

INTRODUCTION

- Despite being the most commonly ordered medication in the critical care setting, mismanagement of intravenous fluids resulting in a positive fluid balance or “fluid overload” state is common in patients being treated for sepsis¹
- However, the guidelines lack recommendations for fluid management in the optimization phase, after resuscitation has taken place. The 2015 FENICE study revealed that discontinuing non-beneficial fluids is sometimes forgotten²
- Certain disease states such as acute renal injury, congestive heart failure, and aneurysmal subarachnoid hemorrhage tend to have poorer outcomes with an excessive fluid balance.³ This issue is compounded with the addition “hidden fluids” in the form of flushes, nutrition, and medication
- Despite the correlation between excess fluid and poor outcomes, the role of IV medications, flushes, and nutrition in contributing to fluid status is largely uncharacterized

PURPOSE

The purpose of this study was to characterize the contribution of “hidden fluids” (i.e. intravenous medications including flushes, blood products, and nutrition) on overall fluid intake in critically ill patients.

METHODS

Design:

- Single-site, retrospective chart review of patients who were admitted to the medical intensive care unit (MICU) from January 1, 2017 to April 1, 2018
- Comorbidities, demographics, input/output, SOFA scores and patient outcomes were collected
- 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 subjects research

Inclusion Criteria:

- Patients ≥ 18 years admitted to the MICU for at least 72 consecutive hours

Exclusion Criteria:

- Patients with diabetes insipidus, diabetic ketoacidosis, or are pregnant

RESULTS

Patient Demographics and Characteristics*

Table 1.

	N = 75
Mean age (yr) ± SD	60 ± 14.8
Male, %	41 (54.7%)
Caucasian, %	37 (49.3%)
Admission weight, mean (kg) ± SD	87.6 ± 11.5
SOFA score, mean ± SD	5.9 ± 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.

	N = 75
Mechanically Ventilated, %	53 (70.7%)
Mechanical ventilator days, mean ± SD	7.8 ± 14.2
Mechanical ventilator free days, mean ± SD	8.7 ± 9.0
New Onset Atrial Fibrillation	5 (6.7%)
New RRT	5 (6.7%)
Total Mortality, %	13 (17.3%)
ICU LOS, mean ± SD	8.56 ± 9.3
Hospital LOS, mean ± SD	16.6 ± 15.5

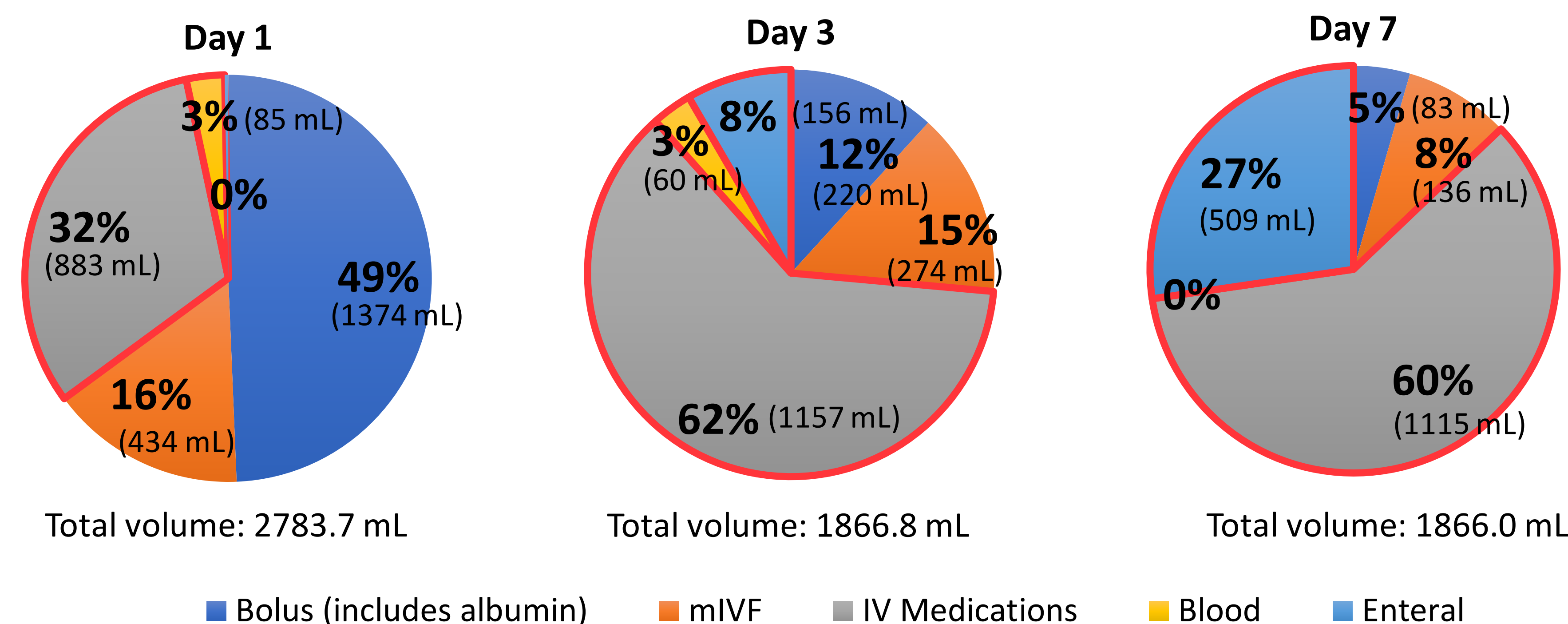
*all data are displayed as N (%) or mean ± SD unless otherwise noted

Average IV Fluid Contribution Per Patient*

Table 3.

Day	Patients	Bolus	mIVF	IV Meds	Blood	Enteral	Total
1	75	1373.9 mL (49.4%)	433.8 mL (15.6%)	883.48 mL (31.7%)	84.56 mL (3.0%)	8.00 mL (0.3%)	2783.7 mL
2	75	536.3 mL (21.1%)	614.4 mL (24.2%)	1272.24 mL (50.1%)	82.60 mL (3.3%)	33.53 mL (1.3%)	2539.1 mL
3	75	219.8 mL (11.8%)	273.9 mL (14.7%)	1156.86 mL (62.0%)	59.81 mL (3.2%)	156.47 mL (8.4%)	1866.8 mL
4	62	190.0 mL (10.4%)	155.2 mL (8.5%)	1124.77 mL (61.3%)	26.90 mL (1.5%)	337.08 mL (18.4%)	1834.0 mL
5	46	347.1 mL (14.3%)	84.9 mL (3.5%)	1332.96 mL (54.9%)	100.54 mL (4.1%)	561.85 mL (23.2%)	2427.4 mL
6	37	570.3 mL (24.0%)	123.2 mL (5.2%)	1275.60 mL (53.6%)	0.00 mL (0%)	411.08 mL (17%)	2380.1 mL
7	24	83.3 mL (4.5%)	136.1 mL (7.4%)	1115.33 mL (60.5%)	0.00 mL (0%)	509.38 mL (27.6%)	1866.0 mL

Figure 1. Hidden fluids – Red



DISCUSSION

- By day 7 of MICU admission, 60% of the overall intravenous fluids administered were from IV medications including flushes
- Contribution of hidden fluids on total volume rose from 35% to 87% between days 1 and 7
- Intravenous medications were the largest contributing source of fluid for all days except day 1

CLINICAL IMPLICATIONS

- IV Medications, flushes, and nutrition alone may be adequate fluid contribution for patients who are slightly volume depleted
- IV medications should be viewed as a major factor contributing to fluid status in the critical care population
- Providers should assess contribution of hidden fluids in each patient before prescribing maintenance fluids
- Pharmacists should reinforce IV to PO conversions whenever possible to prevent fluid excess in critically ill patients
- Pharmacists may play an important role in promoting oral intake of medications. More research is needed to classify the institution’s promptness of IV to PO medication conversions

REFERENCES

- Larsen TR, Singh G, Velocci V, Nasser M, McCullough PA. Frequency of fluid overload and usefulness of bioimpedance in patients requiring intensive care for sepsis syndromes. *Proceedings (Baylor University Medical Center)*. 2016;29(1):12-15.
- Cecconi M, Hofer C, De Backer D, et al. Fluid challenges in intensive care: the FENICE study: A global inception cohort study. *Intensive Care Medicine*. September 2015;41(9):1529-1537. Available from: MEDLINE with Full Text, Ipswich, MA. Accessed January 13, 2018.
- Shen Y, Huang X, Zhang W. Association between fluid intake and mortality in critically ill patients with negative fluid balance: a retrospective cohort study. *Critical Care*. 2017;21:104. doi:10.1186/s13054-017-1692-3.

DISCLOSURES

The authors have no conflicts of interest to disclose.

Author Name, Author Name, Author Name, Author Name
University of Georgia College of Pharmacy and AU Medical Center, Augusta, GA

Background

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolo

Objective

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Lorem ipsum dolor sit amet, consectetur et dolore magna.

Methods

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur.

Results

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor.

Implications

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum Lorem ipsum dolor sit amet, consectetur adipiscing elit.

Author Name, Author Name, Author Name, Author Name
University of Georgia College of Pharmacy and AU Medical Center, Augusta, GA

Background

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea laboris nisi ut aliquip ex ea.

Purpose

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco.

Methods

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea laboris nisi ut aliquip ex.

Results

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco.

Subhead

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Veniam, quis nostrud exercitation ullamco.

Subhead

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Veniam, quis nostrud exercitation ullamco. Veniam, quis nostrud exercitation ullamco.

Discussion

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud.

Conclusions

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud.

References

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad.

Author Name, Author Name, Author Name, Author Name
University of Georgia College of Pharmacy and AU Medical Center, Augusta, GA

Background

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea laboris nisi ut aliquip ex ea laboris nisi ut aliquip ex ea.

Purpose

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco.

Methods

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea laboris nisi ut aliquip ex.

Results

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco.

Subhead

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Veniam, quis nostrud exercitation ullamco.

Subhead

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Veniam, quis nostrud exercitation ullamco. Veniam, quis nostrud exercitation ullamco.

Discussion

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud.

Conclusions

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud exercitation ullamco. Ut enim ad minim veniam, quis nostrud.

Next Steps

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea dolore magna aliqua. Ut enim ad.