# NAE Dose Calculator

## User Guide

Version 1.2

*A Comprehensive Medication Dosing Reference Tool*
*for Healthcare Professionals*

**NAE Medi Solutions LLC**
info@naemedsolutions.com
https://medcalc.naemedsolutions.com

Document Date: February 1, 2026

**Accessibility conformance is documented in the VPAT®/ACR (WCAG 2.1 AA, Revised Section 508)**

# Table of Contents

# 1. Introduction

## 1.1 About NAE Dose Calculator

The NAE Dose Calculator is a web-based medication dosing reference tool designed for healthcare professionals. It provides rapid access to weight-based medication calculations, equipment sizing recommendations, and vital signs references for both pediatric and adult patients.

This application is a reference tool only and should always be used in conjunction with professional medical judgment, institutional protocols, and current clinical guidelines.

All calculation methods and ideal body weight (IBW) estimation formulas used by the application are displayed during use and are based on established clinical formulas (see Appendix A for formula references and validation details).

> ⚠ **Important:** This tool is a reference aid only. All doses must be verified by qualified healthcare professionals before administration. Users are responsible for verifying all outputs against institutional protocols and current clinical references prior to administration.

## 1.2 Key Features

- Pediatric and Adult medication dose calculations
- Weight-based dosing with automatic unit conversions (kg/lb)
- Equipment sizing (ETT, blades, suction catheters, NG/OG tubes, Foley catheters, IO needles)
- Vital signs reference ranges by age
- Pediatric weight-based color zoning
- Body habitus scoring integration
- Quick Find drug search
- Jump to Section navigation
- Print functionality with customizable sections
- Medication selection log
- Version changelog
- Multi-organization support
- Accessibility conformance documented in VPAT®/ACR (WCAG 2.1 AA, Revised Section 508)

## 1.3 System Requirements

The NAE Dose Calculator is a web application accessible through modern web browsers:

- Google Chrome (recommended)
- Mozilla Firefox
- Microsoft Edge
- Safari (macOS/iOS)

An active internet connection is required for authentication and data synchronization.

## 1.4 Progressive Web App (PWA) and Offline Support

The NAE Dose Calculator is built as a Progressive Web App (PWA), providing enhanced performance and limited offline functionality.

### 1.4.1 Installing as an App

The calculator can be installed on your device for quick access:

**Desktop (Chrome/Edge):**

• Look for the install icon in the browser address bar

• Click to install and add to your applications

**Mobile (iOS/Android):**

• Open the browser menu

• Select “Add to Home Screen” or “Install App”

• The app icon will appear on your home screen

### 1.4.2 Fast Loading with Local Caching

The application uses IndexedDB (browser local storage) to cache your organization’s configuration for fast loading:

• **First visit:** Configuration is loaded from the server and cached locally

• **Subsequent visits:** Cached configuration loads instantly while fresh data is fetched in the background

• **Background refresh:** The cache is silently updated with any configuration changes for your next visit

• **Login refresh:** When you log in, fresh configuration is always loaded from the server

This results in significantly faster load times after the initial visit, as the application does not need to wait for network requests to display the calculator interface.

### 1.4.3 Offline Mode

The NAE Dose Calculator provides limited offline functionality for viewing previously cached data:

**What works offline:**

• Viewing the calculator with your organization’s cached medication configuration

• Performing dose calculations

• Navigating the interface

• Viewing the habitus reference image

**What requires internet connection:**

• Logging in or authenticating

• Saving configuration changes (requires token validation)

• Saving to the selection log

• Viewing or restoring configuration versions

When the application detects that you are offline, an orange banner appears at the top of the screen indicating “You are offline – Viewing cached data (read-only).” This banner automatically disappears when connectivity is restored.

### 1.4.4 Automatic Refresh on Reconnection

When internet connectivity is restored after being offline, the application automatically:

- Removes the offline banner
- Refreshes the service worker cache with the latest application files
- Fetches fresh configuration data in the background and updates the local cache

This ensures that the next time you use the application, you will have the most up-to-date configuration without needing to manually refresh the page.

⚠ **Important:** Offline mode is intended for read-only reference only. Any configuration changes attempted while offline will not be saved. When offline, cached content may be outdated; confirm current protocols and concentrations once connectivity is restored. Administrators should ensure they have an active internet connection before making changes to the medication configuration.

# 2. Getting Started

## 2.1 Accessing the Application

Navigate to https://medcalc.naemedsolutions.com in your web browser.

## 2.2 Authentication

The NAE Dose Calculator uses a unified login flow that automatically routes you to the appropriate authentication provider based on your organization's configuration.

### 2.2.1 Login Process

1. Click the 'Login' button in the top-right corner of the application
2. Enter your work email address in the login modal
3. Click 'Continue'
4. The system looks up your organization by email domain
5. You are automatically redirected to your organization's authentication provider (Microsoft or Google)
6. Complete authentication with your organizational credentials
7. You are redirected back to the application, now logged in

> 📌 **Note:** If your organization is not found, contact your administrator to ensure your domain is registered with NAE Medi Solutions LLC.

### 2.2.2 Microsoft-Authenticated Organizations

For organizations using Microsoft 365/Azure Active Directory:

- Authentication occurs through Microsoft's secure OAuth 2.0 flow
- Complete any multi-factor authentication (MFA) required by your organization
- Your Azure AD roles determine your access level (user or admin)
- Sessions are managed server-side with full verification on each action

### 2.2.3 Google-Authenticated Organizations

For organizations using Google Workspace:

- Authentication occurs through Google's secure OAuth 2.0 flow
- Select your organizational Google account when prompted
- Admin access is controlled via server-side adminEmails list verification

## 2.3 Session Management

For Microsoft-authenticated users, sessions are managed server-side with the following characteristics:

- Session duration: 8 hours
- Sessions are validated on each protected operation
- Expired sessions prevent configuration saves until re-authentication

For Google-authenticated users, sessions are managed server-side with the same security model as Microsoft sessions.

# 3. Patient Data Entry

This tool is designed for non-identifiable inputs only (e.g., weight/age/height). Do not enter patient names, MRNs, DOB, or any identifiers.

## 3.1 Weight Entry

Weight is the primary input for most dose calculations. Weight can be entered directly by the user, or it can be automatically estimated by the calculator from other patient data inputs (see Section 3.8).

- Enter weight in kilograms (kg) or pounds (lb)
- Use the toggle switch to change units
- The calculator automatically converts between units
- Weight range: 0.5 kg to 300 kg

**Manual vs. Estimated Weight:** When a user types a weight directly into the weight field, this is a manual entry and the calculator uses that value as-is for all dose calculations. However, if no weight has been manually entered, the calculator will attempt to estimate a dosing weight from the other available inputs (height, age, sex, habitus score). This estimated weight auto-fills the weight field and is displayed with a colored indicator showing which estimation method was used (purple for IBW estimates, brown for TBW estimates). If the user then modifies the weight field manually, the auto-fill is overridden and the user's value takes priority.

> 📌 **Note:** For patients weighing less than 0.5 kg, consult neonatal-specific references and institutional protocols.

## 3.2 Height Entry

Height is used for Ideal Body Weight (IBW) estimation, Body Surface Area (BSA) calculations, equipment sizing (ETT depth), and as a gating criterion for determining which IBW formula applies.

- Enter height in inches (in) or centimeters (cm)
- Use the toggle switch to change units
- Height is optional but strongly recommended for accurate IBW estimation

**How height affects weight estimation:** When height is entered without a manual weight, the calculator uses height (in combination with age and sex if available) to estimate Ideal Body Weight using the most appropriate clinical formula. The formula selected depends on the height range and whether age and sex are also provided. See Section 3.8 for the complete IBW method selection logic.

Height ranges determine which IBW formula is used:

- **Below 19.5 inches (~50 cm):** No clinically validated height-based IBW formula exists. The calculator returns no IBW estimate for this range.

• **19.5–30 inches:** WHO Weight-for-Length 50th percentile tables are used (sex-specific when sex is provided, mean of male/female when sex is unknown).

• **30–60 inches:** Traub formula is used when only height is available (no age). When age ≥2 years is also available, CDC BMI-for-Age 50th percentile is preferred (sex-specific or mean).

• **Above 60 inches:** Devine adult IBW formula is used as a fallback (sex-specific or mean).

## 3.3 Age Entry

Age affects IBW method selection, vital signs reference ranges, equipment sizing, and certain dose calculations.

• Enter years in the first field

• Select additional months from the dropdown (0–11)

• For infants, you can enter fractional years or use the months selector

• Days field available for neonatal patients

**How age affects weight estimation:** Age is used in combination with height to select the most appropriate IBW formula. When both age and height are available, the calculator can use the CDC BMI-for-Age 50th percentile method (ages 2–18 with height 30–60 inches), which is more precise than height-only methods because it accounts for the expected BMI at the patient's specific age. For infants under 2 years with height, the WHO Weight-for-Length 50th percentile is used instead.

**Age-only estimation (Luscombe formula):** When age is entered without height and no weight has been manually entered, the calculator uses the Luscombe formula: Weight (kg) = (3 × age) + 7. This formula is valid for ages 1–14 years only. Below age 1 or above age 14 without height, no weight estimate can be made.

The Luscombe formula estimates total body weight (TBW), not ideal body weight (IBW). This is a critical distinction: because it is not an IBW estimate, the habitus score adjustment is never applied to Luscombe-derived weights. Applying a CDC percentile-based habitus factor to a non-IBW value would be methodologically incorrect. The weight field label displays "Luscombe age-only weight" in purple to indicate this is an age-based TBW estimate rather than a height-derived IBW.

**Age ≥18 years:** Triggers adult context for IBW calculation. The Devine adult IBW formula is used when height is also available (height must be ≥60 inches). Without height, no IBW estimate can be made for adults.

## 3.4 Sex Selection

Sex affects IBW formula selection, habitus factor table lookup, and certain equipment sizing estimates.

• Select Male or Female from the dropdown

• Default is Male if not specified

**How sex affects IBW estimation:** When sex is provided, sex-specific reference data is used for all IBW calculations: sex-specific WHO Weight-for-Length tables (infants under 30 inches), sex-specific CDC BMI-for-Age 50th percentile values (children 2–18 years), and sex-specific Devine formulas (adults and tall children over 60 inches). When sex is not provided, the calculator uses the mean (average) of the male and female reference values for whichever formula applies.

**How sex affects habitus adjustment:** The habitus factor lookup tables are derived from sex-specific CDC weight-for-age percentile data (separate tables for male and female). When sex is provided, the calculator uses the appropriate sex-specific table. When sex is unknown, it averages the male and female habitus factors for the given IBW and score. See Section 3.5 for full habitus details.

## 3.5 Body Habitus Score

The body habitus score (1-7) is a visual reference tool used to adjust doses for patients whose actual weight differs significantly from their ideal body weight (IBW). The score corresponds to CDC growth chart percentiles, with 3 representing IBW (50th percentile).

| Score | CDC Percentile | Description |
|---|---|---|
| 1 | 10th percentile | Severely underweight |
| 2 | 25th percentile | Underweight |
| 3 | 50th percentile (IBW) | Ideal body weight |
| 4 | 75th percentile | Above average build |
| 5 | 90th percentile | Overweight |
| 6 | 95th percentile | Obese |
| 7 | 97th percentile | Severely obese |

Click the ' ℹ ' button next to the habitus field to view the visual habitus scale reference chart.

**How the habitus score works:** When a valid height-based IBW has been computed and a habitus score other than 3 is selected, the calculator retrieves a habitus factor from sex-specific CDC weight-for-age percentile lookup tables. The factor is interpolated by IBW value within the table. The estimated Total Body Weight (TBW) is then calculated as:

TBW = IBW × Habitus Factor

For example, if the calculated IBW is 20 kg and the habitus score is 5 (90th percentile), and the lookup table returns a factor of 1.314, the estimated TBW would be 20 × 1.314 = 26.28 kg. This TBW value auto-fills the weight field and is used for all subsequent dose calculations. The weight field label displays “TBW ESTIMATE CDC PLOT” in brown to indicate a habitus-adjusted TBW is active.

When habitus score 3 (P50) is selected, the factor is 1.000, meaning TBW equals IBW and no adjustment is applied.

**When habitus adjustment IS applied:** All of the following conditions must be met:

• A valid IBW has been estimated from height (not from age-only/Luscombe)

• A habitus score between 1 and 7 is selected

• The patient's age is ≤12 years (or age is not entered)

• The patient's height is ≤60 inches (≤152.4 cm)

• The calculated IBW is ≤50 kg (the validated range of the CDC habitus tables)

**When habitus adjustment is NOT applied:** The habitus factor is not used in any of the following situations:

• No IBW is available (weight was entered manually, or no height/age data exists to derive one)

• **Luscombe age-only estimate:** The Luscombe formula produces a TBW estimate, not an IBW. Applying a CDC percentile-based habitus factor to a non-IBW value would be methodologically invalid. When Luscombe is the active method, the habitus score is ignored for dosing weight purposes.

• The patient's age exceeds 12 years

• The patient's height exceeds 60 inches (152.4 cm)

• The calculated IBW exceeds 50 kg (outside the validated CDC habitus table range)

In all of these cases, the weight field displays the IBW (or Luscombe TBW estimate) without habitus adjustment.

**Visual indicators:** When an IBW estimate is active (no habitus adjustment), the weight field is highlighted in purple with a label showing the formula used (e.g., "Traub height-only", "CDC BMI-50 (ht/age/sex)", "Devine adult IBW", "Luscombe age-only weight"). When a TBW estimate (IBW × habitus factor) is active, the weight field is highlighted in brown and the label reads "TBW ESTIMATE CDC PLOT". When weight is entered manually by the user, no color indicator is shown.

## 3.6 Pediatric vs. Adult Mode

Toggle between Pediatric (PEDS) and Adult mode using the switch in the header.

• PEDS mode: Displays pediatric-specific medications and weight-based dosing

• Adult mode: Displays adult medications with standard adult dosing

The mode affects which medications are displayed and how doses are calculated.

## 3.7 Clearing Patient Data

Click the 'Clear' button to reset all patient data fields. A confirmation dialog will appear to prevent accidental data loss.

# 4. Dose Calculations

## 4.1 Understanding the Dose Table

The main dose table displays medications organized by clinical category (sections). Each row contains:

| Column | Description |
|---|---|
| Drug | Medication name and any special notes |
| Concentration | Available concentration/formulation |
| Dosing | Dosing parameters (mg/kg, mcg/kg, etc.) |
| Route | Route of administration (IV, IM, PO, etc.) |
| Calculated Dose | Patient-specific calculated dose based on weight |

## 4.2 Dose Calculation Types

### 4.2.1 Weight-Based Dosing (mg/kg)

The most common calculation type. The system multiplies the mg/kg dose by the patient's weight.

Example: Amoxicillin 25 mg/kg × 20 kg patient = 500 mg

### 4.2.2 Volume Calculations (mL)

For liquid medications, the system calculates the volume to administer based on the concentration.

Example: Medication 100 mg in 5 mL concentration, dose 200 mg = 10 mL

### 4.2.3 Infusion Rates (mg/kg/hr, mcg/kg/min)

For continuous infusions, the system calculates hourly or per-minute rates.

### 4.2.4 Maximum Dose Limits

Many medications have maximum dose limits. When a calculated dose exceeds the maximum, the system displays the maximum dose with a 'MAX' indicator.

## 4.3 Colorzone Display

The colorzone indicator in the header displays a weight-based color category using generally accepted pediatric color zoning standards. This provides quick visual reference for emergency equipment sizing.

# 5. Navigation Features

## 5.1 Quick Find Search

Use the Quick Find feature to quickly locate specific medications:

1. Click the 'Quick Find' button in the header
2. A search input field expands
3. Type the medication name or partial name
4. Results filter in real-time as you type
5. Click the 'Quick Find' button again or clear the input to show all medications

## 5.2 Jump to Section

Use the section dropdown to navigate directly to a clinical category:

1. Click the 'Jump to Section' dropdown
2. Select the desired category
3. The section expands in an overlay view for focused review
4. Click 'Back' to return to the main view

## 5.3 Version Changelog

Click the version badge (e.g., ‘Version 1.0’) in the top-right toolbar to view the changelog overlay. This displays the history of updates and changes to the application.

## 5.4 Skip Navigation

For keyboard users, a 'Skip to main content' link appears when pressing Tab from the top of the page. This allows bypassing the header controls to reach the main dose table directly.

# 6. Medication Selection Log

## 6.1 Accessing the Selection Log

Click the ‘Log’ button in the top-right toolbar to open the selection log overlay.

## 6.2 Log Features

The selection log supports lightweight tracking of medication selections:

• Records log entry and timestamp when the user presses ‘Log’

• Entries are stored per organization

• Log data persists across sessions

• Log entries do not include patient identifiers and are not linked to a patient record. The log stores only the medication name (or row ID) and a timestamp; it does not store patient-entered values (weight, age, height), and it does not provide any free-text entry fields.

## 6.3 Log Retention

Administrators can configure log retention periods. By default, logs are retained for the organization's specified retention period.

# 7. Printing

## 7.1 Opening Print Options

Click the 'Print' button in the top-right toolbar to open the print configuration overlay.

## 7.2 Selecting Sections

The print overlay allows you to select which sections to include:

• Use checkboxes to select/deselect individual sections

• Use 'Select All' to include all sections

• Entered values (e.g., weight/age/height/sex/habitus) are included at the top of the printout. Do not enter patient identifiers.

## 7.3 Print Output

Click 'Confirm Print' to generate the print preview. The output is optimized for:

• Single-page or multi-page printing

• Color or black-and-white printing

• Portrait orientation

# 8. Configuration Editor (Administrators)

⚠ **Important:** The Configuration Editor is restricted to authorized administrators only. Unauthorized modifications may affect patient safety.

## 8.1 Access Requirements

### 8.1.1 Microsoft-Authenticated Organizations

Access is controlled by Azure Active Directory roles:

- Your Azure AD account must have an authorized role assigned
- Allowed roles are configured per organization (default: 'admin', 'Admin')
- Role verification occurs server-side on every save operation
- Session token is validated against the server for each action

📌 **Note:** Microsoft authentication provides complete server-side verification. All configuration saves are validated against your session and role before being accepted.

### 8.1.2 Google-Authenticated Organizations

Access is controlled by the organization's admin email list (server-side verified):

- Your email must be in the organization's adminEmails list
- Admin status is verified server-side during authentication
- Session token is validated against the server for each save operation
- Existing admins can add or remove admin emails through the editor

## 8.2 Opening the Editor

1. Click the '✎ Edit' button in the top-right toolbar
2. For Microsoft users: Access is granted automatically if you have an admin role
3. For Google users: Access is granted automatically if your email is in the admin list

## 8.3 Editor Features

### 8.3.1 Medication Management

- Add new medications using the 'Add Row' button
- Edit existing medications by modifying fields directly
- Delete medications by selecting rows and clicking 'Delete Selected'
- Reorder medications using the Rank field

### 8.3.2 Medication Fields

| Field | Description |
|---|---|
| Medication/Label | Drug name as displayed to users |
| Route | Administration route (IV, IM, PO, etc.) |
| Concentration | Available formulation/concentration |
| Dosing | Dosing parameters (e.g., '1-2 mg/kg') |
| Max Dose | Maximum single dose limit (mg) |
| Dosing Note | Additional notes displayed with the medication |
| Adult Dose | Standard adult dose (for adult mode) |
| Rank | Display order within section |

### 8.3.3 Saving Changes

Click 'Save' to commit your changes. For Microsoft-authenticated organizations, the following server-side validations and logging occur:

- Session token verification
- Role authorization check
- Tenant ID validation
- Organization membership verification
- Complete configuration change logged to Usage container for audit trail

All saves are fully validated server-side before being accepted. The entire configuration change is logged with user attribution for compliance and accountability.

## 8.4 Allowed Roles Configuration (Microsoft Organizations Only)

For Microsoft-authenticated organizations, administrators can configure which Azure AD roles grant editor access. This feature appears in the editor toolbar only for Microsoft users.

### 8.4.1 Adding a Role

1. In the editor toolbar, locate the 'Edit Roles:' section
2. Type the Azure AD role name in the input field (e.g., 'MedCalcAdmin')
3. Click 'Add' to add the role
4. The role appears as a tag in the list

### 8.4.2 Removing a Role

1. Locate the role tag you want to remove
2. Click the 'x' on the role tag to remove it

Changes are saved automatically. Users with the specified Azure AD roles will have admin access on their next login.

📌 **Note:** Default allowed roles are 'admin' and 'Admin'. At least one role should always remain configured to prevent lockout.

## 8.5 Admin Email Management (Google Organizations)

To manage administrator access for your organization:

1. In the editor toolbar, locate the 'Admin Emails' section
2. Type the email address of the new admin and click 'Add'
3. To remove an admin, click the '×' on their email tag
4. At least one admin email must remain (system prevents removing the last admin)

## 8.6 Configuration Versioning

The NAE Dose Calculator maintains a complete version history of all configuration changes. This feature provides administrators with the ability to view past configurations and restore them if needed.

### 8.6.1 Version Labeling

Each time an administrator saves a configuration change, a version record is automatically created with a unique label in the following format:

**user@email.com:YYYYMMDD(n)**

Where:

• **user@email.com** – The email address of the administrator who made the change

• **YYYYMMDD** – The date of the change (e.g., 20260201 for February 1, 2026)

• **(n)** – A sequential number for multiple saves by the same user on the same day (e.g., (1), (2), (3))

Example version labels:

• admin@hospital.org:20260201(1) – First save by admin@hospital.org on February 1, 2026

• admin@hospital.org:20260201(2) – Second save by the same user on the same day

### 8.6.2 Accessing Version History

To view the configuration version history:

1. Open the Configuration Editor by clicking the '✎ Edit' button
2. Click the 'Versions' button in the editor toolbar
3. The Versions overlay opens, displaying all saved versions in reverse chronological order (newest first)
4. Each version entry shows the version label and timestamp

### 8.6.3 Restoring a Previous Version

Administrators can restore any previous configuration version:

1. Open the Versions overlay from the editor

2. Locate the version you wish to restore
3. Click the ‘Restore’ button next to that version
4. A confirmation dialog appears with a warning that this will replace the current configuration
5. Click ‘Restore Version’ to confirm, or ‘Cancel’ to abort
6. Upon successful restore, the calculator reloads with the restored configuration

📌 **Note:** Restoring a previous version creates a new version entry in the history. This provides a complete audit trail showing who restored which version and when. The original version being restored is not modified.

### 8.6.4 Version Storage

Configuration versions are stored in Azure Cosmos DB with the following characteristics:

• Each version is stored as a separate document in the Usage container
• Versions are isolated by organization (orgId)
• The complete configuration JSON is stored with each version
• Versions are retained indefinitely for audit and compliance purposes
• Version records include: version label, email, timestamp, authentication provider, and configuration data

### 8.6.5 Version Security

Version management is protected by the same security controls as configuration editing:

• **Viewing versions:** Requires valid authenticated session (admin access to editor)
• **Restoring versions:** Requires admin role, verified server-side before any changes are made
• **Organization isolation:** Users can only view and restore versions belonging to their own organization
• **Demo mode restriction:** Version history is not available in demo mode

## 8.7 Internal Test Calculator

The Internal Test Calculator is a built-in validation tool accessible from within the Configuration Editor. It allows administrators and testers to run the calculator’s dose computation engine against all configured medications using a standardized set of test weights, producing a comprehensive results matrix for verification.

This tool is intended for internal quality assurance and configuration validation. It is not visible to end users and does not affect the production calculator in any way.

⚠️ **Important:** The Internal Test Calculator is an administrative tool for validation only. It is not for clinical use. All test outputs must be independently verified against institutional protocols and current clinical references.

### 8.7.1 Purpose

The Internal Test Calculator serves as a verification tool for the dose calculation engine. It enables administrators to:

• Validate that all configured medications produce correct dose calculations across a full range of patient weights

• Confirm that adult default doses are applied correctly for medications that have them

• Verify that maximum dose limits are respected

• Produce a printable verification worksheet with space for manual hand-calculation comparisons

• Support quality assurance sign-off processes when onboarding a new organization or after configuration changes

### 8.7.2 Accessing the Test Calculator

The Test Calculator is accessed from within the Configuration Editor:

1. Open the Configuration Editor (requires admin access; see Section 8.2)

2. Click the '💉 Test Calc' button in the editor toolbar

3. The Test Calculator overlay opens as a full-screen dialog

### 8.7.3 How It Works

The Test Calculator uses the same core calculation engine (calcDoseMg) as the production calculator. It does not use separate or simplified logic. When a test is run, the tool temporarily sets the application state to each test weight, calls the same dose computation functions that run during normal calculator use, and then restores the original state. This ensures that test results are an exact representation of what the production calculator would display for the same inputs.

**Calculation Authenticity:** The test results are generated by the identical code path used in production. The tool calls calcDoseMg (the main dose function), getConcentrationInDoseUnits, roundToStep, and all other shared helper functions. Equipment sizing rows call the same estimateUncuffedETT, estimateCuffedETT, estimateNgTube, estimateFoley, and related functions. No results are approximated or independently recalculated.

**Rows requiring additional inputs:** Medications that require manual inputs beyond weight (such as Parkland burn calculations, protamine reversal, Andexxa, Vitamin K dosing, and Kcentra) are flagged in the results with a warning indicator noting that additional inputs are required. These rows cannot be auto-calculated by the test tool and must be verified manually.

### 8.7.4 Running a Test

The test runs all selected medications against all 11 test scenarios in a single operation:

1. In the Test Calculator overlay, use the row checklist to select which medications to include (Select All / Deselect All buttons are available)

2. Click '▶ Run All Weights'

3. The calculator runs every selected medication against all 10 preset weights plus the Adult Default scenario

4. Results are displayed in a scrollable matrix table within the overlay

### 8.7.5 Test Weight Scenarios

The following 11 test scenarios are executed automatically for every selected medication:

| # | Description | Weight (kg) | Mode |
|---|---|---|---|
| 1 | 5 lb (2.3 kg) — Neonate | 2.27 | Pediatric (weight-based dosing) |
| 2 | 10 lb (4.5 kg) — Infant | 4.54 | Pediatric (weight-based dosing) |
| 3 | 20 lb (9.1 kg) — Toddler | 9.07 | Pediatric (weight-based dosing) |
| 4 | 30 lb (13.6 kg) — Preschool | 13.61 | Pediatric (weight-based dosing) |
| 5 | 50 lb (22.7 kg) — School Age | 22.68 | Pediatric (weight-based dosing) |
| 6 | 80 lb (36.3 kg) — Adolescent | 36.29 | Pediatric (weight-based dosing) |
| 7 | 120 lb (54.4 kg) — Adult Small | 54.43 | Pediatric (weight-based dosing) |
| 8 | 160 lb (72.6 kg) — Adult Medium | 72.57 | Pediatric (weight-based dosing) |
| 9 | 200 lb (90.7 kg) — Adult Large | 90.72 | Pediatric (weight-based dosing) |
| 10 | Adult Default (70 kg) | 70.00 | Adult mode — uses adultDose if configured; null if not |

Scenario 10 (Adult Default) tests the adult dosing pathway. For medications that have an **adultDose** configured, the adult dose value is displayed. For medications without an adultDose, the result displays “null” in italics, confirming that no adult default exists for that row.

### 8.7.6 Results Display

After running the test, results are displayed in a matrix format with the following structure:

• **Rows:** One row per selected medication, showing the drug name, concentration, dosing formula, and route

• **Columns:** One column per test weight (10 pediatric weights + 1 Adult Default), plus a Manual Verification column

• **Cells:** Each cell shows the calculated dose (in the appropriate unit), with mL volume shown below when a concentration is available. Maximum dose indicators and adult dose labels are shown where applicable.

• **Adult Default column:** Highlighted with a green background. Displays the adult dose for rows that have one configured, or “null” for rows without an adultDose.

• **Manual Verification column:** A blank column highlighted with a warm background, intended for testers to record their independently hand-calculated values next to the calculator’s results for comparison.

### 8.7.7 Printing Test Results

After running a test, click the '🖶 Print Results' button to generate a printable verification worksheet. The printout is optimized for landscape orientation and includes:

- **Header fields:** Blank lines for Tester Name, Date, and Config/Version to be filled in by hand
- **Full results matrix:** The complete test results table with all weight columns and the Manual Verification column (highlighted with a left border for easy identification)
- **Sign-off section:** Blank lines for Verified By, Date, and Signature at the bottom of the page
- **Disclaimer:** A statement that the output is for internal validation only and not for clinical use

> 📌 **Note:** The printed worksheet is designed for use as a physical verification document. Testers should independently calculate expected doses by hand (using the dosing formula, weight, concentration, and max dose from the medication's configuration) and write their results in the Manual Verification column. Discrepancies between the calculator's output and the hand calculation indicate a potential configuration or calculation issue that should be investigated.

# 9. Security Architecture

## 9.1 Authentication Security

### 9.1.1 Microsoft OAuth 2.0 Flow

Microsoft authentication implements enterprise-grade security:

- OAuth 2.0 authorization code flow with PKCE
- Token exchange occurs server-side (never exposed to browser)
- ID tokens are validated and parsed server-side
- Tenant ID verification prevents cross-tenant access
- Azure AD roles are extracted from the token claims
- Server-side sessions with cryptographically random tokens
- 8-hour session expiration with automatic renewal

### 9.1.2 Google OAuth 2.0 Flow

Google authentication provides domain-based security:

- OAuth 2.0 authorization code flow
- Token exchange occurs server-side
- Domain-based organization lookup
- Usage logging for audit purposes

## 9.2 Session Security

### 9.2.1 Microsoft Sessions

| Feature | Implementation |
|---|---|
| Session Token | 256-bit cryptographically random (crypto.randomBytes) |
| Storage | Server-side in Azure Cosmos DB Sessions container |
| Duration | 8 hours from creation |
| Validation | Verified on each protected API call |
| Contents | orgId, email, name, role, tenantId, expiration |

### 9.2.2 Google Sessions

Google sessions now use the same server-side security as Microsoft. Session tokens are created server-side in Azure Cosmos DB with 256-bit cryptographic randomness, 8-hour expiration, and validated on every protected API call. Admin status is determined by the adminEmails array in the organization's configuration.

## 9.3 Data Security

### 9.3.1 Data at Rest

• All data stored in Azure Cosmos DB with encryption at rest

• Organization data isolated by orgId

• No patient health information (PHI) is stored. The application does not store patient identifiers and is intended for use without PHI.

### 9.3.2 Data in Transit

• All communications over HTTPS (TLS 1.2+)

• API endpoints hosted on Azure Functions with managed SSL

## 9.4 Access Control

### 9.4.1 Organization Isolation

Each organization's data is isolated:

• Domain-based organization lookup

• Tenant ID verification for Microsoft organizations

• All API calls include organization context

### 9.4.2 Role-Based Access

Two permission levels exist:

| Role | Capabilities | Assignment |
|---|---|---|
| User | View doses, use calculator, print, access log | Default for all authenticated users |
| Admin | All user capabilities plus: edit configuration, manage roles/admin emails | Azure AD role (MS) or adminEmails list (Google) |

### 9.4.3 Server-Side Save Validation

**Every configuration save operation is validated server-side before any data is written.** There is no way to bypass authentication by manipulating client-side code. The server performs these checks:

1. Session Required – Request must include a valid sessionToken (HTTP 401 if missing)
2. Session Valid – Token must exist in server-side Sessions container (HTTP 401 if invalid)
3. Not Expired – Session must not be expired, 8-hour lifetime (HTTP 401 if expired)
4. Org Match – Session's orgId must match request's orgId (HTTP 403 if mismatch)
5. Admin Role – Session's role must be 'admin' (HTTP 403 if not admin)

Only after all checks pass is the configuration written to the database and logged to the audit trail.

## 9.5 Audit Logging

For both Microsoft and Google authenticated organizations, comprehensive audit logging is maintained server-side in the Usage container.

### 9.5.1 Login Events

All authentication events are logged:

- Successful and failed login attempts
- Authentication provider used (Microsoft/Google)
- User email and name
- Organization ID
- Tenant ID
- User role assignment
- Timestamp

### 9.5.2 Configuration Change Logging

For Microsoft-authenticated organizations, all configuration saves are logged with complete audit trail:

- User who made the change (email, name)
- Session token validation
- Organization ID
- Timestamp of change
- Complete configuration snapshot saved

This provides full accountability for all medication configuration changes and supports compliance requirements.

> 📌 **Note:** Both Microsoft and Google authenticated organizations now have full server-side configuration change logging with complete audit trails.

# 10. Technical Architecture

## 10.1 Technology Stack

| Component | Technology |
|---|---|
| Frontend | Single-page HTML/CSS/JavaScript application |
| Backend API | Azure Functions (Node.js) |
| Database | Azure Cosmos DB (NoSQL) |
| Authentication | Microsoft OAuth 2.0, Google OAuth 2.0 |
| Hosting | Azure (Canada Central region) |
| Source Control | GitHub repository with CI/CD |

## 10.2 Database Structure

Azure Cosmos DB containers:

| Container | Purpose |
|---|---|
| OrgData | Organization configurations, domains, tenant IDs, allowed roles, admin emails |
| Sessions | Server-side session storage for authenticated users (Microsoft and Google) |
| Usage | Authentication events, login logging, audit trail |

### 10.2.1 OrgData Document Structure

Each organization document in the OrgData container uses this universal structure:

```
{
  "id": "",  "orgId": "",  "domains": [],  "tenantId": "",
  "emails": [],  "adminEmails": [],  "allowedEditRoles": [],
  "authProvider": "",  "configJSON": "",  "logJSON": "",
  "imageUrl": "",  "logRetentionHours": 0  }
```

**Key fields by authentication type:**

• Microsoft orgs: Set domains array, allowedEditRoles, authProvider="microsoft" (tenantId captured on first login)

• Google orgs: Set domains array, adminEmails array, authProvider="google"

• Individual users: Set emails array, adminEmails array (same email), authProvider="google"

## 10.3 API Endpoints

| Endpoint | Function |
|---|---|
| /lookupDomain | Verify organization by email domain |

| | |
|---|---|
| /loadData | Retrieve organization medication configuration |
| /saveConfig | Save medication configuration (admin only) |
| /saveLog | Save log entry (medication selection + timestamp) |
| /saveLogRetention | Configure log retention period (admin only) |
| /saveAdminEmails | Update admin emails list (Google orgs, admin only) |
| /saveAllowedRoles | Configure Azure AD roles for admin access |
| /msAuth | Microsoft OAuth callback and session creation |
| /googleAuth | Google OAuth callback |

# 11. Compliance

## 11.1 Accessibility Compliance

The NAE Dose Calculator documents conformance with:

### 11.1.1 WCAG 2.1 Level AA

Conformance with Web Content Accessibility Guidelines 2.1 Level A and Level AA success criteria is documented in the accompanying VPAT/ACR, including:

- Non-text content alternatives (alt text, aria-labels)
- Keyboard accessibility for all functionality
- Focus management and visible focus indicators
- Color contrast ratios meeting 4.5:1 minimum
- Resizable text up to 200% without loss of functionality
- Screen reader compatibility (JAWS, NVDA, VoiceOver tested)
- Error identification and prevention
- Consistent navigation and identification

### 11.1.2 Section 508 (Revised 2018)

Conformance with applicable Revised Section 508 standards is documented in the VPAT/ACR:

- Chapter 3: Functional Performance Criteria
- Chapter 5: Software (Web Application)
- Chapter 6: Support Documentation

### 11.1.3 Accessibility Features

Key accessibility implementations:

- Skip navigation link for keyboard users
- ARIA landmarks, roles, and live regions throughout
- Focus trapping in all modal dialogs (7 modals)
- Screen reader announcements for dynamic content (3-second timeout)
- Minimum 44x44 pixel touch targets
- Confirmation dialogs for destructive actions
- aria-busy states for loading content
- Proper table structure with scope attributes

## 11.2 VPAT/ACR Documentation

A complete Voluntary Product Accessibility Template (VPAT) Version 2.5 Accessibility Conformance Report (ACR) is available documenting:

- All WCAG 2.1 Level A criteria evaluations
- All WCAG 2.1 Level AA criteria evaluations
- Section 508 functional performance criteria

• Detailed remediation log of accessibility improvements

VPAT®/ACR available upon request: info@naemedsolutions.com

## 11.3 Security Compliance

Security controls are implemented appropriate to a non-PHI clinical reference tool, including OAuth-based authentication, encrypted transport, and organization-level access controls:

• OAuth 2.0 authentication (industry standard)

• Server-side session management

• Encrypted data at rest and in transit

• Role-based access control

• Audit logging of authentication events

• Organization data isolation

This product is not a HIPAA-regulated PHI system and is intended to be used without PHI.

## 11.4 Regulatory Positioning (CDS / SaMD Clarity)

### 11.4.1 Intended Use Statement

The NAE Dose Calculator is a configurable reference calculator that performs weight-based arithmetic using medication data supplied and maintained entirely by the subscribing organization. It is intended to assist—not replace—the clinical judgment of qualified healthcare professionals. All outputs must be independently verified by the end user before any clinical action is taken.

### 11.4.2 What This Product Is

• A reference calculator that multiplies user-supplied dosing parameters (mg/kg, mcg/kg/min, etc.) by a patient weight to produce a calculated dose and, where a concentration is configured, a corresponding volume.

• A blank template at onboarding: organizations supply their own medication formulary data (drug names, concentrations, dosing ranges, maximum doses, routes) through the Configuration Editor. NAE Medi Solutions LLC can assist with data entry, but the clinical accuracy of all medication content is the sole responsibility of the subscribing organization.

• An equipment-sizing reference that displays generally accepted sizing estimates based on patient weight and age using published clinical formulas (see Appendix A).

• A tool whose calculation logic is deterministic and transparent: dose = dosing parameter × weight, capped at maximum dose when configured. No clinical inference, risk scoring, diagnostic suggestion, or treatment recommendation is generated by the software.

### 11.4.3 What This Product Is Not

• Not a Clinical Decision Support (CDS) system. The calculator does not analyze patient-specific clinical data (diagnoses, lab values, allergies, drug interactions, comorbidities), does not generate alerts or recommendations, and does not suggest, modify, or withhold therapy. It performs arithmetic on organization-supplied parameters and displays the result.

• Not Software as a Medical Device (SaMD) under FDA guidance. The product does not acquire, process, or analyze medical images or signals; does not provide a diagnosis,

prognosis, or treatment plan; and does not drive or control a medical device. It is analogous to a reference card or dosing chart rendered in digital form.

• Not an electronic prescribing or medication administration system. It does not interface with EHR/EMR systems, pharmacy systems, or medication dispensing devices.

• Not a source of clinical content. NAE Medi Solutions LLC does not author, supply, or warrant the accuracy of any medication names, concentrations, dosing parameters, or maximum doses displayed in the calculator. All clinical content is entered and maintained by the subscribing organization.

### 11.4.4 Regulatory Rationale Summary

The NAE Dose Calculator is positioned as a non-regulated reference calculator based on the following rationale: (a) it performs only deterministic arithmetic on user-supplied inputs; (b) it does not incorporate patient-specific clinical data beyond weight, height, age, and sex for the purpose of calculation; (c) it does not generate clinical recommendations, alerts, or diagnoses; (d) it does not meet the IMDRF definition of SaMD because it does not inform clinical management without the independent review of a healthcare professional; and (e) organizations retain full ownership and responsibility for all clinical content configured within the tool. This positioning should be reviewed periodically as regulatory frameworks evolve.

## 11.5 Clinical Content Ownership and Update Process

Because the NAE Dose Calculator is a reference tool whose clinical accuracy depends entirely on organization-supplied formulary data, each subscribing organization should establish a governance workflow for managing its medication configuration. The following framework is recommended.

### 11.5.1 Content Ownership

• The subscribing organization owns all medication formulary data configured in the calculator, including drug names, concentrations, dosing parameters, maximum doses, routes, and dosing notes.

• NAE Medi Solutions LLC provides the calculation platform and can assist with initial data entry, but does not validate, verify, or warrant the clinical appropriateness of any medication content.

• The organization is responsible for ensuring that all configured data reflects its current institutional protocols, formulary, and applicable clinical guidelines.

### 11.5.2 Authorized Change Personnel

Organizations should designate specific individuals authorized to modify the medication configuration. It is recommended that only personnel with clinical pharmacology knowledge or equivalent training (e.g., pharmacists, medical directors, clinical educators) be granted administrator access to the Configuration Editor. Admin access is controlled through Azure AD roles (Microsoft organizations) or the adminEmails list (Google organizations) as described in Section 8.

### 11.5.3 Recommended Review Cadence

Organizations should conduct periodic reviews of their calculator configuration to ensure continued accuracy. The following cadence is recommended:

• Routine review: At least annually, or per the organization’s existing formulary review cycle.

• Triggered review: Whenever the organization updates its medication formulary, protocols, or clinical guidelines; when new medications are added or existing ones are discontinued; or when manufacturer concentration changes occur.

• Post-change validation: After any configuration change, use the Internal Test Calculator (Section 8.7) to verify dose outputs across the standard test weight scenarios before returning the calculator to clinical use.

### 11.5.4 Suggested Two-Person Verification Workflow

To reduce the risk of configuration errors, organizations are encouraged (but not required) to adopt a two-person check process for medication configuration changes. A suggested workflow is as follows:

1. Author: An authorized administrator enters or modifies medication data in the Configuration Editor and saves the change. The system automatically creates a versioned record with user attribution and timestamp (see Section 8.6).

2. Verify: A second qualified individual (e.g., pharmacist, medical director, or clinical educator) independently reviews the changes by running the Internal Test Calculator (Section 8.7), comparing outputs against hand-calculated expected values, and confirming accuracy against institutional protocols.

3. Sign-off: The reviewer documents their verification using the printed test worksheet sign-off fields (Section 8.7.7) or the organization's own sign-off process. A template sign-off table is provided in Appendix A.6.

4. Rollback: If errors are found, the reviewer or an authorized administrator can restore the previous configuration version using the version history feature (Section 8.6.3).

### 11.5.5 Platform-Provided Safeguards

While the governance workflow is the organization's responsibility, the NAE Dose Calculator platform provides the following built-in safeguards to support configuration management:

• Complete version history with user attribution and timestamps for every configuration save (Section 8.6).

• One-click version restore to roll back to any previous configuration (Section 8.6.3).

• Internal Test Calculator for automated dose verification across standard weight scenarios (Section 8.7).

• Printable verification worksheet with manual verification column and sign-off fields (Section 8.7.7).

• Role-based access control restricting configuration changes to designated administrators only (Section 9.4).

• Server-side audit logging of all configuration changes and authentication events (Section 9.5).

# 12. Support

## 12.1 Contact Information

**NAE Medi Solutions LLC**

Email: info@naemedsolutions.com

Website: https://medcalc.naemedsolutions.com

## 12.2 Reporting Issues

To report bugs, accessibility issues, or request features:

1. Email info@naemedsolutions.com with a detailed description
2. Include your browser and operating system
3. Describe the steps to reproduce any issues
4. Include screenshots if applicable

## 12.3 Accessibility Feedback

If you encounter accessibility barriers when using this product, please contact info@naemedsolutions.com. We are committed to ensuring equal access for all users and will work to address any accessibility issues promptly.

# 13. Document Version History

| Version | Date | Changes |
|---|---|---|
| 1.0 | January 24, 2026 | Initial release of User Guide |
| 1.2 | February 1, 2026 | Added Progressive Web App (PWA) and offline support documentation (Section 1.4). Added Configuration Versioning feature documentation (Section 8.6). |

*Note: The accompanying VPAT/ACR (Product Version 1.2, Report Date January 24, 2026) documents the accessibility conformance of this product version. The VPAT report date precedes this User Guide document date as accessibility testing was completed prior to final documentation.*

# Appendix A: IBW and Equipment Sizing Validation

This appendix documents the internal verification testing performed on the Ideal Body Weight (IBW) calculation methods, habitus factor adjustments, and medical equipment sizing recommendations used by the NAE Dose Calculator. All calculation methods are based on established clinical formulas and reference data. Internal verification examples are provided in this appendix.

## A.1 IBW Methods and Equations

The following methods are used for calculating Ideal Body Weight based on available patient data:

### A.1.1 Traub Formula (Height-Only)

Used for pediatric patients when only height is available (30-60 inches).

**IBW (kg) = 2.396 × e^(0.01863 × height_cm)**

Where height_cm = height_in × 2.54

### A.1.2 WHO Weight-for-Length 50th Percentile

Used for infants/toddlers with length 19.5-30 inches. Sex-specific tables with interpolation. Source: WHO Child Growth Standards, Weight-for-length tables (birth to 2 years), 2006 revision.

- Male: IBW = WHO50_male[length_in]
- Female: IBW = WHO50_female[length_in]
- Mean (sex unavailable): IBW = (WHO50_male + WHO50_female) / 2

### A.1.3 CDC BMI-for-Age 50th Percentile

Used for children ages 2-18 years with height 30-60 inches and known age. Source: CDC Growth Charts, BMI-for-age percentiles (2-20 years), 2000 revision.

**IBW (kg) = BMI50(age) × Height_m²**

Where BMI50 is the sex-specific (or mean) 50th percentile BMI for the patient's age.

### A.1.4 Luscombe Formula (Age-Only)

Used when only age is available (≥1 year). Sex is not used in this calculation.

**IBW (kg) = (3 × Age_years) + 7**

### A.1.5 Devine Formula (Adult IBW)

Used for adults (≥18 years) and as fallback for tall pediatric patients (≥60 inches).

- Male: IBW (kg) = 50 + 2.3 × (Height_in - 60)
- Female: IBW (kg) = 45.5 + 2.3 × (Height_in - 60)
- Mean (sex unavailable): IBW = (Male + Female) / 2

### A.1.6 No IBW (Height Too Short)

For patients with height < 19.5 inches, no valid IBW equation exists. Returns null.

# A.2 Reference Data Tables

The following reference tables are used for IBW calculations:

## A.2.1 WHO Weight-for-Length 50th Percentile Tables

### Male

| Length (in) | Median Weight (kg) |
|---|---|
| 19.7 | 3.3 |
| 21.7 | 4.4 |
| 23.6 | 5.6 |
| 25.6 | 6.9 |
| 27.6 | 8.3 |
| 29.5 | 9.7 |
| 31.5 | 11.1 |
| 33.5 | 12.5 |
| 35.4 | 13.8 |
| 37.4 | 15.1 |
| 39.4 | 16.4 |
| 41.3 | 17.7 |
| 43.3 | 19.0 |

### Female

| Length (in) | Median Weight (kg) |
|---|---|
| 19.7 | 3.2 |
| 21.7 | 4.2 |
| 23.6 | 5.3 |
| 25.6 | 6.5 |
| 27.6 | 7.9 |
| 29.5 | 9.2 |
| 31.5 | 10.5 |
| 33.5 | 11.8 |
| 35.4 | 13.1 |
| 37.4 | 14.4 |
| 39.4 | 15.7 |
| 41.3 | 17.0 |
| 43.3 | 18.3 |

## Mean (No Sex Input)

| Length (in) | Median Weight (kg) |
|---|---|
| 19.7 | 3.25 |
| 21.7 | 4.3 |
| 23.6 | 5.45 |
| 25.6 | 6.7 |
| 27.6 | 8.1 |
| 29.5 | 9.45 |
| 31.5 | 10.8 |
| 33.5 | 12.15 |
| 35.4 | 13.45 |
| 37.4 | 14.75 |
| 39.4 | 16.05 |
| 41.3 | 17.35 |
| 43.3 | 18.65 |

## A.2.2 CDC BMI-for-Age 50th Percentile Table

Values are in kg/m². Used with height to calculate IBW.

| Age (yr) | Male BMI-50 | Female BMI-50 | Mean BMI-50 |
|---|---|---|---|
| 2 | 16.5 | 16.4 | 16.45 |
| 3 | 16.0 | 15.9 | 15.95 |
| 4 | 15.7 | 15.6 | 15.65 |
| 5 | 15.5 | 15.4 | 15.45 |
| 6 | 15.4 | 15.3 | 15.35 |
| 7 | 15.5 | 15.4 | 15.45 |
| 8 | 15.7 | 15.6 | 15.65 |
| 9 | 16.0 | 15.9 | 15.95 |
| 10 | 16.4 | 16.3 | 16.35 |
| 11 | 16.9 | 16.8 | 16.85 |
| 12 | 17.4 | 17.3 | 17.35 |
| 13 | 18.0 | 17.9 | 17.95 |
| 14 | 18.6 | 18.5 | 18.55 |
| 15 | 19.2 | 19.1 | 19.15 |
| 16 | 19.8 | 19.7 | 19.75 |
| 17 | 20.4 | 20.3 | 20.35 |
| 18 | 21.0 | 20.8 | 20.90 |
| 19 | 21.6 | 21.3 | 21.45 |
| 20 | 22.2 | 21.7 | 21.95 |

# A.3 IBW Calculation Validation

## A.3.1 Pediatric - Height Only

Method selection: <19.5" → No IBW | 19.5-30" → WHO WFL (mean) | 30-60" → Traub | ≥60" → Devine (mean)

| Test Input | Expected | Actual | Method Used | Pass/Fail | Validator/Date |
|---|---|---|---|---|---|
| 5 in | null | null | No IBW | PASS | |
| 25 in | 6.33 kg | 6.32 kg | WHO WFL (19.5-30") | PASS | |
| 40 in | 15.90 kg | 15.90 kg | Traub (30-60") | PASS | |
| 65 in | 59.25 kg | 59.25 kg | Devine (≥60") | PASS | |

| KEY | |
|---|---|
| ■ | No IBW (<19.5") |
| □ | WHO WFL (19.5-30") - sex unavailable → mean table |
| ◉ | Traub (30-60") |
| ◇ | Devine fallback (≥60") - sex unavailable → mean Devine |

## A.3.2 Pediatric - Height + Sex

Method selection: Same as height-only but uses sex-specific WHO and Devine tables.

| Test Input | Expected | Actual | Method Used | Pass/Fail | Validator/Date |
|---|---|---|---|---|---|
| 5 in, male | null | null | No IBW | PASS | |
| 25 in, female | 6.14 kg | 6.14 kg | WHO WFL (19.5-30") | PASS | |
| 40 in, female | 15.90 kg | 15.90 kg | Traub (30-60") | PASS | |
| 65 in, male | 61.50 kg | 61.50 kg | Devine (≥60") | PASS | |

| KEY | |
|---|---|
| ■ | No IBW (<19.5") |
| □ | WHO WFL (19.5-30") - sex-specific |
| ◉ | Traub (30-60") - not sex-based |
| ◇ | Devine fallback (≥60") - sex-specific |

## A.3.3 Pediatric - Age Only

Uses Luscombe IBW formula for all ages ≥1 year. Sex is not used. Returns null for <1 year.

| Test Input | Expected | Actual | Method Used | Pass/Fail | Validator/Date |
|---|---|---|---|---|---|
| 0.5 yr | null | null | N/A (<1yr) | PASS | |
| 1.2 yr | 10.6 kg | 10.6 kg | Luscombe IBW | PASS | |
| 6 yr | 25 kg | 25 kg | Luscombe IBW | PASS | |
| 17 yr | 58 kg | 58 kg | Luscombe IBW | PASS | |

| KEY | |
|---|---|
| ◉ | Luscombe IBW (age-only; sex not used, only for ≥1yr old) |

## A.3.4 Pediatric - Age + Height + Sex

Method selection: <19.5" → No IBW | 19.5-30" → WHO WFL | 30-60" → CDC BMI-50 | ≥60" → Devine

| Test Input | Expected | Actual | Method Used | Pass/Fail | Validator/Date |
|---|---|---|---|---|---|
| 0.5yr, 18in, male | null | null | No IBW | PASS | |
| 2yr, 29in, female | 8.9 kg | 8.9 kg | WHO WFL-50 (female) | PASS | |
| 5yr, 39in, no sex | 15.16 kg | 15.16 kg | CDC BMI-50 (mean) | PASS | |
| 15yr, 66in, male | 54 kg | 53.96 kg | CDC BMI-50 (male) | PASS | |

| KEY | |
|---|---|
| ■ | No IBW (<19.5") |
| □ | WHO WFL (19.5-30") - sex-specific (mean without sex input) |
| ● | CDC BMI-50 (30-60") - sex-specific (mean without sex input) |
| ◇ | Devine fallback (≥60") - sex-specific (mean without sex input) |

## A.3.5 Adult - Height Only

Uses Devine mean formula for all heights ≥60 inches when sex unavailable.

| Test Input | Expected | Actual | Method Used | Pass/Fail | Validator/Date |
|---|---|---|---|---|---|
| 45 in | null | null | No IBW | PASS | |
| 60 in | 47.8 kg | 47.75 kg | Devine (mean) | PASS | |
| 66 in | 61.6 kg | 61.55 kg | Devine (mean) | PASS | |
| 80 in | 93.8 kg | 93.75 kg | Devine (mean) | PASS | |

| KEY | |
|---|---|
| ◇ | Devine IBW (sex unavailable → Devine mean) |

## A.3.6 Adult - Height + Sex

Uses sex-specific Devine formula.

| Test Input | Expected | Actual | Method Used | Pass/Fail | Validator/Date |
|---|---|---|---|---|---|
| 45 in, Female | null | null | No IBW | PASS | |
| 60 in, Male | 50 kg | 50 kg | Devine IBW | PASS | |
| 66 in, Female | 59.3 kg | 59.3 kg | Devine IBW | PASS | |
| 88 in, Male | 114.4 kg | 114.4 kg | Devine IBW | PASS | |

| KEY | |
|---|---|
| ◇ | Devine IBW (sex-specific formula) |

# A.4 Habitus Factor Adjustment

## A.4.1 Methodology

For each sex and age (or length) bin, a 7-point habitus scale (1-7) is anchored to CDC weight-for-age percentiles P10, P25, P50, P75, P90, P95, and P97.

**Habitus Score Mapping:**

1 → P10 (underweight)

2 → P25

3 → P50 (baseline/normal)

4 → P75

5 → P90

6 → P95

7 → P97 (overweight/obese)

**The habitus factor is calculated as:**

Habitus Factor = W_hab / W_50

Where W_hab is the weight at the selected percentile and W_50 is the median (P50) weight.

**Final adjusted weight:**

W_adj = IBW × Habitus Factor

## A.4.2 Habitus Factor Validation Tests

| Test ID | IBW (kg) | Habitus | Sex | Factor | Expected | Actual | Pass | Test Purpose |
|---|---|---|---|---|---|---|---|---|
| HAB-001 | 20 | 3 | male | 1.000 | 20.00 kg | 20.00 kg | PASS | P50 baseline (no adjustment) |
| HAB-002 | 20 | 1 | male | 0.852 | 17.04 kg | 17.04 kg | PASS | P10 underweight |
| HAB-003 | 20 | 7 | male | 1.348 | 26.96 kg | 26.96 kg | PASS | P97 overweight |
| HAB-004 | 30.04 | 5 | female | 1.314 | 39.47 kg | 39.47 kg | PASS | P90 female |
| HAB-005 | 15 | 4 | male | 1.083 | 16.25 kg | 16.25 kg | PASS | P75 male |
| HAB-006 | 22.5 | 3 | male | 1.000 | 22.50 kg | 22.50 kg | PASS | Interpolated IBW |
| HAB-007 | 17.5 | 6 | female | 1.345 | 23.54 kg | 23.54 kg | PASS | Interpolated IBW |
| HAB-008 | 50 | 3 | male | 1.000 | 50.00 kg | 50.00 kg | PASS | Boundary test (50kg) |
| HAB-009 | 25.08 | 2 | — | 0.900 | 22.57 kg | 22.57 kg | PASS | P25 sex unknown (mean) |
| HAB-010 | 35.02 | 5 | — | 1.326 | 46.44 kg | 46.44 kg | PASS | P90 sex unknown (mean) |

# A.5 Equipment Sizing Validation

Equipment sizing tests across standard patient profiles. Age-based methods are preferred when available; weight is used as fallback.

Note: For age-only input, IBW function must be used to derive weight for certain equipment.

*PASS indicates the output matches the intended clinical recommendation after standard clinical rounding; minor differences that do not change the recommended size or range are considered acceptable.*

## A.5.1 Airway Management

### Cuffed ETT Size (mm ID)

Age-based: (Age/4) + 3.5 for <18yr; Adult defaults for ≥18yr

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 4 | 5.5 | 7 | 3.5 | 5 | 7 | 4.5 | 7 |
| **Actual** | 4 | 5.5 | 7 | 3.5 | 5 | 7 | 4.5 | 7 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

### Cuffed ETT Insertion Depth (cm)

Pediatric: 3 × ETT diameter (mm); Adult: Male 23cm, Female 21cm, Unknown 22cm

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 12.0 | 16.5 | 21.0 | 10.5 | 15.0 | 21.0 | 13.5 | 21.0 |
| **Actual** | 12.0 | 16.5 | 22.0 | 10.5 | 15.0 | 22.0 | 13.5 | 22.0 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

### Uncuffed ETT Size (mm ID)

Age-based: (Age/4) + 4.0 for <18yr

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 4.5 | 6 | 7.5 | 3.5 | 5.5 | 7.5 | 5 | 7.5 |
| **Actual** | 4.5 | 6 | 7.5 | 3.5 | 5.5 | 7.5 | 5 | 7.5 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

### Uncuffed ETT Insertion Depth (cm)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 13.5 | 18.0 | 22.5 | 10.5 | 16.5 | 22.5 | 15.0 | 22.5 |
| **Actual** | 13.5 | 18.0 | 22.0 | 10.5 | 16.5 | 22.0 | 15.0 | 22.0 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## Laryngoscope Blade

Age-preferred with weight fallback

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | Miller 2 | Mac 2 | Mac 4 | Miller 1-2 | Mac 2-3 | Mac 4 | Mac 2 | Mac 4 |
| **Actual** | Miller 2 | Mac 2 | Mac 4 | Miller 1-2 | Mac 2-3 | Mac 4 | Mac 2 | Mac 4 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## OPA Size (mm)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 60 | 70 (child) | 100 (adult) | 50-60 | 70-80 | 90-100 | 70 (child) | 100 (adult) |
| **Actual** | 60 | 70 (child) | 100 (adult) | 50-60 | 70-80 | 90-100 | 70 (child) | 100 (adult) |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## NPA Size (mm ID)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 3.5-4.0 | 4.0-5.0 | 7.0-8.0 | 3.0-4.0 | 5.0-6.0 | 7.0-8.0 | 4.0-5.0 | 7.0-8.0 |
| **Actual** | 3.5-4.0 | 4.0-5.0 | 7.0-8.0 | 3.0-4.0 | 5.0-6.0 | 7.0-8.0 | 4.0-5.0 | 7.0-8.0 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## BVM Mask Size

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | Child | Child | Adult | Infant | Small Adult | Adult | Child | Adult |
| **Actual** | Child | Child | Adult | Infant | Small Adult | Adult | Child | Adult |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## Suction Catheter (Fr)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 10 | 12 | 16 | 8 | 12 | 16 | 10 | 16 |
| **Actual** | 10 | 12 | 16 | 8 | 12 | 16 | 10 | 16 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

# A.5.2 Cardiovascular

## Defibrillation - Pulseless (J)

Weight × 2 to Weight × 4 joules; Adult fallback: 200-360J. Adult defibrillation may default to an initial 200 J with escalation per protocol.

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 20-40 | 44-88 | 200-360 | 8-16 | 72-144 | 160-320 | 44-88 | 200-360 |
| **Actual** | 21-42 | 56-112 | 200-360 | 8-16 | 72-144 | 160-200 | 44-88 | 200-360 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## Cardioversion - With Pulse (J)

Weight × 1 to Weight × 2 joules; Adult fallback: 50-200J

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 10-20 | 22-44 | 50-200 | 4-8 | 36-72 | 80-160 | 22-44 | 120-200 |
| **Actual** | 11-21 | 28-56 | 50-200 | 4-8 | 36-72 | 80-160 | 22-44 | 120-200 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## IO Needle

<3kg: 15mm (pink); <40kg: 25mm (blue); ≥40kg: 45mm (yellow)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 25mm (blue) | 25mm (blue) | 25-45mm | 25mm (blue) | 25mm (blue) | 45mm (yellow) | 25mm (blue) | 45mm (yellow) |
| **Actual** | 25mm (blue) | 25mm (blue) | 25-45mm | 25mm (blue) | 25mm (blue) | 45mm (yellow) | 25mm (blue) | 45mm (yellow) |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

# A.5.3 Tubes and Catheters

## NG Tube (Fr)

Age-preferred with weight fallback

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 8 | 10 | 16 | 8 | 12 | 16 | 10 | 16 |
| **Actual** | 8 | 10 | 16 | 8 | 12 | 16 | 10 | 16 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## OG Tube (Fr)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 10 | 12 | 16 | 8 | 12 | 16 | 12 | 16 |
| **Actual** | 10 | 12 | 16 | 8 | 12 | 16 | 12 | 16 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## Foley Catheter (Fr)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 6 | 8 | 14 | 6 | 10 | 14 | 8 | 14 |
| **Actual** | 6 | 8 | 14 | 6 | 10 | 14 | 8 | 14 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

## Chest Tube (Fr)

| Test Input → | 1.2 yr | 7 yr | 19 yr | 4 kg | 36 kg | 80 kg | 4yr, 22kg | 33yr, 120kg |
|---|---|---|---|---|---|---|---|---|
| **Expected** | 16 | 20 | 28 | 12 | 20 | 28 | 16 | 28 |
| **Actual** | 16 | 20 | 28 | 12 | 20 | 28 | 16 | 28 |
| **Pass/Fail** | P | P | P | P | P | P | P | P |

# A.6 Optional Organization Validation Sign-Off (Template)

This appendix provides internal verification test cases for reference. Organizations are responsible for their own clinical review and approval prior to use.

| Role | Name / Signature | Date |
|---|---|---|
| Validator | | |
| Clinical Reviewer | | |
| QA Approval | | |
| Final Approval | | |