# Best Evidence Statement (BESt)

**Date published/posted**

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***Topic and/or question as originally asked***

How much waste should be drawn from an intravenous saline-well catheter to obtain a subsequent undiluted blood sample?

**Clinical Question**

| | |
|---|---|
| P (population/problem) | In adult patients with intravenous saline well catheters who are undergoing testing, |
| I (intervention) | does 1ml of "waste" blood obtained prior to the actual blood specimen, |
| C (comparison) | compared to 5ml of "waste" blood obtained prior to the actual blood sample |
| O (outcome) | provide samples that produce accurate serum sodium levels? |

**Target Population**

Adult patients with intravenous saline well catheters who need lab specimens obtained.

**Recommendation(s)**

There is insufficient evidence and lack of consensus to make a recommendation on the minimum amount of blood wastage needed to permit effective samples in adult patients. (Davies, et al, 2000 4b; Herr et al, 1990 4a; Yucha & DeAngelo, 1996 4a; Zlotowski, et al, 2001 4a.)

It is recommended that a research study be conducted to determine the minimum amount of blood wastage needed to permit effective undiluted blood specimen (renal panel) to add to the body of knowledge on this topic.

There is no current Saline Well Policy at Cincinnati Children's Hospital Medical Center (CCHMC).

**Discussion/summary of evidence**

Yucha and DeAngelo (1996, 4a) studied nine healthy adults and compared hematocrit readings of blood obtained from an IV catheter following waste draws of 1 mL, 1.5 mL, and 2.5 mL to the average hematocrit readings of blood obtained from blood drawn from an IV catheter following more than 2.5 mL of waste. They concluded, with 95% confidence, that there was no difference in hematocrit readings between blood obtained following 1.5 mL of waste (three times the dead space of the catheter used) and the subjects' true hematocrit reading, which they defined as the average of the hematocrit readings drawn after at least 2.5 mL of waste was drawn.

Davies, Mehr, and Morley (2000, 4b) studied sodium levels of blood obtained through an IV catheter following waste draws of 0.6 mL, 0.9 mL, 1.3 mL, and 1.6 mL. These values were compared to a control sodium level that was obtained through the IV catheter following a 10 mL waste. They concluded that drawing 1.6 mL of waste prior to obtaining a blood sample was adequate to obtain accurate sodium levels. A confidence percentage was not included in this study.

Zlotowski, Kupas, & Wood (2001, 4a) studied 33 healthy volunteers and compared venipuncture to IV catheter with no waste drawn to IV catheter with a 12 mL waste drawn. They report a 95% confidence

 

interval of 0.81-1.32, indicating that 16 of the 19 laboratory tests that they evaluated were similar. Using a 99 % agreement interval, potassium, bicarbonate, and glucose were the three tests that did not meet the predetermined clinical criteria. There were differences in potassium, bicarbonate, and glucose in three samples between the venipuncture sample and sample following no waste or a 12 mL waste due to laboratory error.

Herr and colleagues (1990, 4a) studied 38 subjects and compared blood obtained via venipuncture to blood obtained from an IV catheter with no waste drawn first and then with 5 mL of waste drawn first. They analyzed the blood samples for CBC, electrolytes, BUN, creatinine, and glucose. They concluded, with 95% confidence, that only bicarbonate values were clinically and statistically different between the three samples.

In summary, there have been few studies that have examined the minimum volume of waste required to be drawn from an indwelling peripheral IV catheter to provide a subsequent undiluted blood sample. Two of the studies that addressed volume of waste compared lab values obtained following waste samples of varying volumes to either an average lab value drawn from the same IV catheter (Yucha & DeAngelo, 1996, 4a) or to a lab value drawn from the same IV catheter following a large waste volume (Davies, Mehr, & Morley, 2000, 4b). The assumption made by these investigators is that an average of the lab values of all samples obtained with greater than 2.5 mL of waste (Yucha & DeAngelo, 1996, 4a) or the lab value obtained following 10 mL (Davies, Mehr, & Morley, 2000, 4b) are accurate estimations of true undiluted lab values.

In addition, two studies compared blood obtained via venipuncture to blood obtained via IV catheters following varying volumes of waste. Zlotowski, Kupas, & Wood (2001, 4a) found that many lab values were similar in blood obtained via venipuncture and blood obtained after no waste or 12 mL of waste. Any difference in lab value is assumed to be laboratory processing error. In the sample with no waste drawn, the investigators obtained 12 mL of blood from the IV catheter following a flush. While there may have been normal saline or heparinized saline in the catheter, drawing a 12 mL sample did not result in enough dilution to alter lab values. Herr and colleagues (1990, 4a) found that for the majority of tests, blood obtained through venipuncture, an IV catheter with no waste drawn first, and an IV catheter with 5 mL of waste drawn first were similar. Neither of these studies examines blood drawn after smaller increments of waste draws. They both examined a blood sample that was relatively large (5 mL or 12 mL) and minimal dilution may not have altered lab values.

These four studies show moderate grade of evidence due to studies reporting inconsistent results. Further research would be beneficial in this area.

## Health Benefits, Side Effects and Risks

Health Benefits - Identifying the minimum amount of waste required prior to obtaining a blood specimen from a saline well could result in a smaller amount of unnecessary wasted blood being removed.
Side Effects - Discomfort associated with IV insertion, risk of bruising, and risk of infection.

## References/citations

**Note:** When using the electronic version of this document "_____☜" refers to journal articles that have a hyperlink to the PubMed abstract. A second hyperlink http://xxxxxxxxxxxxxxxxxxxxxxxx after the symbol will access a PDF of the full article for those who have access to the CCHMC network..

Davies, M., Mehr, S., & Morley, C. (2000). The Effect of Draw-up Volume on the Accuracy of Electrolyte Measurements from Neonatal Arterial Lines. *J Paediatr Child Health, 36(2)*, 122-124. (Level of Evidence 4b, Longitudinal) _____ ☜. _____ .

 

Herr, R. et al. (1990). Intravenous Catheter Aspiration for Obtaining Basic Analytes during Intravenous Infusion. *Annals of Emergency Medicine, 19:7,* 789-792. (Level of Evidence 4a, Longitudinal) _____ ☜ .

Yucha, C., & DeAngelo, E. (1996). the Minimum Discard Volume: Accurate Analysis of Peripheral Hematocrit. *The Journal of Intravenous Nursing, 19,* 141-146. (Level of Evidence 4a, Longitudinal) _____ ☜ _____.

Zlotowski, S., Kupas, D., & Wood, G. (2001). Comparison of Laboratory Values Obtained by Means of Routine Venipuncture versus Peripheral Intravenous Catheter after a Normal Saline Solution Bolus. *Annals of Emergency Medicine, 38:5,* 497-504. (Level of Evidence 4a, Longitudinal) _____ ☜ _____ .

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Note: Full tables of evidence grading system available in separate document:

- Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality (abbreviated table below)
- Grading a Body of Evidence to Answer a Clinical Question
- Judging the Strength of a Recommendation (abbreviated table below)

**Table of Evidence Levels** (see note above)

| ***Quality level*** | ***Definition*** |
|---|---|
| 1a† or 1b† | Systematic review, meta-analysis, or meta-synthesis of multiple studies |
| 2a or 2b | Best study design for domain |
| 3a or 3b | Fair study design for domain |
| 4a or 4b | Weak study design for domain |
| 5 | Other: General review, expert opinion, case report, consensus report, or guideline |

†a = good quality study; b = lesser quality study

**Table of Recommendation Strength** (see note above)

| ***Strength*** | ***Definition*** |
|---|---|
| "Strongly recommended" | There is consensus that benefits clearly outweigh risks and burdens (or visa-versa for negative recommendations). |
| "Recommended" | There is consensus that benefits are closely balanced with risks and burdens. |
| No recommendation made | There is lack of consensus to direct development of a recommendation. |

***Dimensions:*** In determining the strength of a recommendation, the development group makes a considered judgment in a consensus process that incorporates critically appraised evidence, clinical experience, and other dimensions as listed below.

1. Grade of the Body of Evidence (see note above)
2. Safety / Harm
3. Health benefit to patient *(direct benefit)*
4. Burden to patient of adherence to recommendation *(cost, hassle, discomfort, pain, motivation, ability to adhere, time)*
5. Cost-effectiveness to healthcare system *(balance of cost / savings of resources, staff time, and supplies based on published studies or onsite analysis)*
6. Directness *(the extent to which the body of evidence directly answers the clinical question [population/problem, intervention, comparison, outcome])*
7. Impact on morbidity/mortality or quality of life

 

## Supporting information

### Introductory/background information

Patients undergoing testing in a hospital setting often will have a peripheral indwelling intravenous catheter inserted. The IV may be used to infuse medications or converted to a saline well to obtain frequent blood samples. After an n IV catheter is inserted, the catheter is flushed with 2 mLs of 0.9% normal saline to flush the blood out of the catheter and ensure patency of the IV. Before the next blood sample is obtained, a "waste" sample is drawn to remove the saline or heparin that was in the catheter. The purpose of this evidence evaluation is to investigate how to minimize the volume of waste required to be drawn from an indwelling intravenous catheter to obtain a subsequent undiluted blood sample.

### Group/team members

*Group/Team Leader:* Michelle Lawrence RNIII, MSN, A3S

*Other group/team members:* Rachel Baker RN PhD Research Nurse II, A3S
Suzanne Summer RD, MS Bionutritionist, CRC
Amy Shova BS Clinical Research Coordinator II, CRC
Cathy McGraw BA Application Specialist III, CRC

### Search strategy

**OVID Databases**
Medline, CINAHL, and Cochrane Databases for Systematic Reviews

**PubMed Databases** Clinical Queries for Systematic Review

**Scopus Databases** Clinical Queries for Systematic Review

**Filters:**

| | |
|---|---|
| Publication Date | 1980 to present |
| Limits | Humans and English language |

**Search Terms:**
"intravenous catheter", "IV catheter", "indwelling catheter", "blood", "blood sample", "waste", "volume", "dilution", "blood specimen", "catheter", "sample dilution", "specimen dilution", and "saline well".

### Known conflicts of interest

All team members have signed a conflict of interest declaration and none were found.

### Applicability issues

Because insufficient evidence to guide practice was found, a research study is planned to be conducted in the CRC at CCHMC.



 

electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at HPCEInfo@cchmc.org for any BESt adopted, adapted, implemented or hyperlinked by the organization is appreciated.

*For more information about CCHMC Best Evidence Statements and the development process, contact the Center for Professional Excellence/Research and Evidence-based Practice office at* ***CPE-EBP-Group@chmcc.org*** .

## Note

**This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.**

## Reviewed by Center for Professional Excellence