

Why Do Pipetting Errors Affect Experimental Results?

Causes and Practical Solutions

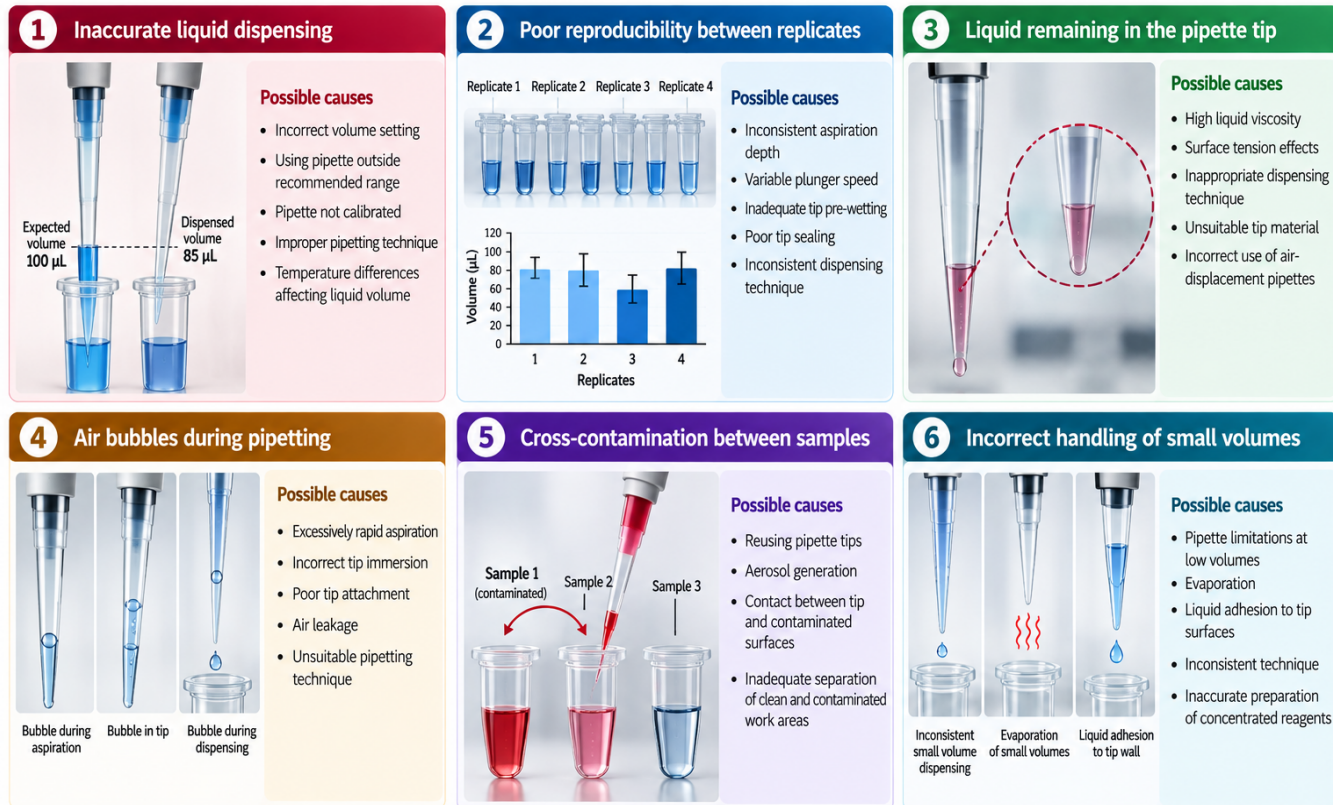
Introduction

Accurate pipetting is fundamental to almost every laboratory workflow, including PCR, ELISA, cell culture, chemical analysis, and sample preparation.

Even small liquid-handling errors can significantly affect experimental outcomes, particularly when working with low-volume reactions or sensitive analytical methods.

Understanding the causes of pipetting errors helps researchers improve precision, accuracy, and reproducibility.

Common Pipetting Errors and Their Effects on Experimental Results



1. Inaccurate Liquid Dispensing

The Problem

The volume delivered differs from the intended volume.

Possible Causes

- Incorrect pipette volume setting.
- Pipette used outside its recommended range.

- Calibration problems.
- Inappropriate pipetting technique.
- Temperature differences between the liquid, pipette, and environment.

Practical Solutions

Choose a pipette suitable for the required volume and follow the manufacturer's operating instructions.

Use calibrated equipment and appropriate pipetting techniques.

Practical tip: Avoid routinely dispensing volumes at the extreme lower limit of a pipette's operating range when a more suitable pipette is available.

2. Poor Reproducibility Between Replicates

The Problem

Repeated dispensing of the same nominal volume produces inconsistent results.

Possible Causes

- Inconsistent aspiration depth.
- Variable plunger speed.
- Inadequate tip pre-wetting.
- Poor tip sealing.
- Inconsistent dispensing technique.

Practical Solutions

Maintain a consistent pipetting angle, immersion depth, aspiration speed, and dispensing procedure.

Pre-wet tips when recommended for the liquid and pipetting method.

3. Liquid Remaining Inside the Pipette Tip

The Problem

Part of the aspirated liquid remains inside the tip after dispensing.

Possible Causes

- High liquid viscosity.
- Inappropriate dispensing technique.
- Unsuitable tip material.
- Incorrect use of air-displacement pipettes.

Practical Solutions

Use a pipetting technique suitable for the liquid properties.

Reverse pipetting may improve handling of certain viscous or foaming liquids, while positive-displacement pipettes can be useful for difficult liquids.

Low-retention tips may reduce sample loss in appropriate applications.

4. Air Bubbles During Pipetting

The Problem

Air bubbles appear during aspiration or dispensing, causing inconsistent liquid volumes.

Possible Causes

- Excessively rapid aspiration.
- Incorrect tip immersion.
- Poor tip attachment.
- Air leakage.
- Unsuitable pipetting technique.

Practical Solutions

Aspirate smoothly, maintain appropriate tip immersion, and ensure the tip is securely attached.

Inspect pipettes for leakage or mechanical problems when bubbles occur repeatedly.

5. Cross-Contamination Between Samples

The Problem

Material from one sample is unintentionally transferred into another.

Possible Causes

- Reusing pipette tips.
- Aerosol generation.
- Contact between tips and contaminated surfaces.
- Inadequate separation of clean and contaminated work areas.

Practical Solutions

Use fresh tips between samples and aerosol-resistant filter tips when appropriate.

Follow established contamination-control procedures, especially for PCR and nucleic acid workflows.

6. Incorrect Handling of Small Volumes

The Problem

Very small-volume reactions produce inconsistent results.

Possible Causes

- Pipette limitations near the minimum operating volume.
- Evaporation.
- Liquid adhesion to tip surfaces.
- Inconsistent technique.
- Inaccurate preparation of concentrated reagents.

Practical Solutions

Use a pipette designed for the required volume range.

Where scientifically appropriate, prepare intermediate dilutions to reduce the need for extremely small dispensing volumes.

Quick Troubleshooting Reference

Problem	Possible Cause	Recommended Check
Incorrect volume	Calibration or technique	Verify pipette performance
Variable replicates	Inconsistent aspiration	Standardize pipetting technique
Liquid retention	Viscosity or tip interaction	Consider low-retention tips
Air bubbles	Rapid aspiration or leakage	Inspect technique and tip fit
Cross-contamination	Aerosols or reused tips	Use fresh filter tips
Small-volume errors	Pipette range limitations	Select an appropriate pipette

Conclusion

Pipetting accuracy and precision are essential for reliable laboratory results.

Proper pipette selection, calibration, consistent technique, and suitable consumables can significantly reduce experimental variability.

Researchers should also consider liquid properties, environmental conditions, and contamination risks when choosing liquid-handling methods.

Relevant Laboratory Products

EMDA International supplies micropipettes, filter tips, low-retention tips, pipette controllers, and other liquid-handling consumables for laboratory research.

Email Now: sales@emdainternational.com

For research use only. Follow manufacturer instructions and applicable laboratory quality procedures.