Smart Sanitation:
as a Public Health Tool

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Hosted by Jim Gauthier
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Agenda

- What is Smart Sanitation Technology?
- Potential and Challenges
- Policy Guidelines

Policy Guidelines for Smart Sanitation Technology as a Public Health Tool

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Abstract

Smart sanitation technology, or SST, refers to digital technologies applied to the sanitation industry. The breadth of applications can be wide, and they are quickly rising as popular public health tools, especially thanks to their potential for epidemiological analysis. While SST might sustain the vision of the UN Sustainable Development Goals, it can also lead the continuous surveillance of individuals—an often-criticized feature of smart city architecture—to an exceedingly private location: the toilet. The data collected by many SST applications can be considered health data, the improper use of which can generate harm and stigma. This paper provides the first discussion of a policy framework for this technology by applying basic and uncontroversial principles (scientific evidence, necessity, proportionality, time boundedness, and privacy) to the use of SST for public health purposes.

What is Smart Sanitation Technology?

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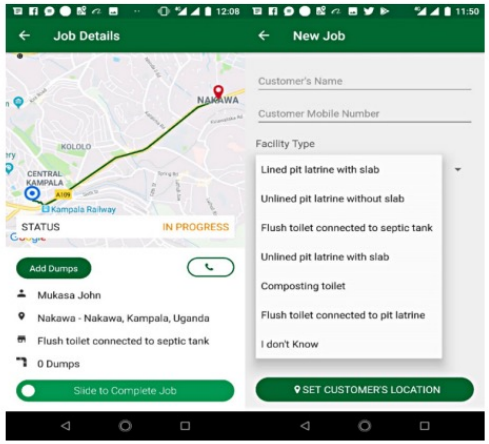

TBC 2020. Improving Public Health Through Smart Sanitation and Digital Water

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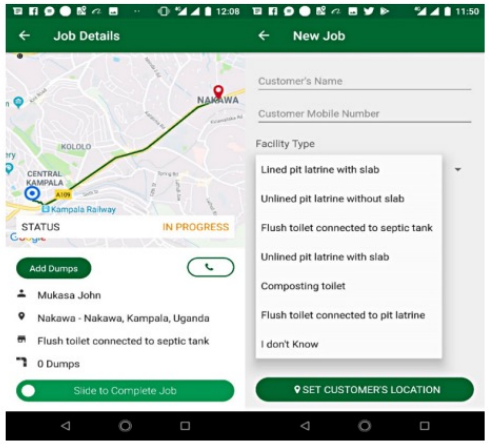

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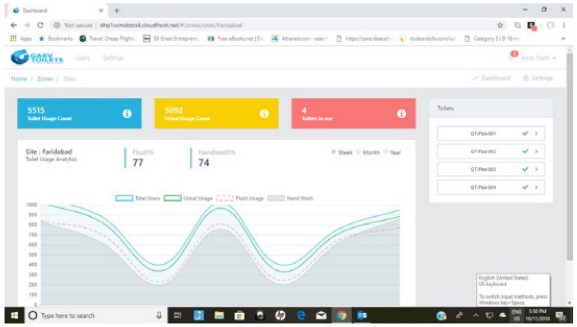

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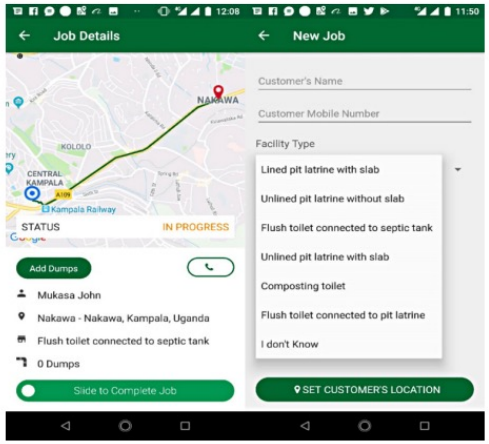

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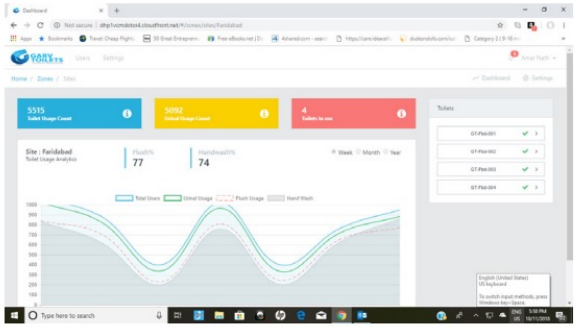
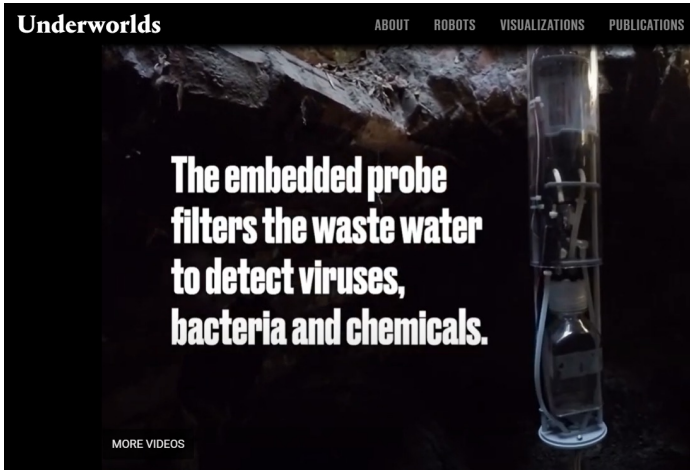


THE UNDERWORLDS PROJECT



http://underworlds.mit.edu/

TBC 2020. Improving Public Health Through Smart Sanitation and Digital Water

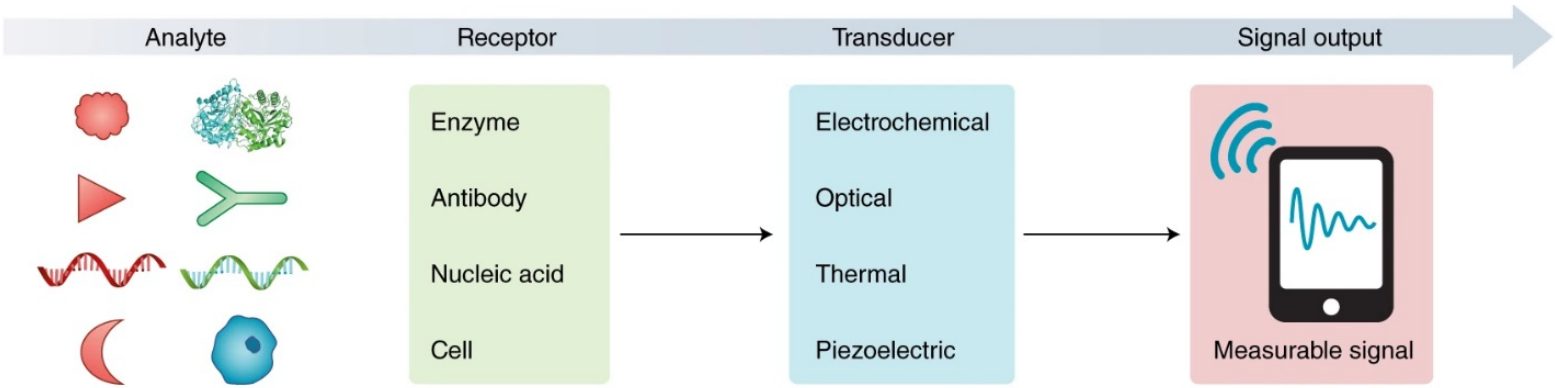
What is a Biosensor?

"an independently integrated receptor transducer device, which is capable of providing selective quantitative or semi-quantitative analytical information using a biological recognition element"

International Union of Pure and Applied Chemistry (IUPAC)

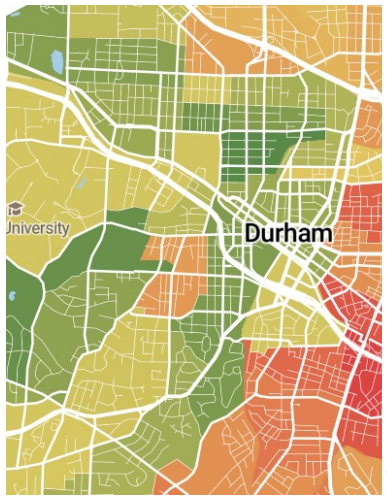
Biosensors can be used to detect:

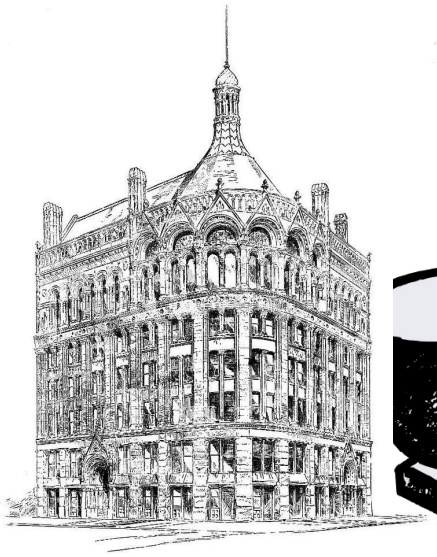
- Infectious diseases (COVID-19, HIV, E.coli, and tuberculosis)
- Cancer
- Bacteria
- Drug use



Kim, J., Campbell, A.S., de Ávila, B.EF. et al. Wearable biosensors for healthcare monitoring. Nat Biotechnol 37, 389–406 (2019). https://doi.org/10.1038/s41587-019-0045-y

Geographical Level of Analysis





New Partnership Tracks COVID-19 Infections in Cambridge by Analyzing Wastewater

November 12, 2020

Since the novel coronavirus emerged in Massachusetts this past winter, the Cambridge Public Health Department (CPHD) has been working to slow its spread through testing, contact tracing, and educating the public about prevention measures. These tried and true public health strategies are routinely used to limit transmission of infectious diseases.

Now a partnership with Biobot Analytics, Inc. in Cambridge offers a new approach to tracking COVID-19 outbreaks: analyzing wastewater. This week, for the first time, Cambridge will have access to local wastewater data that will serve as an early warning signal of increased COVID-19 infections in the city. This new monitoring tool will augment more traditional public health approaches for tracking and

COVID-19

Wastewater Sampling

In spring 2021 we partnered with Duke Facilities and with the Gunsch Lab to pilot a study of wastewater-based COVID-19 surveillance on three residence halls on Duke Campus. The pilot aimed to assess the wastewater sampling approach and compare its sensitivity to the existing nasal-swab-based surveillance program. The immediate goals were to define installation and maintenance best practices and to assess published analytical protocols. The workflow included daily 24-hours composite wastewater samples collection and specimen concentration by membrane filtration. Then RNA was extracted and virus quantification obtained by PCR; a number of process controls were included in the workflow.

Outcomes from the research were published in Science of The Total Environment.

Methods to Detect SARS-CoV-2 in Wastewater

The Wastewater Dashboard aims to summarize and organize methods that have been reported to detect SARS-CoV-2 (SARS-2) in wastewater around the world. It is meant to be a quick resource for researchers and for those who are interested in identifying potential partnerships. Results include peer-reviewed papers and preprints. The dashboard can be downloaded and filtered by country, sampling method (grab vs. composite), concentration method category (e.g. precipitation, ultracentrifugation), and PCR methods and is up to date as of December 2020.

http://washaid.pratt.duke.edu/covid-19

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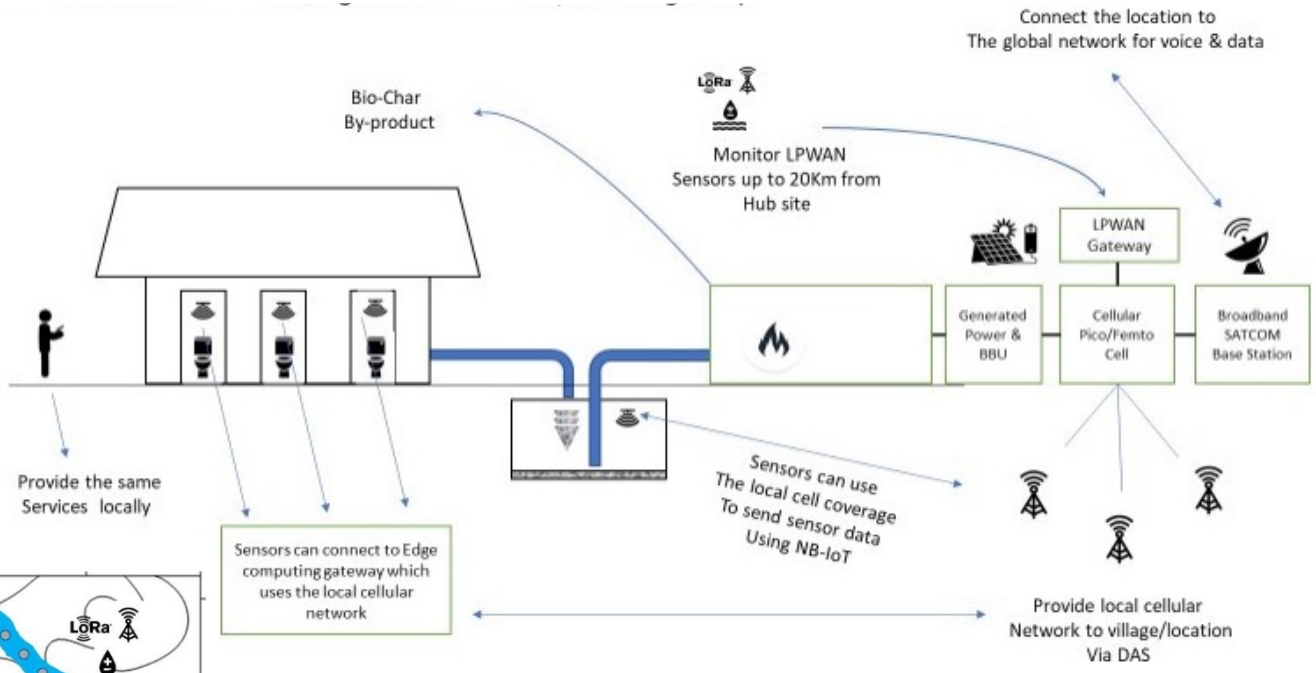

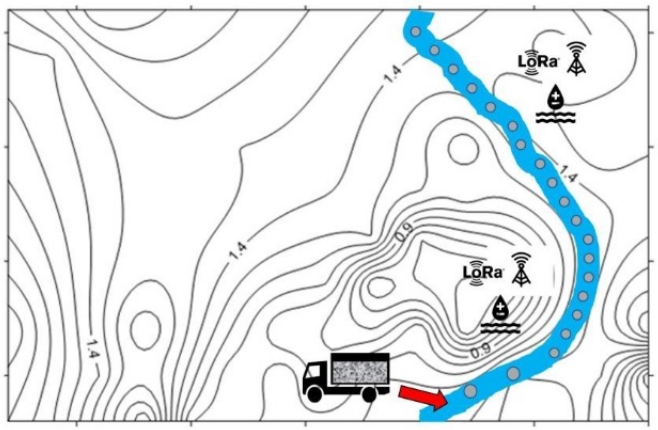

Space for Sanitation - Woodco | ESA Business Applications

Smart Toilet

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The Actually Smart Toilet Company

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- Collects a fecal specimen automatically post-flush for biochemical analysis
- Provides real-time feedback on straining to benefit constipation

Learn More

https://www.coprata.com/

Smart Toilet

Park, Seung-min, et al. "A mountable toilet system for personalized health monitoring via the analysis of excreta." *Nature biomedical engineering* 4.6 (2020): 624-635.

Potential

Potential

- Continuous Monitoring
- Non-invasive
- On-site
- Predictive vs Reactive approach

  Water Borne diseases account for 1.5 million deaths annually

- Lack of Preventive Care:

  56.2% of men 50-64 y.o. and 61.2% of women received colon cancer screening in the US in 2015.

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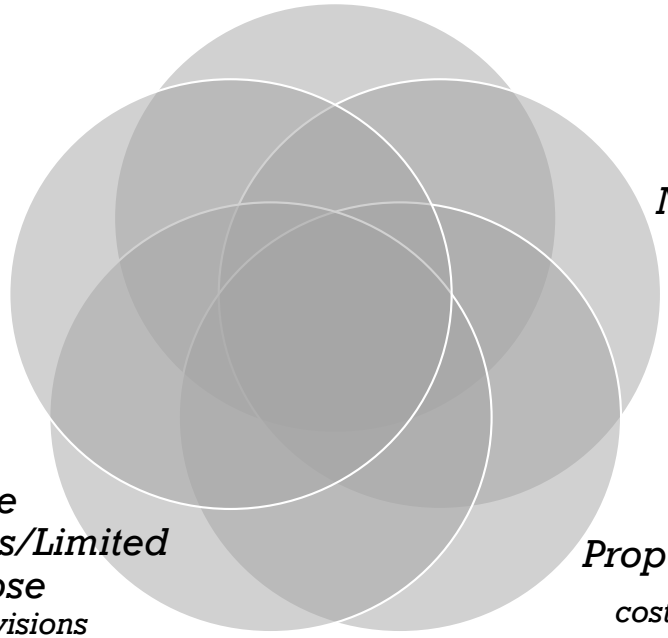
Challenges

- Privacy
- Data Governance
- Limited Purpose
- Auditing
- Surveillance

Policy Guidelines

Scientific Validity

there is evidence that it improves outcomes



Privacy

does not disclose more personal information than an individual might want to share

Necessity

there are no better and less harmful alternatives

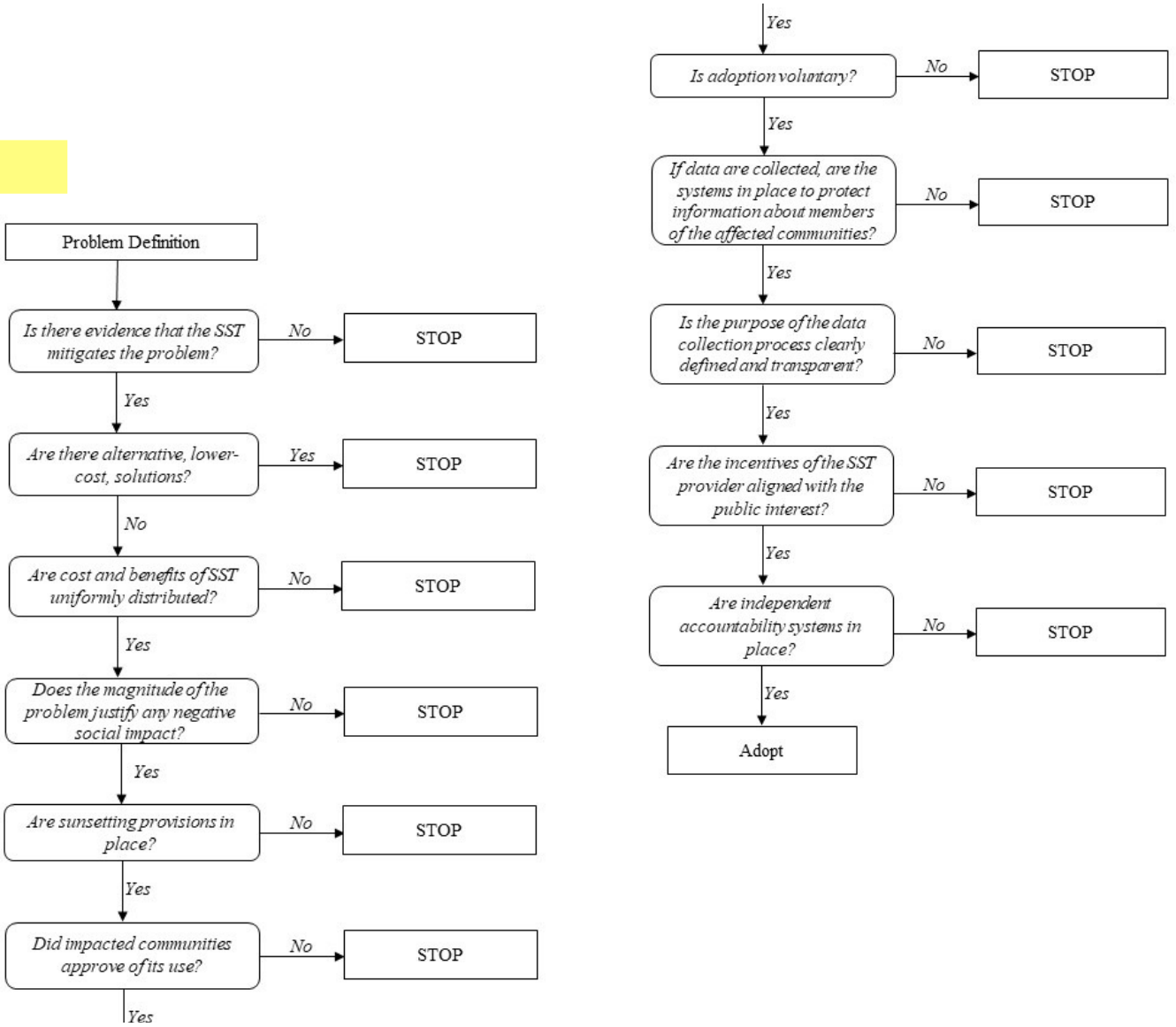
Time Boundedness/Limited Purpose

reasonable and realistic sunsetting provisions

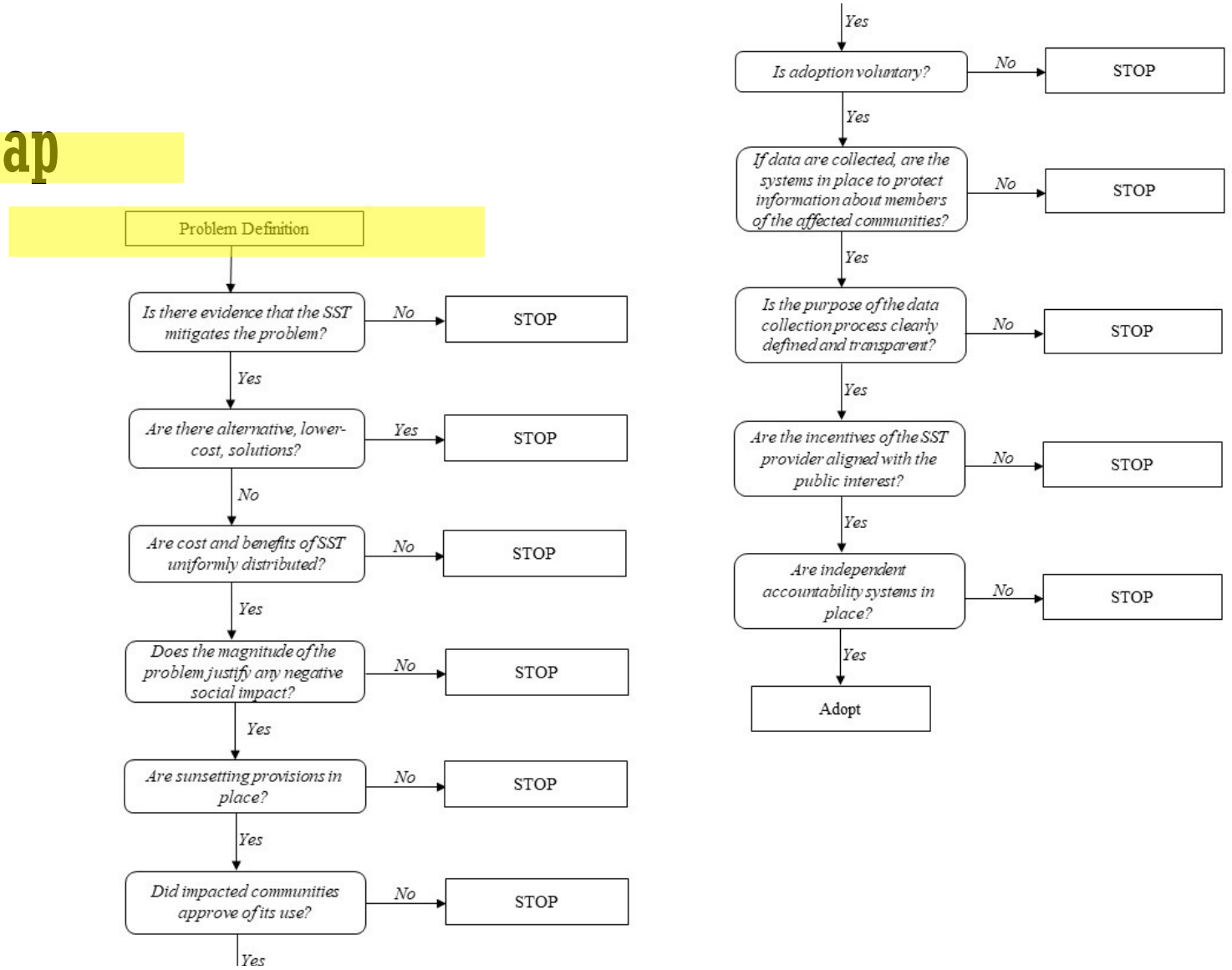
Proportionality

costs are justified by the gravity of the situation

Decision Map



Decision Map



Acknowledgements

Thank you!

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November 19, 2024	*(European Teleclass)* **NURSES IN ANTIMICROBIAL STEWARDSHIP INTERVENTIONS – MISSING OPPORTUNITIES, WASTED TALENT** Speaker: **Dr. Enrique Castro-Sánchez**, Brunel University London
November 27, 2024	*(FREE* Australasian Teleclass) **THE ART OF IV LINE CARE** Speaker: **Prof. Claire Rickard**, The University of Queensland, Australia
December 5, 2024	**EFFECTIVE INFECTION PREVENTION MEASURES IN LONG-TERM CARE FACILITIES IN SWITZERLAND** Speaker: **Dr. Nando Bloch** & **Dr. Jasmin Männer**, Cantonal Hospital St.Gallen, Switzerland
December 12, 2024	*(FREE Teleclass)* **NEW DEVELOPMENTS IN ENVIRONMENTAL CLEANING AND DISINFECTION** Speaker: **Dr. Curtis Donskey**, Louis Stokes Cleveland VA Medical Center, Ohio

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