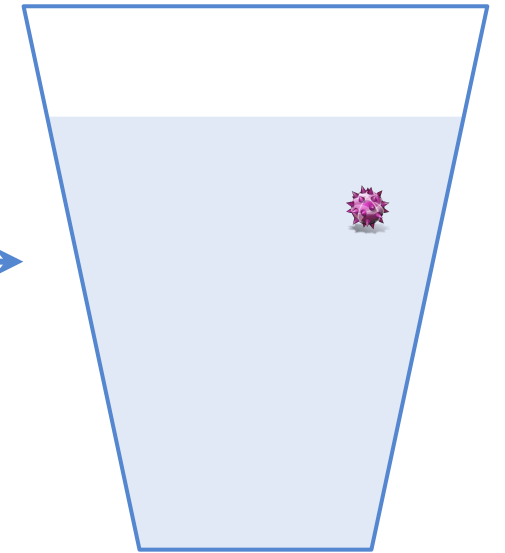
Chemicals



Pathogen Monitoring: Why is this important?



Level of treatment required

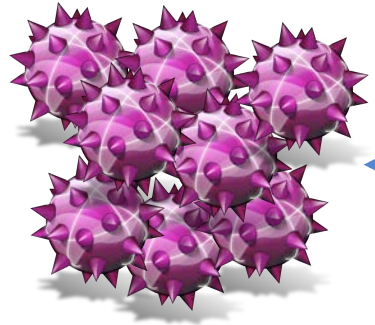


High

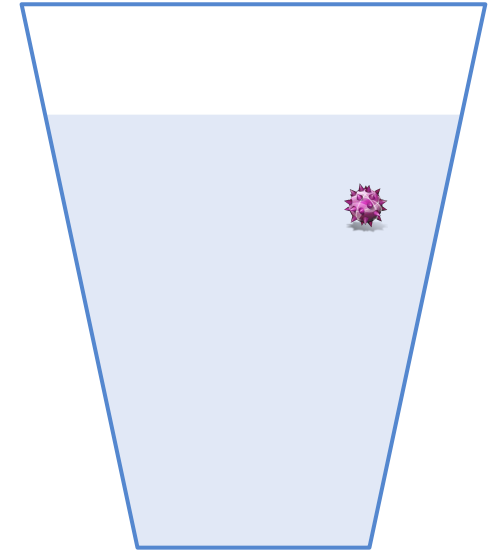
Pathogen Concentration

Very Low

Pathogen Monitoring: Why is this important?



Higher concentrations require higher degree of treatment

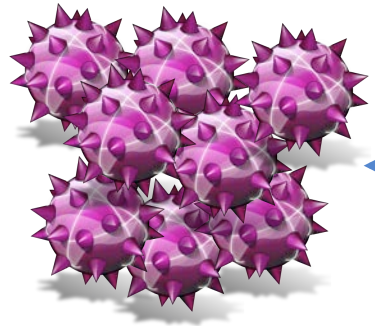


High

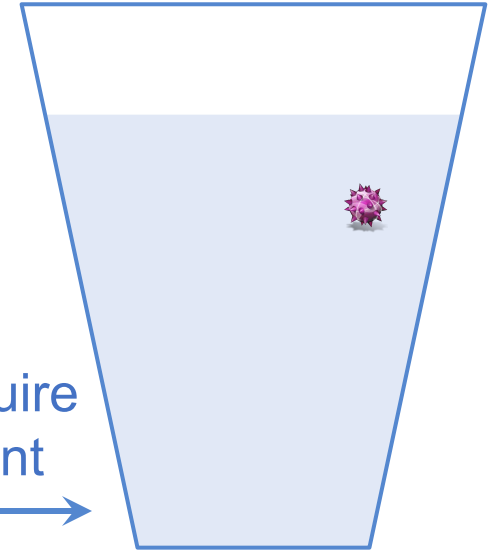
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Pathogen Monitoring: Why is this important?



Higher concentrations require higher degree of treatment



Lower concentrations require lower degree of treatment



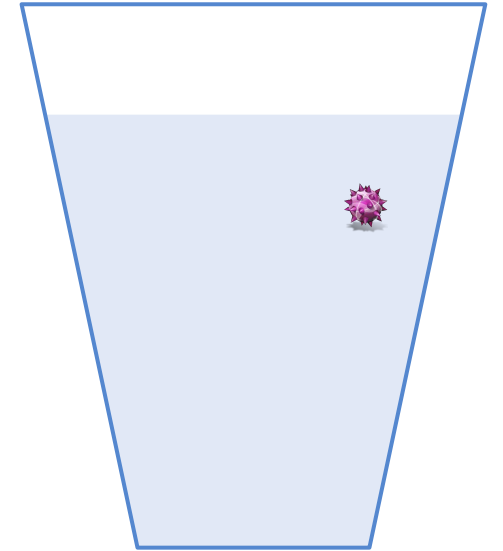
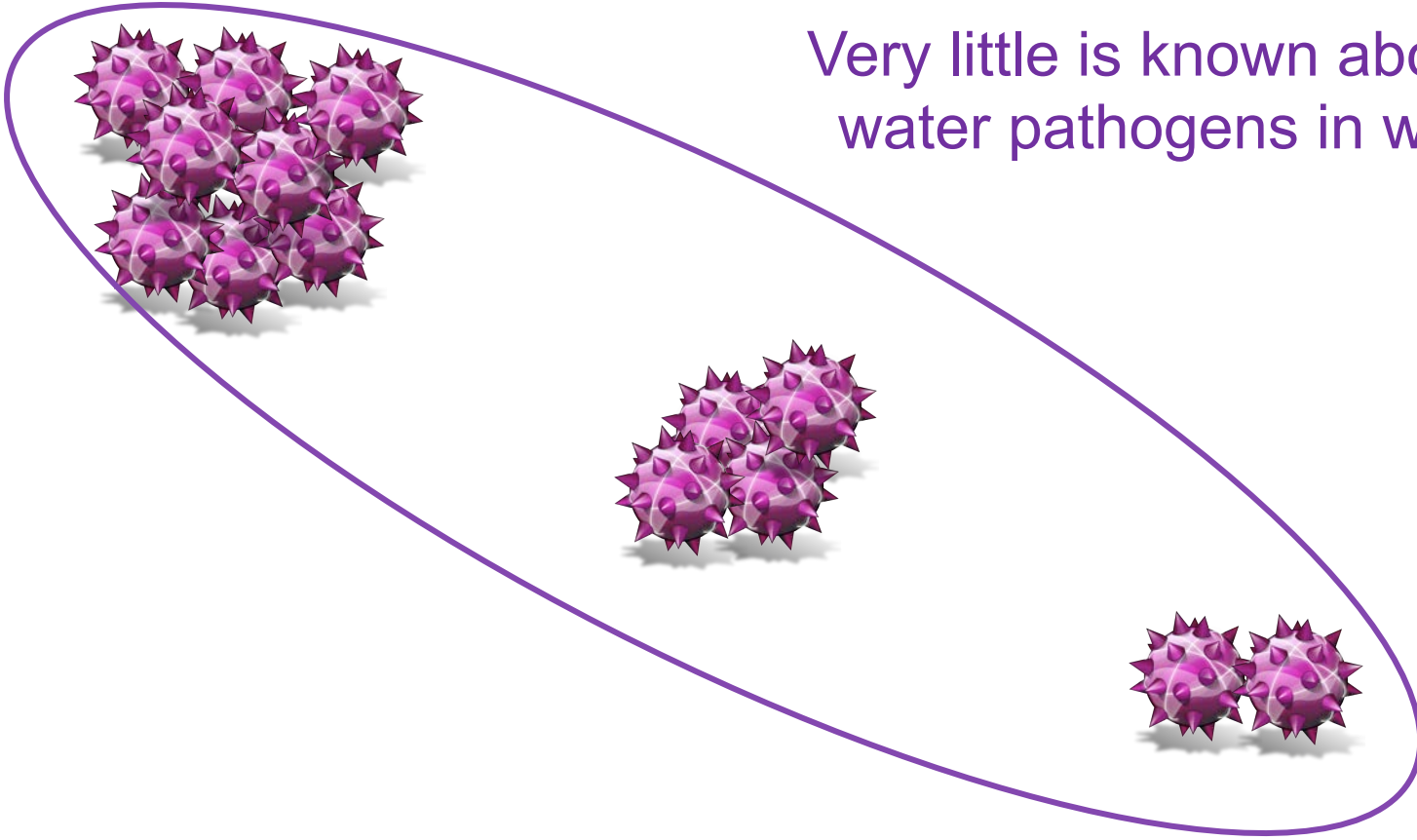
High

Pathogen Concentration

Very Low

Pathogen Monitoring: Why is this important?

Very little is known about drinking water pathogens in wastewater!



High

Pathogen Concentration

Very Low

Pathogen and Outbreak Monitoring



- *Why is this important?*

- Critical for defining safe levels of treatment
- Improved understanding of the factors that affect pathogen loading
 - Seasonality, outbreaks, geography, community health
- Aids in understanding and crediting pathogen removal through wastewater treatment plants



Ongoing Research: Pathogen Monitoring

- Ongoing pathogen monitoring campaigns
 - City of Oceanside: 17 sampling events
 - City of San Diego's NCWRP: 24 sampling events
- Research studies to improve pathogen monitoring
 - WE&RF 14-17: Non-culture based methods for pathogen monitoring in potable reuse (White Paper)
 - WE&RF 15-07: Methods for measurement of infectivity and concentration of pathogens
 - WRF 4508: Assessment of techniques to evaluate and demonstrate the safety of water from DPR treatment facilities



QMRA

Pathogens

Outbreak Monitoring

Pathogen Monitoring

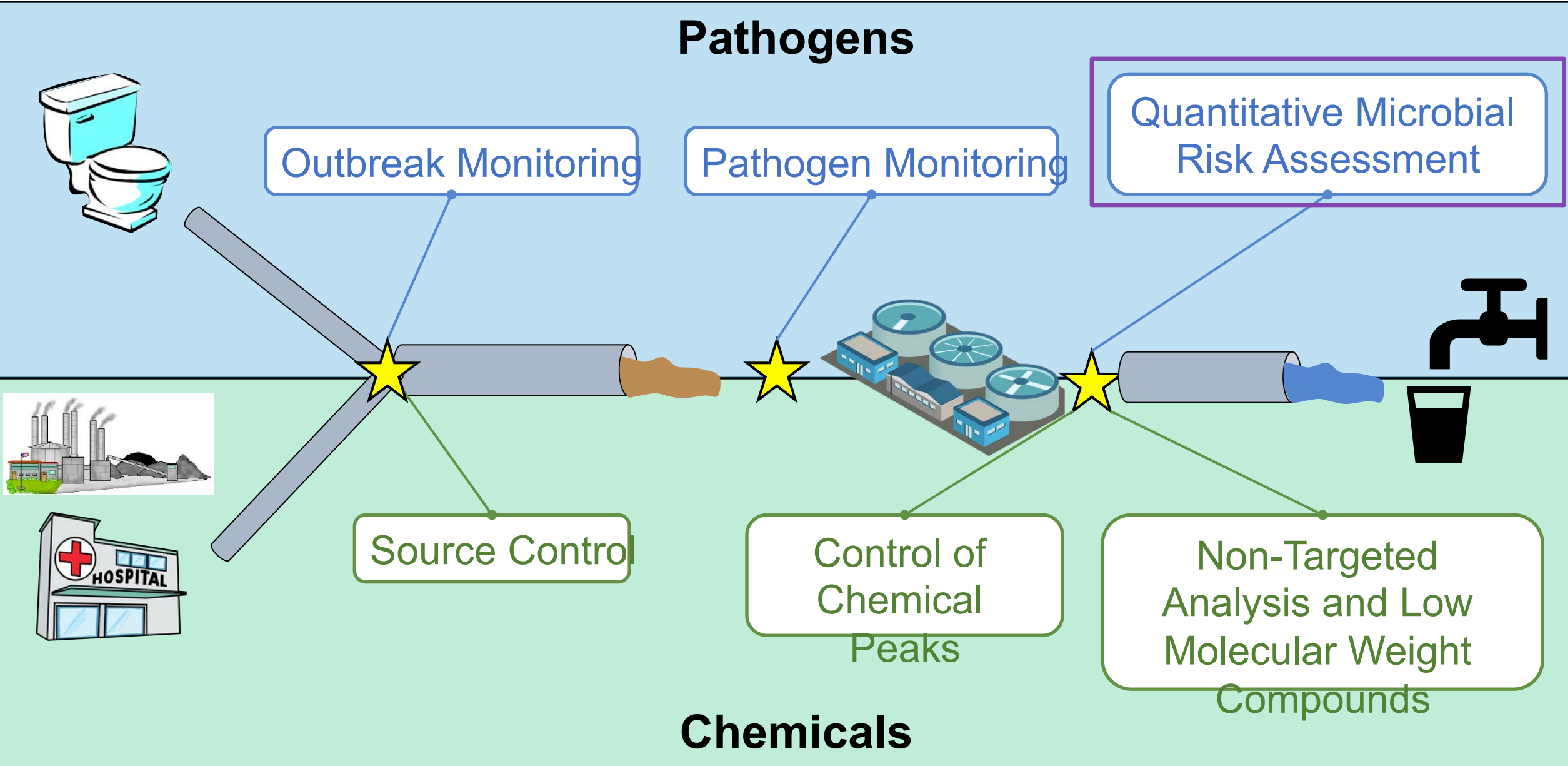
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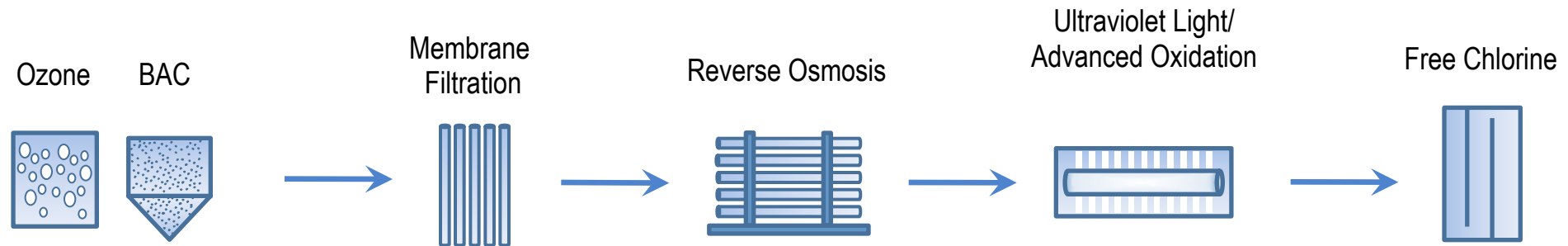
Chemicals



QMRA

- *Why is this important?*
 - We set risk-based goals for the safety of conventional drinking water
 - DPR should provide the same level of safety
 - QMRA allows us to quantify the safety of different DPR systems
 - Provides insight into criteria that can inform DPR regulations
- *Why is QMRA a powerful tool?*
 - Accounts for multiple aspects of DPR systems including
 - Pathogen loading and building
 - Process performance
 - Impact of failures
 - Treatment train configuration

WRRF 14-12: QMRA of DPR Treatment Train



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Reliability of pathogen control in direct potable reuse: Performance evaluation and QMRA of a full-scale 1 MGD advanced treatment train



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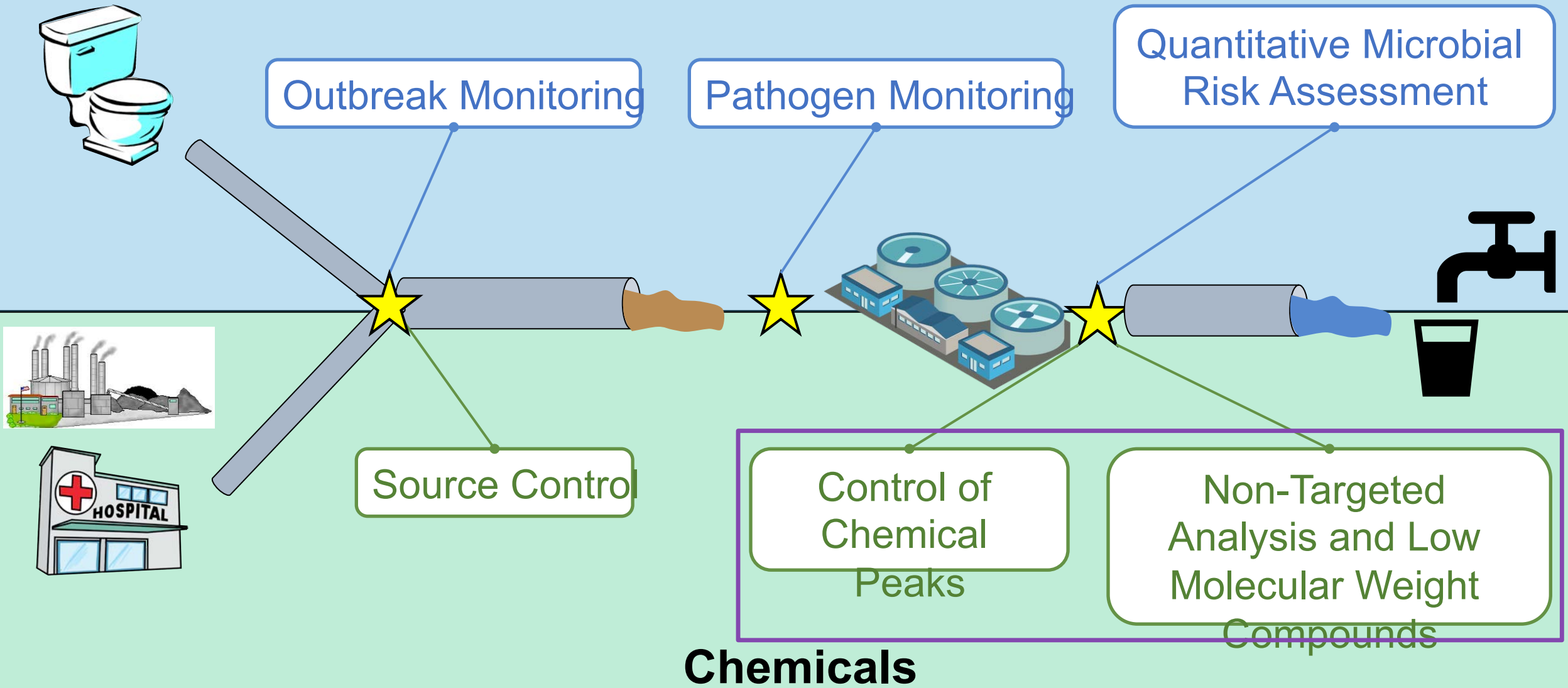
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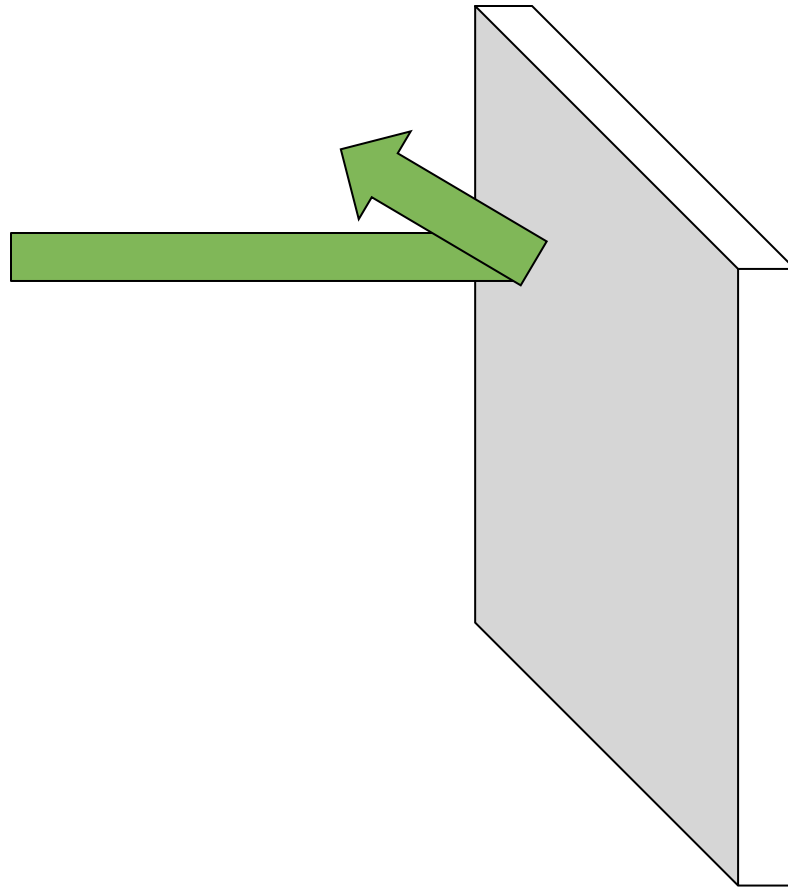
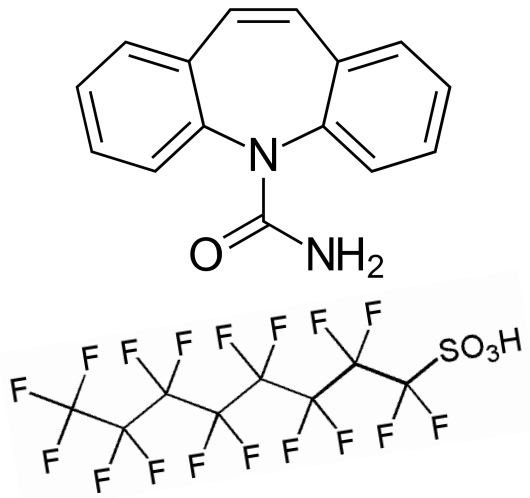
^f Drexel University, 3141 Chestnut Street, 251 Curtis Hall, Philadelphia, PA 19104, USA

Research Topics Relate to Public Health

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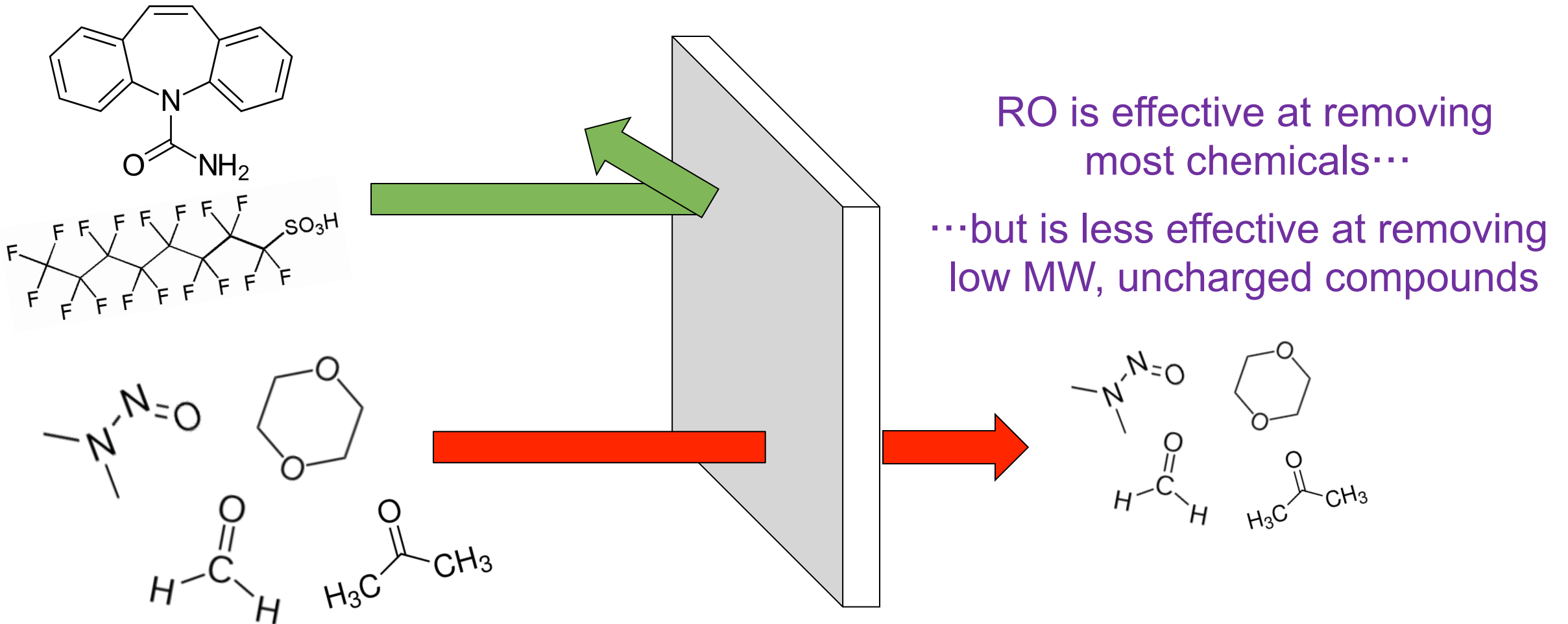


RO Provides Excellent Chemical Control



RO is effective at removing most chemicals...

RO Provides Excellent Chemical Control

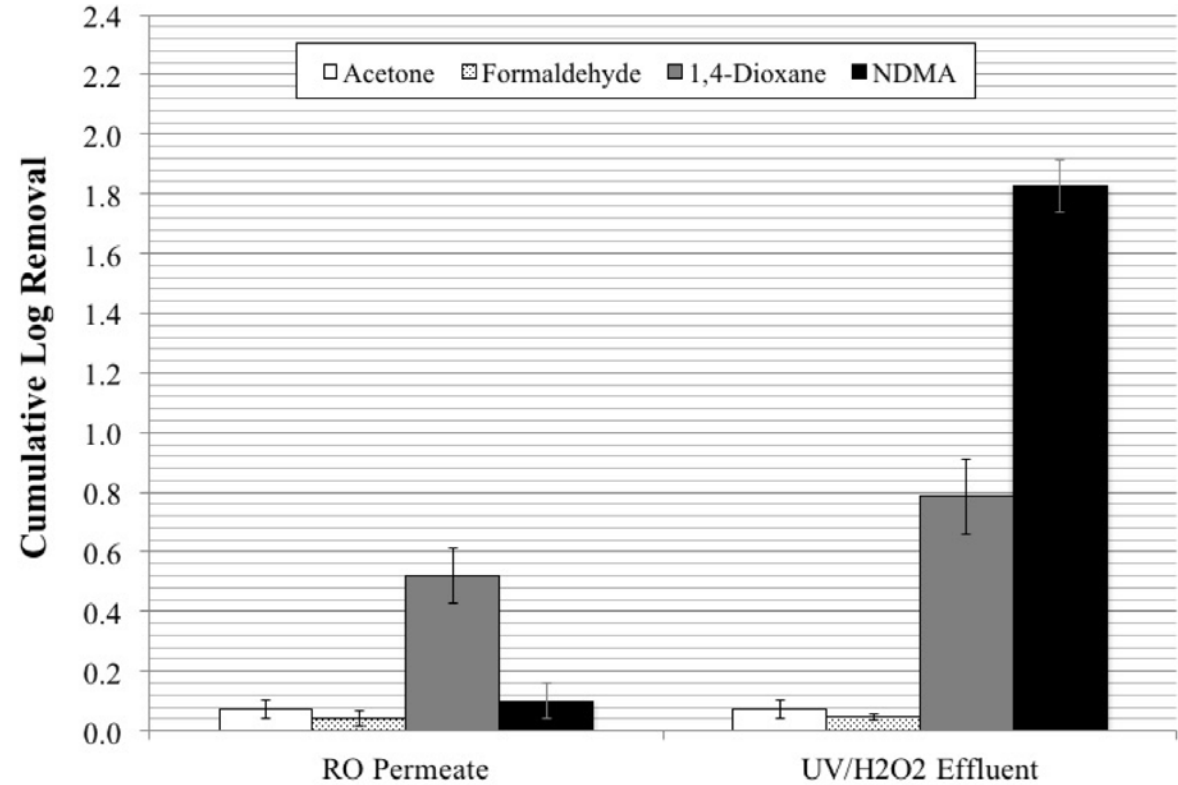
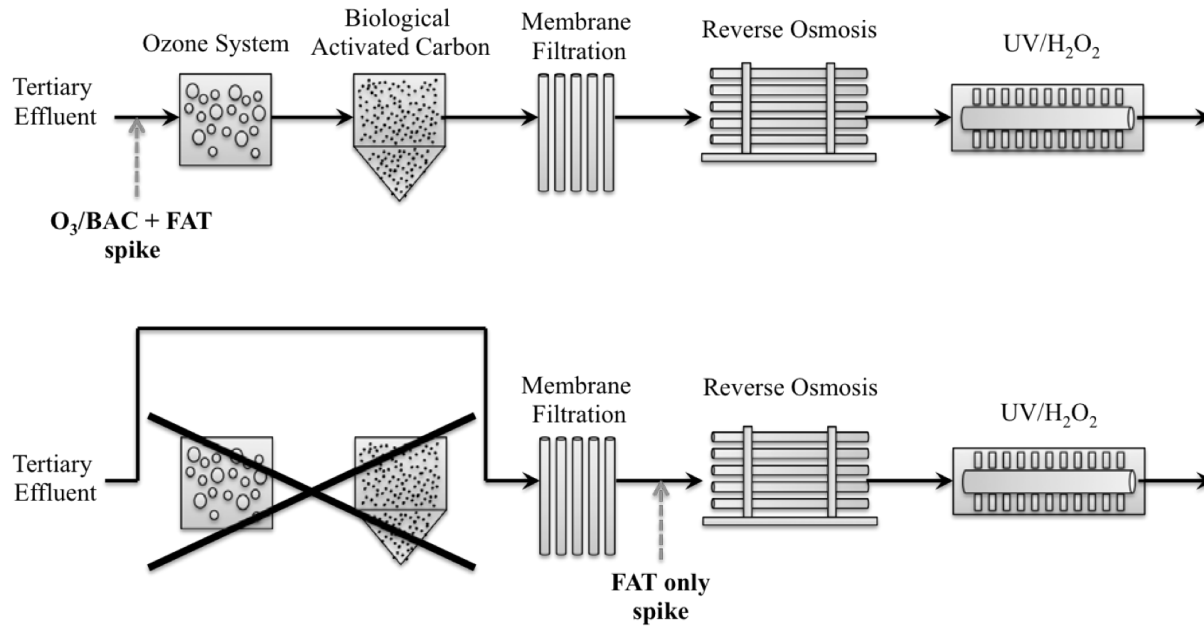


Chemical Control and Detection

- *Why is this important?*
 - DPR facility is the last line of treatment with no environmental buffer
 - Research may identify **which compounds** remain in treated effluents (non-targeted analysis)
 - Solutions for controlling **persistent chemicals** should be identified
 - Solutions for controlling **chemical peaks** should be identified



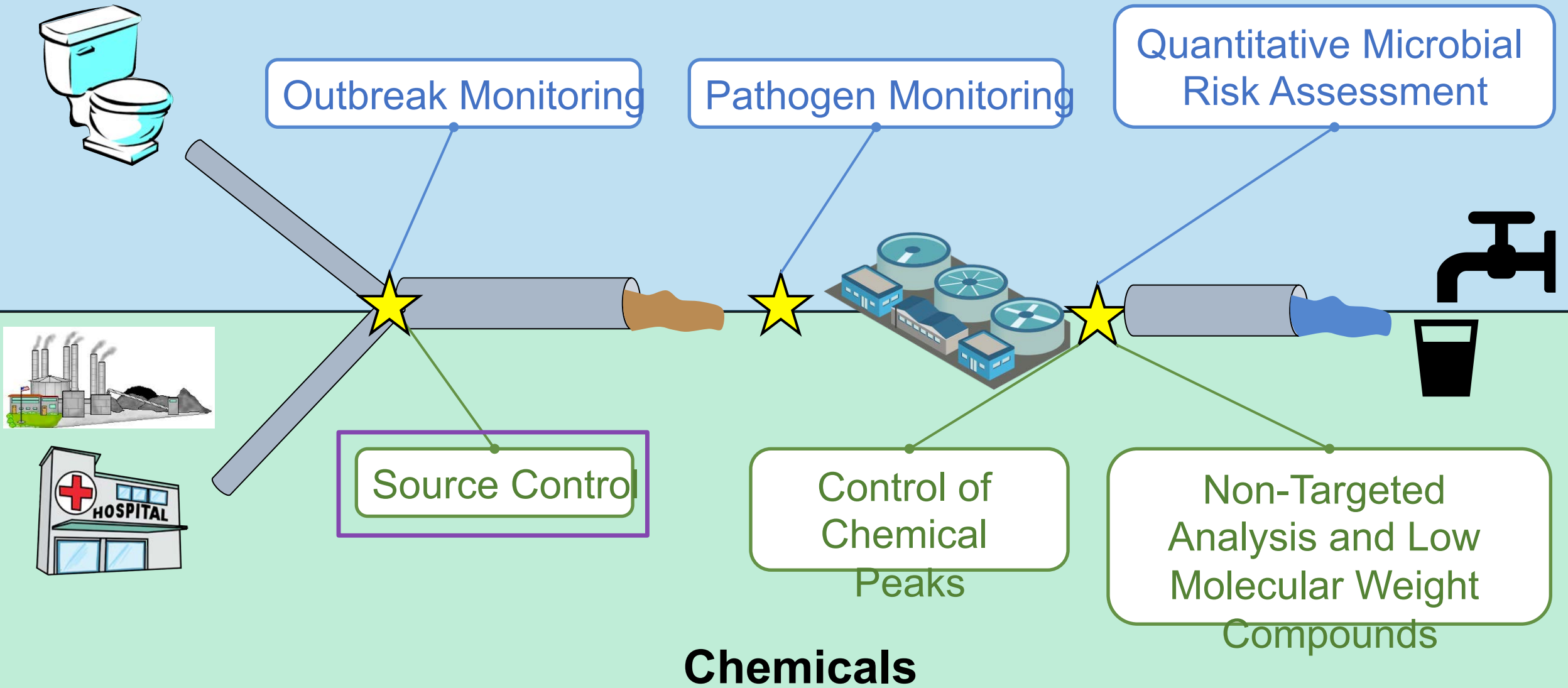
WRRF 14-12: Chemical Challenge Testing



Graphics courtesy of Tackaert et al. (*submitted*) Enhanced Robustness of O₃/BAC-MF-RO-UV/HOClI 1 MGD Demonstration Potable Reuse Train for Removal of Acetone, Formaldehyde, NDMA, and 1,4-dioxane in Comparison to MF-RO-UV/H₂O₂ Full Advanced Treatment.

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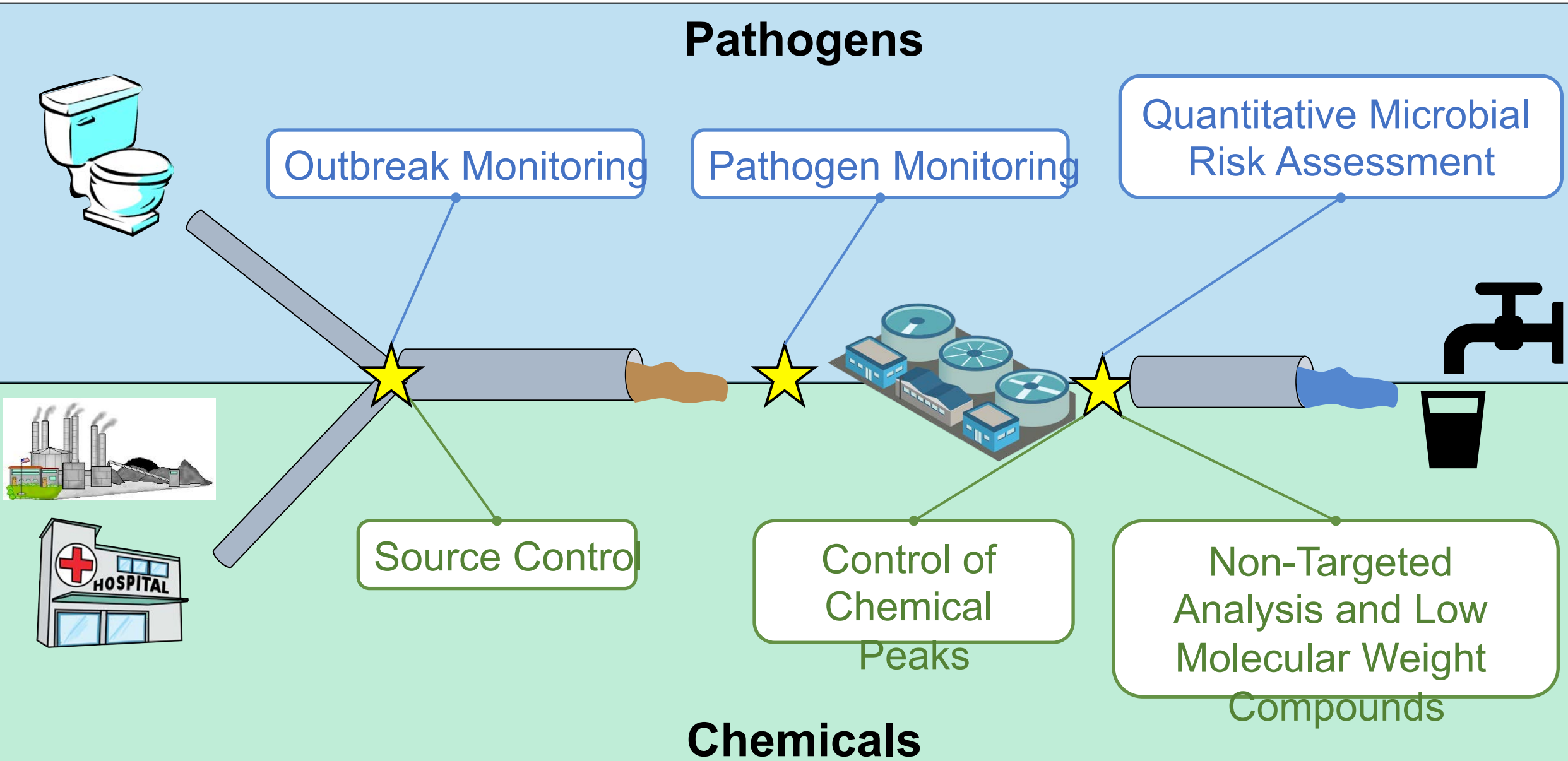


Enhanced Source Control

- *Why is this important?*
 - Source control works in tandem with treatment to reduce effluent chemical concentrations
 - DPR systems should actively track emerging health risks
 - New threats should be included in source control and monitoring



In addition to these research topics...



DPR Should Leverage GWR and SWA Experience

- Groundwater recharge
 - 40+ years of experience prior to final regulations
- Surface water augmentation
 - Provides opportunity to understand potable reuse with shorter response times (i.e., more direct)
- Phased DPR approach recommended by State Expert Panel, DDW, and AB 574



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Thank you for listening!

