

# Characterization of medications as a source of fluids in the medical intensive care unit

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## INTRODUCTION

- Fluids are among the most common medications used in the intensive care unit (ICU) setting<sup>1</sup>
- Positive fluid balance in critically ill patients has been associated with increased mortality in the first 72 hours, increased use of renal replacement therapy, increased acute kidney and acute lung injury, and increased duration of mechanical ventilation<sup>2,3</sup>
- Positive fluid balance may be secondary to unrecognized or “hidden” sources of fluids such as intravenous (IV) medications<sup>2,4</sup>

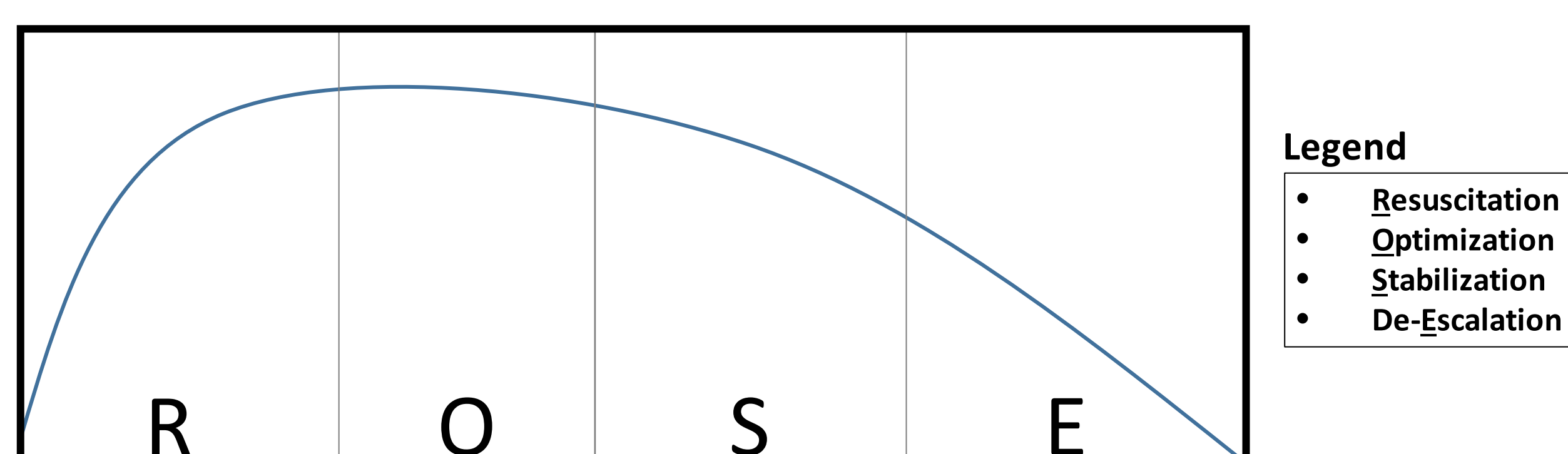


Figure 1. Fluid Resuscitation Strategy<sup>5</sup>

- Evaluation of IV medications may improve management in the Optimization Phase of Fluid Resuscitation

## PURPOSE

The purpose of this study was to characterize medications as a source of fluids in critically ill patients

## METHODS

- A retrospective review of electronic medical records of medical ICU patients was conducted
- Patients  $\geq 18$  years of age and admitted to the ICU for over 72 hours were included
- Patients with a diagnosis of diabetes insipidus or diabetic ketoacidosis or who were pregnant were excluded
- Data collected included patient demographics, milliliters of fluids administered, and types of IV medications administered
- The primary objective of this study was to identify the classes of IV medications contributing the greatest amount of fluids to critically ill patients during the first 72 hours of the ICU admission
- This project is part of the health system medication use evaluation (MUE) and improvement program, which has been reviewed by the Augusta University Institutional Review Board and determined not to be human subject research

## DISCLOSURES

The authors have no conflicts of interest to disclose

## RESULTS

Table 1. Patient Demographics

Characteristics	n = 75
Mean age (yr)	60 $\pm$ 14.8
Male	41 (54.7%)
Caucasian	37 (49.3%)
Admission weight (kg)	87.6 $\pm$ 11.5
SOFA score	5.9 $\pm$ 2.8
Septic on Admission	37 (49.3%)
Co-morbidities	
Chronic Lung Disease	26 (34.7%)
Heart Disease	21 (37.3%)
EF < 40%	8 (10.7%)
Atrial Fibrillation	6 (9.3%)
Chronic Liver Disease	9 (12%)
CKD	17 (22.7%)
Cancer	11 (14.7%)

Table 2. Mean Volume of IV medications (mL)

Class (n=75)	72 Hours (mL)	Day 1 (mL)	Day 2 (mL)	Day 3 (mL)
Antibiotics	102,610 (1,368)	32,900 (439)	36,960 (493)	31,750 (437)
Pain, agitation & delirium (PAD)	31,128 (415)	6,805 (91)	12,440 (166)	11,882 (159)
Vasoactive medications	27,937 (373)	7,299 (373)	12,293 (164)	8,345 (111)
Electrolytes	22,465 (300)	8,295 (111)	8,060 (108)	6,110 (82)
Sodium Bicarbonate	13,717 (183)	6,252 (83)	7,465 (100)	0 (0)
Anticoagulations	10,988 (147)	2,094 (28)	4,481 (60)	4,413 (59)
Anti-arrhythmics	4,116 (55)	1,401 (19)	1,450 (19)	1,265 (17)
Albumin	3,550 (47)	1,400 (19)	1,900 (25)	250 (3)
Anticonvulsants	3,170 (42)	950 (12.67)	1,060 (60)	1,160 (16)
PPI Drips	2,983 (40)	538 (7)	1,275 (17)	1,170 (16)
Flushes	2,730 (36)	540 (7)	1,090 (15)	1,100 (15)
Antifungals	1,950 (26)	250 (3)	750 (10)	950 (13)
Insulin	1,150 (15)	183 (2)	356 (5)	611 (8)
Dextrose	568 (8)	250 (3)	118 (2)	200 (3)
PPI bolus	510 (7)	210 (3)	200 (3)	100 (1)
Diuretics	225 (3)	76 (1)	40 (1)	110 (1)
Antivirals	100 (1)	100 (1)	0 (0)	0 (0)
Total	490,185 (6,536)	202,757 (2,703)	176,558 (2,354)	110,869 (1,478)

\*All data displayed as n (%) or mean  $\pm$  standard deviation unless otherwise noted

Figure 2. Average Fluid Administration (mL) Over 72 Hours

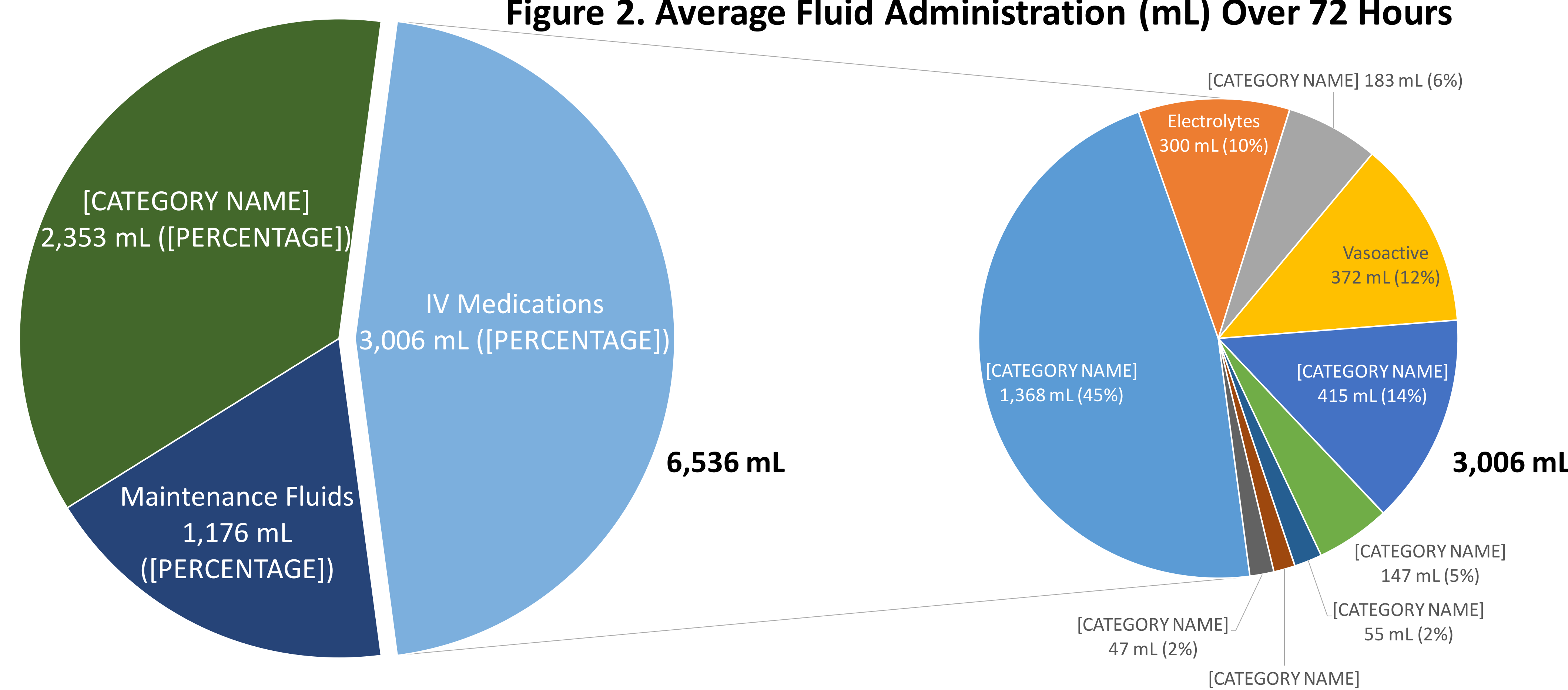
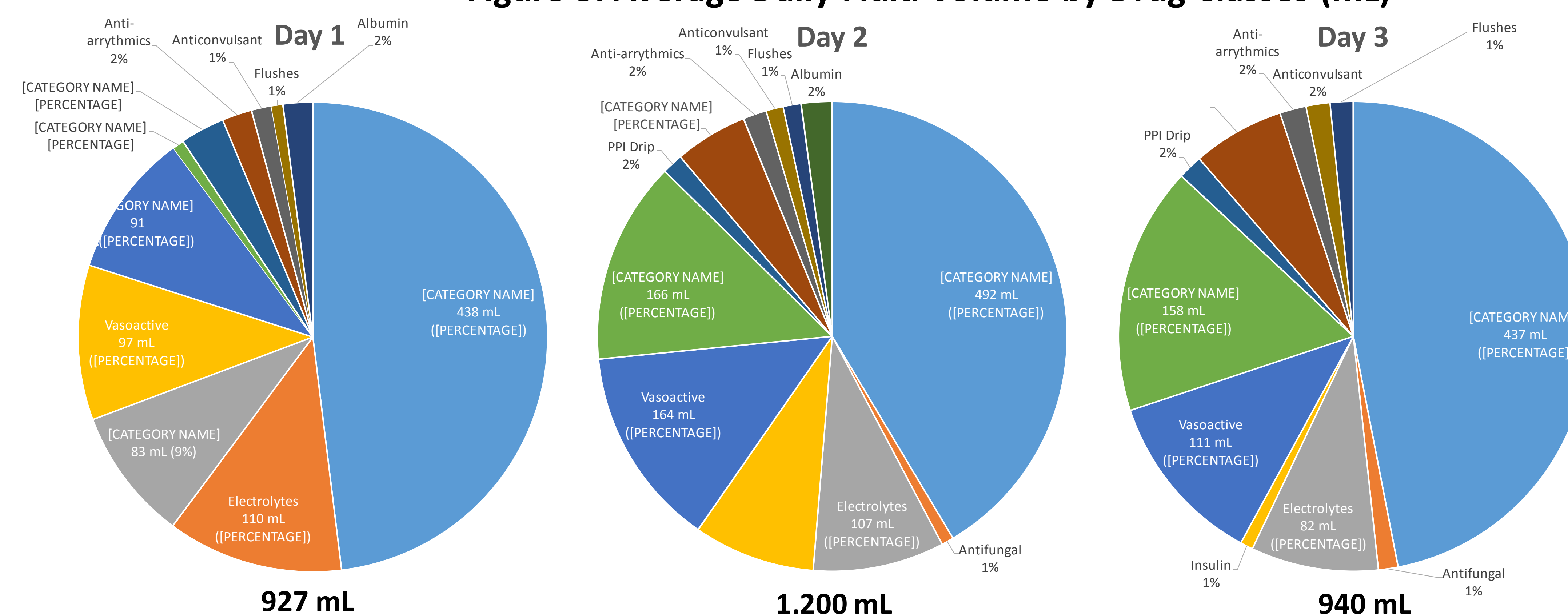


Figure 3. Average Daily Fluid Volume by Drug Classes (mL)



## DISCUSSION

- At 72 hours, patients received on average 1,368 mL  $\pm$  353 mL of antibiotics, 415 mL  $\pm$  188 mL of PAD medications, and 373 mL  $\pm$  294 mL of vasoactive agents
- IV medications are a major contributor to total fluid intake, especially in the first 48 hours
- The biggest contributors, in order of contribution, were antibiotics, PAD medications, vasoactive agents, and electrolytes

## CLINICAL IMPLICATIONS

- Standardized concentrations of antibiotics, PAD medications, and vasoactive agents may optimize the amount of fluid received from IV medications in critically ill patients
- Providers should incorporate IV medications into evaluation of fluid therapy when throughout the different stages of fluid resuscitation (ROSE)
- This study highlights the potential for daily interventions regarding fluid concentration and IV to oral conversions

## NEXT STEPS

- Systematic quality improvement initiatives regarding protocols for standard concentrations should be reviewed in order to reduce total fluid intake from IV medications
- Further study should be conducted to evaluate the relationship between medication-related fluid sources and patient outcomes

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