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Ethical Nail Salons: A community-governed and SDL-facilitated approach to mitigate occupational chemical hazards in nail salons

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1. Introduction

Chemical hazards are a major concern in nail salons. These hazards are linked to adverse health outcomes, such as respiratory illness, skin disease, and other potential health impacts, such as endocrine disruption [1][2]. However, regulatory and enforcement gaps allow the use of products that are falsely labelled as "non-toxic" or contain components that are known to be unsafe [3][4]. Moreover, high costs and low function prevent the use of safer nail products [5]. The burden of exposure and disease is disproportionately borne by immigrant and newcomer women, who largely make-up the workforce in nail salons [6].

While it is beneficial to describe the hazards, such exposure data alone does not lead to safer products and workplaces. **In a unique collaboration of two self-driving labs (SDLs), occupational health experts, and a community organization, this project moves from hazard identification to mitigation.**

2. Objectives and Methodology

Drawing on frameworks for community-governed materials discovery [7], the Acceleration Consortium's (AC) values and mission, and the principles of community-based participatory research design [8], **this project envisions and develops a model of safe and functional nail polish, grounded in the priorities of nail technicians (Fig. 1).** This broader objective comprises three goals:

- To develop a process for designing SDL workflows to create a safe, affordable, and functional nail polish as a model of "ethical substance" (Goal #1).
- To create a model of community-governed SDL research design that can be replicated and adapted across SDLs in the broader field of materials science (Goal #2).
- To build the foundation to create a nail salon worker-governed SDL to create safer nail products (Goal #3).

Our community-grounded and interdisciplinary research encompasses qualitative methods, technical assessments, and the Robotic Autonomous Imaging Surface Evaluator (RAISE), developed by the Frank Gu Lab and the AC's SDL 5 (Formulations).

Initially designed for automated wettability (contact angle) evaluation, RAISE integrates liquid formulation preparation, droplet deposition, real-time imaging, and data-driven Bayesian optimization through a high throughput closed-loop framework. Our project applies RAISE to nail polishes to characterize their qualities, with attention to solvents and plasticizers. The modular design of RAISE allows for expansion to include other key characterization workflows related to nail polish performance (e.g. evaporation rate, adhesion strength, film durability, and rheological properties), as well as potential for worker exposure (e.g., VOC measurements) by integrating additional low-cost sensors and imaging routines. RAISE enables feedback loops and that will lead to faster cycles for iterative improvement.

This collaborative project creates a model of community-governed SDL research to reduce chemical hazards in nail polish. This is novel in the field of materials science. **This model can be utilized within the AC's SDLs as well as in**

the broader field, as a potentially field-altering innovation towards community-led materials science as an ethical intervention.

2.1 Related work

This project unites various forms of expertise toward community-governed materials discovery. Shadaan is a community-based researcher and, with M. Murphy at the Indigenous Science and Ethical Substance lab, brings expertise on values-based research, inclusive of community-governed processes, and community-grounded chemicals risk assessment [9]. Arrandale holds a wealth of expertise in occupational hygiene, exposure assessment, and occupational health interventions, including in nail salons, and is the Director of the Centre for Occupational Disease Prevention [1] [2]. Begum is a qualitative researcher, who focuses on labour rights in nail salons. Since 2013, the Parkdale Queen-West Community Health Centre has been Canada's leading advocate in nail technicians' health and safety. The SDL teams (Gu, Le Dévédec, Nazeri, Ng, Melville, Gupta) bring expertise in materials formulation and workflow design relevant to nail polishes [10].

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2.2 Figures

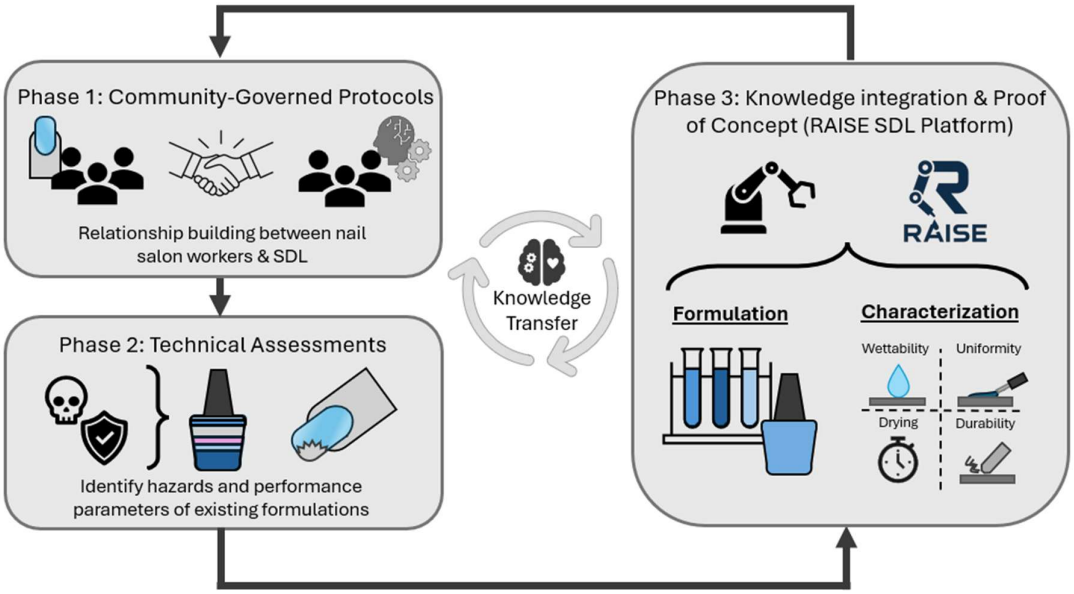

Fig. 1

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