IMPACT Project
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Answering global bacterial multi-resistance with sustainable preventive solutions

Group 3
Cécile ELLERT, Céline BARTHES, Chaitrali KETKALE

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FRAME THE PROBLEM

Context	Issue	Necessity	Intention
Bacterial multi-resistance poses a serious **threat to healthcare sustainability** for the following reasons: • **Treatment failure**: higher costs and increased complications • **Safety of surgeries in jeopardy**: surgery risks without effective antibiotics • **Impact on vulnerable populations**: elderly, immunocompromised, chronic diseases or patients in healthcare facilities at risk	Bacterial multi-resistance is a **public health concern** caused by: • **Overuse of antibiotics** in humans and livestock • **Incomplete treatments** leading to resistant strains • **Environmental antibiotic release** through wastewater • **Genetic mutations** in bacterial structures	**Antimicrobial resistance** and a **weakening healthcare system** impact: **SDG 3: Good Health and Well-being** • Rising treatment failures threaten health outcomes. • Resistant infections increase mortality and healthcare costs. **SDG 9: Industry, Innovation, and Infrastructure** • Industry faces pressure for sustainable antibiotic practices. • Innovation needed for alternative natural treatments and diagnostics.  	intention is to **democratize the use of natural aromatic compounds as alternative sustainable solution** to reduce antibiotic usage and multi-resistance**:** • **Cost-effective** extraction of potent antibacterial essential oils. • Reduces antibiotics in humans, food, and water. • Provides **safe, non-resistance methods for prevention and treatment.** • **Lowers contamination** of water and natural resources.

ETHICS involving Natural Aromatic Compounds vs Antibiotics

	Antibiotics		Essential Oils	
Benefits	Healthcare impact & Productivity	• Rapid treatment and recovery • Supports livestock productivity *(economic benefit but controversial)*	Environmental impact	• Lowers contamination of water and natural resources.
			Local economic growth	• Supports sustainable local farming (fair-trade practices)
			Lower risk of resistance	• Provides safe, non-resistance methods for prevention and treatment.
Costs	Antimicrobial Resistance (AMR)	• Higher costs of treatments and complications: ○ Death toll of AMR to reach 8M-10 M per year by 2050 ○ US$ 1 trillion additional healthcare costs by 2050	Regulatory Gaps	• Lack of standardized evaluation frameworks • Insufficient safety and efficacy data • Approval and labelling challenges
	Over-prescription	• Overuse of antibiotics in humans and livestock	Environmental impact	• Risks of overharvesting, land degradation, water depletion, pollution
	Environmental impact	• Antibiotic release through wastewater		

POTENTIAL RISKS of Generalizing the Use of Essential Oils

Several factors should be carefully considered:

Health Risks	• Skin / respiratory irritations (very rare with the selected EO), and allergic reactions • Toxicity, with incorrect dosage and application (if not properly diluted or ingested, still, very rare) • Interactions with medications, either enhancing or inhibiting their effects (none with the selected EO)
Environmental Impacts	• Overharvesting risks : overexploitation of flora and fauna, threatening biodiversity • Land degradation: deforestation, soil erosion, or monocropping. • Water depletion: significant water resources required for extraction processes • Pollution: from by-products used for extraction processes (that could eventually alter the quality of the oils)
Ethical Concerns	• Exploitation risks: Communities supplying raw materials could face unfair wages and working • Transparency: Claims about efficacy could mislead users into substituting antibiotics for essential oils in some inadequate cases (post-surgeries for instance)

ADAPTABLE INFRASTRUCTURE for our Solution

Leverage contributing factors

Sustainable and High-Quality Soil Management
- **Regenerative Agriculture:** Preserve soil fertility with crop rotation.
- **Precision Farming:** Use AI and IoT for soil monitoring and efficient irrigation.

Good Farming Practices
- **Fair Trade and Ethical Sourcing**
- **Climate-Resilient Crops**

Skilled Labor Development
- Training Programs, Community Engagement, Technology Integration

Efficient Extraction Process
- **Modular Distillation:** Adapt units to seasonal and regional variations.
- **Closed-Loop Extraction:** Minimize waste.
- **Renewable Energy-Powered Distillation:** Use solar, biomass, or geothermal energy.

Mitigate uncertainties

Climate and Environmental Risk Management
- **Diversified Sourcing:** Cultivate in multiple climate zones to reduce weather risks (for example: **Lavender** is originally from the Mediterranean but now cultivated in France, Bulgaria, and the US)
- **Water Conservation:** Use rainwater harvesting and drip irrigation.
- **Adaptive Supply Chains:** Leverage AI for real-time disruption forecasting and sourcing adjustments.

Goal & Scope of a LIFE CYCLE ASSESSMENT for our project

Goal:

To evaluate and compare the **environmental impact of using essential oils (e.g., Spike Lavender)** vs. traditional **antibiotics**, especially in terms of production, use, and disposal—across healthcare and agricultural applications.

Scope:

Functional Unit	1 kg of antibacterial product (essential oil vs. antibiotic) used in wound care or livestock
System Boundaries	Cradle-to-grave: from raw material cultivation to product application and disposal
Impact Categories	GHG emissions, water use, land use, ecotoxicity, eutrophication, acidification, biodiversity loss
Geographic Scope	Focus on France, USA, India, Brazil
Temporal Scope	Projected impact over 10–20 years for sustainability planning
Target Audience	Policy makers, healthcare providers, farmers, investors, sustainability experts

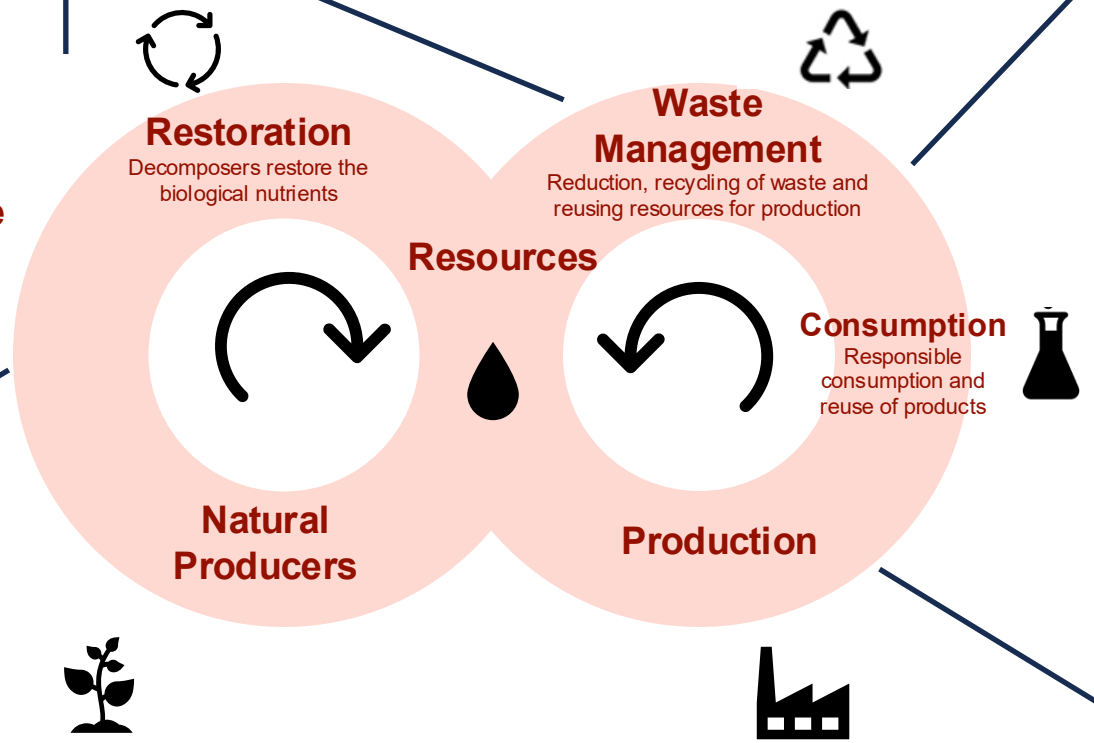
Data set for LIFE CYCLE ASSESSMENT

Life Cycle Process	Essential Oils (focus on Spike Lavender)	Antibiotics
Cultivation	Land use, pesticide/fertilizer, water use	
Manufacturing	= extraction Energy use for steam distillation, solvent, water consumption, waste output	Chemical synthesis data, energy use, by-product emissions
Packaging	Material types, energy for production	Material types, energy for production
Transport / Distribution	Emissions from farm to retailer	Cold chain data when applicable, emissions from factory to retailer
Use	Potential for runoff	Partial metabolism
End-of-life	Biodegradability	Water treatment efficiency, persistence in the environment

CIRCULAR ECONOMY: Causal Loop Diagram

Repurposing Plant material (biomass): The aromatic plant matter used in distillation (flowers, leaves) can be reused to produce hydrosols or biofertilizers, extending its lifecycle.

Reusable Packaging : Encourage glass bottle return schemes, deposit systems, or certified recyclable packaging within local distribution networks



Byproduct Valorization : Explore secondary uses of distillation waste: animal feed (safe biomass), mulch, herbal teas, or natural cosmetics.

Closed-Loop Extraction Systems : Promote solvent-free distillation with water recovery and use of biomass waste for compost or bioenergy.

Measuring IMPACT of Essential Oils

Selected Performance Metrics:

Clinical & Health Impact

1. **Reduction in Antibiotic Usage** → less resistance, main driver of AMR
2. **Treatment Effectiveness** → proven outcomes, credibility with doctors/patients

Sustainability & Efficiency

3. **Carbon & Water Intensity** → responsible essential oil production
4. **Cost per Treatment** → affordability across healthcare systems, key for scalability

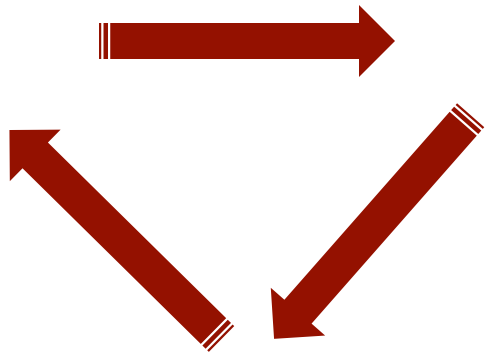
Growth & Adoption

5. **Scalability & Uptake** → Measures how widely the solution can be deployed and adopted

How These Metrics Support the Project

Better Planning

- LCAs reveal efficiency opportunities
- Cost analyses guide resource allocation
- Data-driven insights improve sustainability outcomes



Stakeholder Buy-in

- Reduced antibiotic usage shows credibility
- Proven treatment effectiveness builds trust with doctors & policymakers
- Evidence supports regulatory and public health alignment

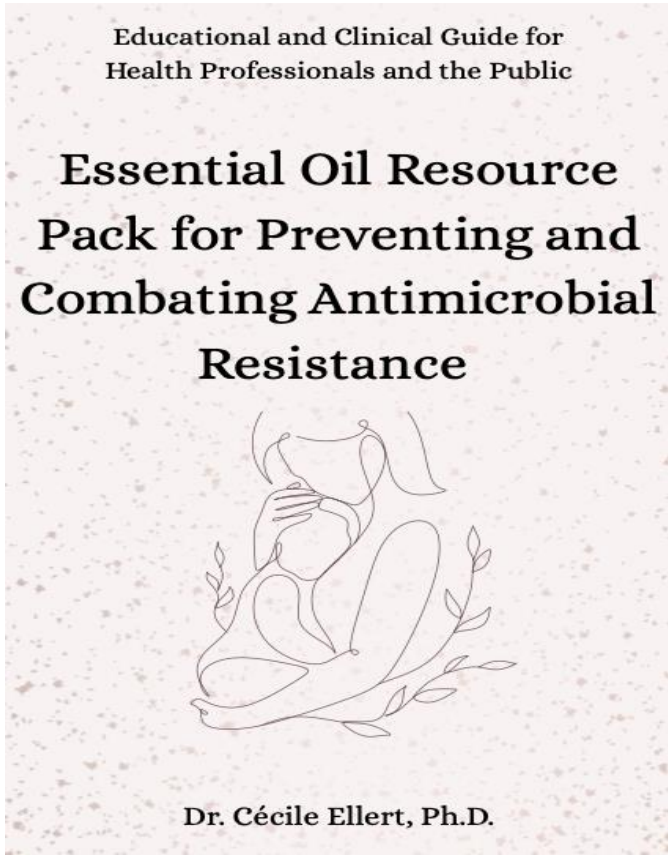
Implementation

- Scalability and adoption metrics track real-world uptake
- Early warning signals if adoption lags
- Enables timely strategy adjustments for rollout success

Takeaway Brochure & Resource Hub

- Easy overview of the protocol
- Access to sourcing links
- Implementation video
- For public & professionals
- Featured at the next NAHA conference in October 2025

(see more in the appendix)



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APPENDIX

Poster Presented at the NAHA conference October 2025

- Please use the QR code to open the brochure

- About the NAHA conference https://conference.naha.org/