Acabuild
AI LabHub

ASEPTO: The Advanced Compounding Simulation

Documentation & User Guide

Release Date: February 2026

Platform: Universal (HTML5/JavaScript) - Client-Side Only

1. Introduction

ASEPTO is a high-fidelity, browser-based clinical simulation tool designed to train pharmacy students and technicians in the rigorous protocols of sterile compounding. Unlike passive video demonstrations, ASEPTO utilizes a physics-based interactive engine to simulate laminar airflow, requiring the user to master manual dexterity and spatial awareness in a risk-free environment.

Key Features:

- **First Air Physics Engine:** Uses real-time raycasting to simulate Horizontal Laminar Airflow. Objects cast "turbulence shadows" (visualized in red), allowing students to instantly see if they have blocked critical "First Air" to a sterile site.
- **Vector-Based Garbing:** Features a realistic anatomical mannequin for the Donning and Doffing of Personal Protective Equipment (PPE), enforcing strict "Dirtiest-to-Cleanest" sequencing.
- **Motion-Sensing Cleaning Tool:** The surface cleaning module tracks mouse movement vectors to enforce unidirectional, overlapping strokes, penalizing circular or scrubbing motions.
- **Procedural Integrity Tracking:** The system logs every user action from the order of dressing to the angle of a needle generating a comprehensive "Session Report Card" at the end.

2. Core Concepts & Mechanics

ASEPTO is built around two core "Invisibility Mechanics", things that are invisible in real life but visualized here for educational purposes.

The "First Air" Principle

In a horizontal laminar flow hood, clean air moves from the back filter (HEPA) to the front operator.

- **The Mechanic:** Every object (vial, hand, syringe) casts a "shadow" downstream.
- **The Rule:** If a critical site (e.g., needle tip, vial septum) enters a shadow, it is contaminated. The app visualizes this violation with a flashing red alert.

The "Swipe" Logic

Proper cleaning requires parallel, overlapping strokes to push contaminants away.

- **The Mechanic:** The physics engine analyzes your mouse cursor's velocity vector.
- **The Rule:** You must move strictly Horizontal (Side-to-Side) or Vertical (Top-to-Bottom). Diagonal or circular scrubbing is detected as "Invalid Motion" and halts the cleaning progress, deducting points.

3. How to simulate

Step 1: Preparation (The Checklist)

Before entering the simulation, you must complete the **Pre-Entry Checklist**. You must confirm the removal of outer garments, jewelry, and makeup. This reinforces the "zero-tolerance" policy for particulate sources.

Step 2: The Five-Phase Workflow

Phase 1: Garbing (The Anteroom)

- **Objective:** Don PPE in the correct order.
- **Action:** Drag items from the shelf to the mannequin.
- **Logic:** The system enforces the *Dirtiest-to-Cleanest* protocol:
    1. **Mask** (Face)
    2. **Hair Cover** (Head)
    3. **Shoe Covers** (Feet - crossing the Line of Demarcation)
    4. **Hand Hygiene** (Sink - 30s wash)
    5. **Gown** (Non-shedding)
    6. **Sanitization** (IPA)
    7. **Sterile Gloves**

Phase 2: Sanitization (The Hood)

- **Objective:** Clean the hood surface.
- **Action:** Click and drag the mouse across the white surface.

- **Constraint:** You must cover 100% of the surface using valid, straight strokes. The cursor turns **Green** for good technique and **Red** for poor technique.

Phase 3: Order Verification

- **Objective:** Verify the dose.
- **Action:** A physician order appears (e.g., "Vancomycin 1g"). You must calculate the required volume based on the stock concentration (e.g., "1g/20mL") and input the answer.

Phase 4: Compounding (The Aseptic Field)

- **Objective:** Draw the medication without contamination.
- **Actions:**
- **Right-Click** items to interact (Peel Wrappers, Uncap Needles, Snap Ampules).
- **Drag** items to move them.
- **Warning:** Watch the "Red Shadows" created by your hand and items. Do not let shadows touch critical sites (marked with red dots).
- **Verification:** Drag the filled syringe to the green "Verification Zone" to complete the product check.

Phase 5: Doffing (The Exit)

- **Objective:** Remove PPE safely.
- **Action:** Drag items *off* the mannequin into the Waste Bin.
- **Logic:** Reverse order (Most Contaminated First): Gloves→Gown →Hair →Mask→Shoes.

4. Assessment & Reporting

The simulation operates on a 100-point scale. Points are deducted in real-time for:

- **Sterility Violations:** Blocking First Air (Major penalty).
- **Protocol Errors:** Incorrect PPE order or improper cleaning motion.
- **Safety Hazards:** Using expired drugs or touching hazardous spills without a kit.
- **Math Errors:** Incorrect volume calculation.

The Report Card: Upon completion, a modal appears displaying:

- Final Letter Grade (A-F).
- Cleaning Efficiency %.
- Count of "First Air" Violations.
- A chronological log of specific procedural errors (e.g., *"Donned Gown before Washing Hands"*).

5. Troubleshooting

Issue	Possible Cause	Solution
Cleaning tool isn't working	Mouse movement is diagonal or circular.	Move the mouse in strict straight lines (Left-to-Right or Up-and-Down). The cursor will turn green when the motion is valid.
"License Revoked" / Critical Fail	You used an expired drug or caused a fatal error.	Check the expiration date on the vial label before drawing fluid. Avoid "Fatal" interactions like touching a hazardous spill.
Cannot remove PPE (Doffing)	Wrong removal order.	You must remove the most contaminated items first (Gloves) before touching the "cleaner" items (Mask/Hair).
Syringe won't draw fluid	Syringe is not touching the vial.	Drag the syringe so its tip overlaps with the vial or ampule, then Right-Click → "Draw Fluid".

6. Glossary of Clinical Terms

- **DCA:** Direct Compounding Area. The critical zone where the sterile product is exposed to first air.
- **First Air:** Undisturbed air coming directly from the HEPA filter. It must bathe the critical site at all times.
- **LOD:** Line of Demarcation. The physical line separating the "dirty" anteroom side from the "clean" side.
- **PPE:** Personal Protective Equipment (Gown, Gloves, Mask, etc.).
- **Zone of Turbulence:** The area of "bad air" (backwash) created behind an object, typically extending 3x the diameter of the object.

7. Technical Specifications

- **Architecture:** Single-Page Application (SPA).
- **Language:** HTML5, CSS3 (Tailwind), Vanilla JavaScript (ES6).
- **Dependencies:** lucide-react (via CDN) for iconography.
- **Privacy:** 100% Client-Side. No student data, scores, or performance metrics are ever sent to a server. Data persists only in the browser's RAM during the session.
- **Concept & Logic:** Dr Shery Jacob; Professor of Pharmaceutics, College of Pharmacy, GMU, Dr. Muhammad AlShorbagy, Dean, College of Pharmacy, GMU.
- **Technical Implementation:** AI-Assisted Development (Code generation).
- **Privacy Model:** Client-Side Sandbox. The application operates entirely within the user's browser memory (RAM). Refreshing the page wipes all data, ensuring compliance with strict academic data privacy regulations.