Evaluating Guideline Adherence in the Early Management of Hypertensive Emergency

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Conflicts of Interest

- The speaker and the speaker's preceptor have no relevant financial conflicts of interest in relation to this activity to disclose

Learning Objectives

- Describe the ACC/AHA recommendations for early management (<24 hours) of hypertensive emergency
- List the evidence supporting guideline recommendations for blood pressure reduction in patients presenting with hypertensive emergency

ACC=American College of Cardiology
AHA=American Heart Association

Background

- According to the American College of Cardiology and American Heart Association, Hypertensive Emergency (HTN-E) is:[1]
  1. Severe Hypertension
     - Systolic blood pressure (SBP) > 180 mm Hg, or
     - Diastolic blood pressure (DBP) > 120 mm Hg, with
  2. Evidence of end-organ damage (EOD)

1. Circulation. 2018;138(17):e426-e483

Pathophysiology

Severe, acute elevations in blood pressure (BP) may cause:[3,4]

- Endothelial dysfunction
- Structural damage
- Autoregulatory failure

…leading to ischemia and end-organ damage

2. Lancet. 1939;233(6021):136. 3. Prog Cardiovasc Dis. 2002;45(1):33
4. Dtsch Arztebl Int. 2010;107(49):866

End-Organ Damage

Types of EOD[1]

- Neurologic: stroke*, encephalopathy, retinopathy
- Cardiac: myocardial infarction, acute heart failure, unstable angina
- Renal: acute renal failure
- Other: eclampsia*, flash pulmonary edema, aortic dissection*

*Compelling indication – Managed using evidence-based therapy

1. Circulation. 2018;138(17):e426-e483

Treatment Recommendations

ACC/AHA 2017 Guidelines: Managing HTN-E[1]

- Start intravenous therapy within one hour [I,B-NR]
- Reduce SBP in the first hour, no more than 25% [I,C-EO]
- Reduce SBP to < 160 mm Hg within 2 to 6 hours [I,C-EO]
- Maintain SBP < 160 mm Hg for 6 to 48 hours [I,C-EO]

CLASS I (STRONG)	Benefit >>> Risk
LEVEL B-NR (Nonrandomized)	LEVEL C-EO (Expert Opinion)
▪ Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies	Consensus of expert opinion based on clinical experience

1. Circulation. 2018;138(17):e426-e483

Study Aims

- Describe the current practice of early management for HTN-E
- Evaluate patient outcomes related to current HTN-E practices

Methods - Design

Observational, single-center, retrospective cohort study

- Enrolled ED patients presenting between Sep 2016 – Aug 2020

Inclusion:	▪ Diagnosis code for HTN-E ▪ ≥ 2 BP readings in the ED consistent with HTN-E criteria
Exclusion:	▪ Compelling indication for altered therapeutic goals ▪ Pregnancy ▪ Leaving against medical advice (AMA) within first 24 hours

ED=Emergency Department

Methods - Endpoints

Primary Outcome: Compliance with all four guideline-based recommendations in the first 24 hours of care

Secondary Outcomes: Adherence to the individual parts of guideline-recommended therapy, and:

- Hypotensive events*
- New-onset EOD*

*Events evaluated with Naranjo Probability Scale to assess relatedness to antihypertensive therapy[5]

5. Clin Pharmacol Ther. 1981;30(2):239-245

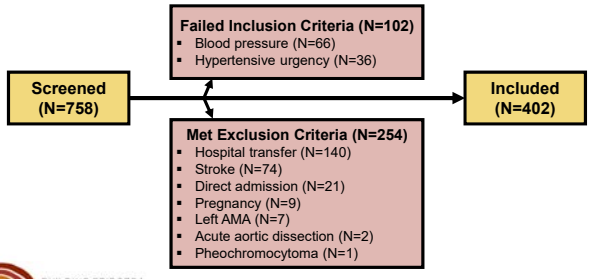
Methods – Data Handling

- Chart review via electronic medical record
- Goal sample size > 400 records
- Descriptive statistics followed by logistic regression

Continuous data	Categorical data
▪ Student t test ▪ Mann-Whitney U test	▪ X^2 test ▪ Fisher exact test

- Biologically plausible independent variables with $P<0.1$ in the univariate analysis were entered into backward regression

Results – CONSORT Diagram



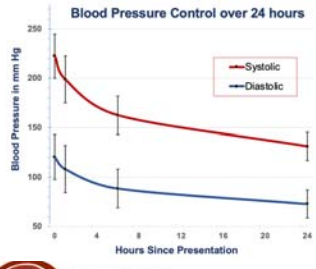
Baseline Characteristics (N=402)

Demographics	
Age, years	54 (38,65)
Female sex, N (%)	225 (56)
BMI, kg/m^2	28 (23,34)
Race, N (%)	
Black	288 (72)
Hispanic	33 (8)
White	15 (4)
Past Medical History, N (%)	
Hypertension	378 (94)
Chronic kidney disease	236 (59)
Diabetes mellitus	171 (43)
Charlson C Index	3 (2,5)

Clinical Presentation	
Initial blood pressure, mm Hg	
SBP	222 (206,236)
DBP	120 (±22)
MAP	154 (±19)
End-organ diagnosis, N (%)	
Neurologic	86 (21)
Renal	104 (26)
Cardiac	185 (46)
Other	118 (29)
Acute pulmonary edema	58

Unless specified, data are presented as:
Mean (±Standard deviation) and Median (Q1,Q3)

Treatment Data, First 24 hours



Antihypertensive Therapy, N (%)	
Drug therapy within 1 hour	167 (42)
Initial oral therapy	305 (76)
Calcium channel blocker	132 (33)
Initial IV bolus	161 (40)
Labetalol	101 (25)
Initial continuous infusion	145 (36)
Nitroglycerin	76 (19)
Other, N (%)	
Treatment with ≥ 3 antihypertensives in 24 hours	301 (75)
ICU admission	194 (48)
Overall length of stay, days	3.1 (1.9,5.4)

Primary Outcome

Adherence with ACC/AHA 2017 Guidelines[1]

Recommendation	Success, N (%)
Intravenous therapy within 1 hour	120 (30)
Reduction of SBP no more than 25% in first hour	259 (64)
Reduction of SBP to < 160 mm Hg in the first 6 hours	176 (44)
Maintain SBP < 160 mm Hg without hypotension for the first 24 hours	36 (9)
Total Compliance	2 (<1%)

1. Circulation. 2018;138(17):e426-e483

Secondary Outcomes

Event†	N (%)
Confirmed Hypotension attributed to antihypertensive therapy	67 (14)
Highly probable	4 (6)
Probable	49 (73)
Possible	10 (15)
Doubtful	4 (6)
New-onset EOD attributed to antihypertensive therapy	21 (5)
Probable	18 (86)
Possible	3 (14)
Acute Renal Failure	20

†Event likelihood is graded using the Naranjo Probability Scale[5]

5. Clin Pharmacol Ther. 1981;30(2):239-245

Multivariable Logistic Regression

Predictor	OR (95% CI)	P
Confirmed Hypotension		
Three or more antihypertensive agents in 24 hours	0.30 (0.15-0.60)	0.001
Charlson Comorbidity Index	1.11 (1.00-1.24)	0.046
Initial therapy with IV continuous infusion	3.81 (2.06-7.04)	<0.001
Pharmacologic intervention within 1 hour	3.49 (1.82-6.70)	<0.001
New End-Organ Damage		
Confirmed hypotension	3.42 (1.31-8.98)	0.012

OR=Odds ratio. CI=Confidence Interval. P values are significant at P<0.05

Conclusions / Impact

- Guideline compliance for HTN-E is poor
- Hypotensive events were predicted by guideline elements
- New-onset EOD is infrequent, but predicted by hypotension
- These data address a 25-year evidence gap ruled by expert opinion
- Results support relaxation/revision of 24-hour blood pressure goals
- The benefits of adherence remain to be explored

Limitations

- Risk of misclassification bias in documentation
- Primary outcome compliance was lower than expected, preventing logistic regression
- Majority of recorded blood pressures were nadirs

References

1. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2018;138(17):e426-e483. doi:10.1161/CIR.0000000000000597
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5. Naranjo CA, Busto U, Sellers EM, et al. A method for estimating the probability of adverse drug reactions. Clin Pharmacol Ther. 1981;30(2):239-45. doi:10.1038/clpt.1981.154

Post-Test Question 1

Select the initial management (<1 hr) recommendation for hypertensive emergency from the ACC/AHA 2017 Clinical Practice Guidelines for Hypertension:

A. Reduction of blood pressure to less than 160/110 mm Hg
B. Intensify oral therapy and arrange follow-up
C. Reduction of systolic blood pressure by at least 25%
D. Administer parenteral therapy with continuous blood pressure monitoring

Post-Test Question 2

Which of the following best describes the current guideline recommendations for hypertensive emergency treatment?

A. Recommendations are based on expert opinion and the benefits are uncertain
B. Supportive data from prospective randomized controlled trials
C. Strong associations drawn from multicenter retrospective studies
D. Systematic reviews demonstrating optimal drug therapies and blood pressure reduction rates

KALMED: Ketamine for Acute Agitation Management in the Emergency Department

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September 25th, 2021

Disclosure

- Author of this presentation has nothing to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation.
- This activity is being presented without bias and without commercial support

Objectives

Define	agitation in the emergency department (ED) and its effect on healthcare providers
Identify	the effect of intramuscular ketamine dosing on sedation and adverse effects in the treatment of acute agitation

Acute Agitation in the ED[1]

- **Miner et al:** Characteristics and Prevalence of agitation at an Urban Level I trauma center
- **Prevalence:** 2.6%
- **Patient characteristics:**
  - Average age: 38 y/o
  - Male: 71%
- **Cause of agitation:**
  - Alcohol related: 83%
  - Psychiatric: 20%
  - Drug use: 12%
  - Medical: 11%
- **Required intervention:**
  - Physical restraint: 84%
  - IM sedation: 72%

Agitation and Violence in the ED[2-4]

- **Acute agitation can lead to increased risk for both patients and the healthcare team**
- **2008 ED workplace violence study:**
  - Respondents feeling physically safe sometimes to never: 27%
- **2014 OSHA report:**
  - Healthcare workers are over four times more likely to experience injuries due to workplace violence
- **2018 ACEP physician survey:**
  - Reported any violence in the past year: 72.4%
  - Reported physical assault: 38.1%
  - Constantly or frequently fearing violence: 30%

Ketamine for Agitation[5]

	Ketamine
Mechanism of action (MOA)	Non competitive NMDA antagonist with amnestic and analgesic properties
Agitation dosing	IM: 2-6 mg/kg IV: 0.5-2 mg/kg
Onset of action	IM: 3-5 minutes IV: 30 seconds
Duration of action	IM: 15-30 minutes IV: 5-10 minutes
Adverse effects	Transient hypertension, tachycardia, hypersalivation, nausea/vomiting, laryngospasm, hypoxia

Ketamine for emergency sedation of agitated patients: A systematic review and meta-analysis

Natalie Sullivan [a], Chen Chen [b], Rebecca Siegel [a], Yan Ma [b], Ali Pourmand [a], Nataly Montano [a], Andrew Meltzer [a,*]

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[b] The George Washington University, Milken Institute School of Public Health, Department of Epidemiology and Biostatistics, Washington, DC, USA

Study Design[6]

Design: Systematic review and meta-analysis

Objective: To evaluate the sedation and airway management rates when ketamine is administered in the prehospital and ED setting for behavioral disorders, agitation, or delirium

Studies included: 13 articles (prehospital: 10; ED: 3)

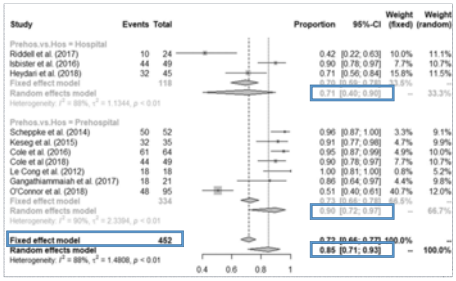
Sample size: 1095 patients (ketamine group: 674; control group: 421)

Inclusion criteria: Full text articles with research conducted in the ED or prehospital setting, patients presenting with behavioral disorders, agitation, or excited delirium

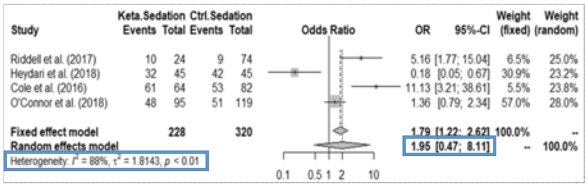
Results: Sedation[6]

Summary:

- Hospital:
  - 3 articles/ 118 pts
  - Sedation: 71%
- Prehospital:
  - 7 articles/ 334 pts
  - Sedation: 90%
- Combination:
  - Sedation: 85%



Results: Sedation - Ketamine Compared to Standard Therapy[6]

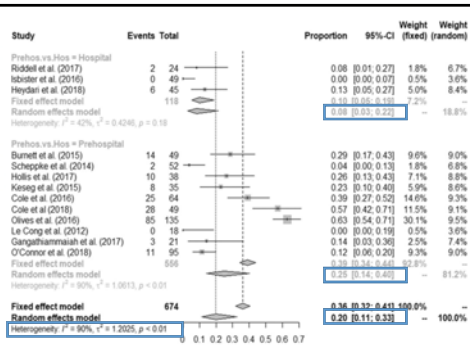


Standard therapy: haloperidol (4 studies), a benzodiazepine (2 studies)

Results: Airway Management[6]

Summary:

- Hospital:
  - 3 articles/ 118 pts
  - Intubation: 8%
- Prehospital:
  - 10 articles/ 556 pts
  - Intubation: 25%
- Combination:
  - Intubation: 20%
- Heterogeneity:



Sullivan et al Discussion[6]

- **Author's conclusion:** " This study demonstrates that adequate sedation can be reliably achieved in agitated patients treated with ketamine"
  - Significant safety concern: Large proportion of patients required mechanical intubation
  - Most of the studies were retrospective or observational

Reduced-dose intramuscular ketamine for severe agitation in an academic emergency department

Michael E. O'Brien[a], Lanting Fuh[a], Ali S. Raja[b,c], Benjamin A. White[b,c], Brian J. Yun[b,c] and Bryan D. Hayes[a,c]

[a]Department of Pharmacy, Massachusetts General Hospital, Boston, MA, USA; [b]Department of Emergency Medicine, Harvard Medical School, Boston, MA, USA; [c]Harvard Medical School, Boston, MA, USA

Study Design[7]

Design: Case series

Objective: To describe the efficacy and safety of a reduced-dose IM ketamine guideline

Duration: September 2017 to February 2019

Participants: 15 patients

Ketamine dosing: 2 mg/kg (max: 200 mg), may repeat once after 5 minutes

Inclusion criteria: Adult patients presenting to the ED with severe agitation, excited delirium, or agitation due to trauma

Results: Demographics and Outcomes[7]

	Ketamine 2 mg/kg (N=15)
Age (years), median	33
Sex (male), n (%)	12 (80)
Weight (kg), median	75
Positive drug and/or ETOH screening, n (%)	10 (67)
Ketamine dose (mg/kg), median (IQR)	2 (1.9-2.1)
Agitation controlled, n (%)	13 (87)
Additional sedation administered 1hr post ketamine, n (%)	6 (40)
Intubation, n (%)	1 (7.6)
Respiratory depression, n (%)	1 (7.6)

O'Brien et al Discussion[7]

- **Author's conclusion:** "Ketamine 2 mg/kg IM may be effective to safely treat agitated patients in the ED"
  - In comparison to previous studies, only one patient required mechanical intubation
  - Larger, prospective, and dual arm studies are required to validate these results

KALMED:

KETAMINE FOR ACUTE AGITATION MANAGEMENT IN THE EMERGENCY DEPARTMENT

Authors

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Methods: Design

Design: Single center, retrospective, double-arm study

Objective: To assess the *effectiveness* and *safety* of low dose (< 2.5 mg/kg) versus high dose (≥ 2.5 mg/kg) of IM ketamine for acute agitation

Duration: September 1st, 2018 to April 5th, 2021

Methods: Inclusion and Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Patients presenting to the ED with acute agitation based on ED documentation	Age less than 18 years old
Patients administered ketamine IM for acute agitation	Concomitant sedative administration at the time of ketamine utilization

PRIMARY OUTCOME	SECONDARY OUTCOMES
Resolved agitation at 15 minutes (+/- 10 minutes)*	Use of IM or IV rescue medications within 30 minutes after ketamine administration
*Definition of resolved agitation: • Documentation of success by a provider • Ability to obtain necessary imaging/labs • Not requiring additional sedation	Adverse events
	Subgroup analysis of patients who only received ketamine for agitation

Methods: Outcomes

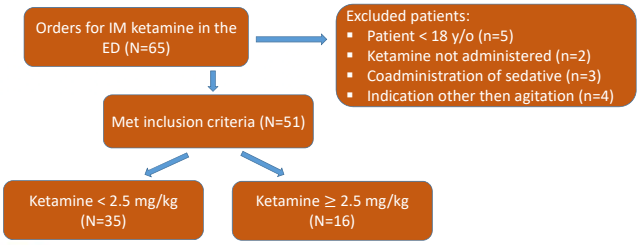
Methods: Statistical Analyses

Sample size needed
- 98 patients
- 80% power to detect a 20% difference

Primary outcome
- Chi-square or Fisher's exact test
- P-value of <0.05 denoting significance

Secondary outcome
- Chi-square or Fisher's exact test
- P-value of <0.05 denoting significance

Patient Enrollment



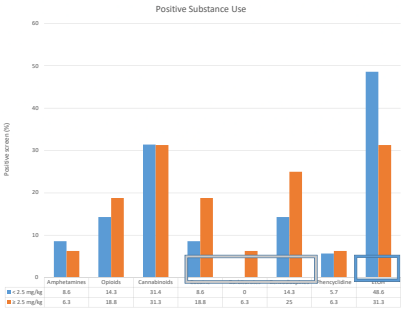
Results: Demographics

	< 2.5 mg/kg (N=35)	≥ 2.5 mg/kg (N=16)	P-Value
Age (years), median (IQR)	**36 (28-52)**	**52 (36-61)**	**0.06**
Sex (male), n (%)	26 (74.3)	12 (75.0)	0.96
Body weight (kg), median (IQR)*	**86.0 (67.1-111.0)**	**68.0 (58.3-91.4)**	**0.08**
Body mass index, median (IQR)	25.8 (23.4-35.4)	23.7 (22.0-28.6)	0.11
Psychiatric history, n (%)	17 (48.6)	7 (43.8)	0.75
Substance abuse history, n (%)	10 (28.6)	5 (31.3)	0.85
Home antipsychotic use, n (%)	**9 (25.7)**	**9 (56.3)**	**0.03**
Home benzodiazepine use, n (%)	**2 (5.7)**	**3 (18.8)**	**0.31**

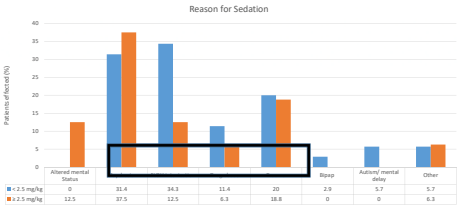
*Estimated body weight used when actual body weight was unavailable

Results: Acute Drug/Etoh Use

Urine tox/ETOH level obtained		
< 2.5 mg/kg (N=35)	**≥ 2.5 mg/kg (N=16)**	**P-Value**
29 (82.9%)	15 (93.8%)	0.29



Results: Cause of Agitation

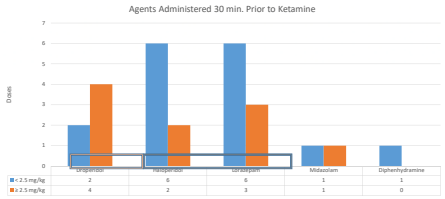


Results: Agitation Treatment

	< 2.5 mg/kg (N=35)	≥ 2.5 mg/kg (N=16)	P-Value
Sedative agent prior to ketamine (30 min), n (%)	**10 (28.6)**	**20 (43.8)**	**0.29**
Time between prior agent and ketamine (min), median (IQR)	15.5 (9-21)	20 (11-25)	0.46
Ketamine dose (mg), median (IQR)	120 (100-200)	200 (200-250)	<0.01
Ketamine dose (mg/kg), median (IQR)*	**1.8 (1.4-2.1)**	**3.0 (2.8-3.4)**	**<0.01**

*Estimated body weight used when actual body weight unavailable

Results: Agitation Treatment Continued



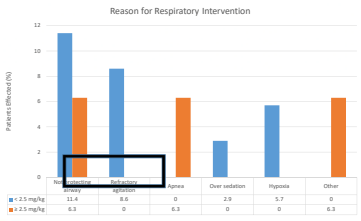
Result: Outcomes

	< 2.5 mg/kg (N=35)	≥ 2.5 mg/kg (N=16)	P-Value
Resolved agitation at 15 minutes (+/- 10 minutes), n (%)	**32 (91.4)**	**16 (100.0)**	**0.54**
Documentation of treatment outcomes, n (%)	32 (91.4)	12 (75.0)	0.19
Additional agent administered after ketamine (within 30 min), n (%)	**4 (16)**	**0 (0)**	**0.55**

Results: Outcomes Continued

	< 2.5 mg/kg (N=35)	≥ 2.5 mg/kg (N=16)	P-Value
Respiratory intervention, n (%)	**6 (17.1)**	**3 (18.8)**	**0.89**
Bag valve mask, n (%)	0 (0.0)	1 (6.3)	0.31
Nasal canula, n (%)	2 (5.7)	2 (12.5)	0.58
CPAP, n (%)	1 (2.9)	0 (0.0)	1.00
Intubation, n (%)	**4 (11.4)**	**1 (6.3)**	**1.00**
Dystonia, n (%)	**0 (0.0)**	**1 (6.3)**	**0.31**
Nausea/vomiting, n (%)	**3 (8.6)**	**0 (0)**	**0.54**

Results: Respiratory Intervention



Patient	Reason for intubation
Low dose # 1	Over sedation
Low dose # 2	Refractory agitation, > 1 hour later
Low dose # 3	Polysubstance use, > 3 hours later
Low dose	Respiratory

Results: Outcomes – Subgroup Analysis Ketamine Monotherapy

	< 2.5 mg/kg (N=25)	≥ 2.5 mg/kg (N=9)	P-Value
Resolved agitation at 15 minutes (+/- 10 minutes), n (%)	**22 (88.0)**	**9 (100.0)**	**0.55**
Additional agent administered after ketamine (within 30 min), n (%)	**4 (16.0)**	**0 (0.0)**	**0.55**
Respiratory intervention, n (%)	6 (24.0)	2 (22.2)	0.89
Bag valve mask, n (%)	0 (0.0)	1 (11.1)	0.26
Nasal canula, n (%)	2 (8.0)	2 (22.2)	0.28
CPAP, n (%)	1 (4.0)	0 (0.0)	1.00
Intubation, n (%)	4 (16.0)	0 (0.0)	0.55
Nausea/vomiting, n (%)	3 (12.0)	0 (0.0)	0.55

Polling Question

Which of the following is true regarding acute agitation in the ED and the administration of IM ketamine?

A. Only about 15% of agitated patients in the ED require IM sedation
B. High dose ketamine was more effective than low dose ketamine at treating acute agitation
C. No difference in the need for respiratory intervention was seen between high and low IM ketamine treatment groups
D. All of the above are true

Overview

- **Study limitations:**
  - Single center
  - Retrospective
  - Under powered study
  - Low median dose in the "high dose" cohort
- **Primary outcome:** To study found no difference in resolved agitation in the low versus high dose group (91.4% vs 100%; p=0.54)
- **Secondary outcome:**
  - No difference in additional agent used after ketamine (16% vs 0%; p=0.55)
  - No difference in intubation rated between groups (11.4% vs 6.3%; p=1.00)
  - No difference in resolved agitation in the ketamine monotherapy sub group analysis (88% vs 100%; p=0.55)
- The study is underpowered and therefore results are inconclusive
  - **Future directions:** Expansion of inclusion dates and creating a study with a prospective design

Resources

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Assessing a Novel Automated Communication System for On-Call Pharmacy Resident Services

Presented by:
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University of Illinois at Chicago/UI Health
September 25, 2021

Disclosures

- There are no relevant financial conflicts of interest in relation to this activity to disclose.

Objectives

1. Describe the implemented system of automated communication and experiences of pharmacists receiving automated notifications
2. Discuss the impact of this novel communication system and identify the benefits of automated notifications on patient care services and residency learning.

Setting

University of Illinois at Chicago (UIC) / University of Illinois Hospital and Health Sciences Systems (UI Health):

- 450-bed academic medical center
- 21 outpatient clinics
- Residency programs:
  - 34 residents/fellows
    - PGY1: 12 residents
    - Various PGY2 specialties and fellowships

In-house, Inpatient, On-call Program

- PGY1 residents and select PGY2 pharmacy residents/fellows (e.g., infectious disease, emergency medicine, critical care)
- Overnight (weekdays), all-day (weekends and holidays)
- Services:
  - Drug information (e.g., antibiotic selection, anticoagulation dosing)
  - Pharmacokinetics consults (e.g., "pharmacy-to-dose" vancomycin)
  - Emergency responses (e.g., codes [rapid response, stroke] , sexual assault, naloxone dispensing)
  - Total parenteral nutrition dosing
  - Transplant induction therapy selection
  - Patient counseling

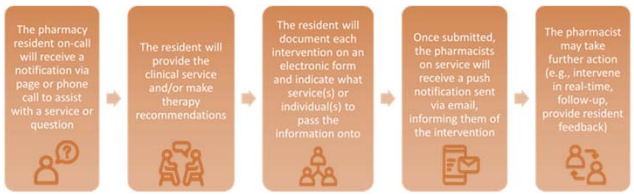
Background

Automated communication: communications are predetermined and set up to automatically send when an event or action is recorded

- June 2020, a web-based data capture application (REDCap) was implemented to document pharmacy resident on-call interventions
- Additionally, a novel, automated notification system was implemented to directly email intervention information in real-time to pharmacists on pertinent services as the pharmacy residents completed their interventions

REDCap
Research Electronic Data Capture

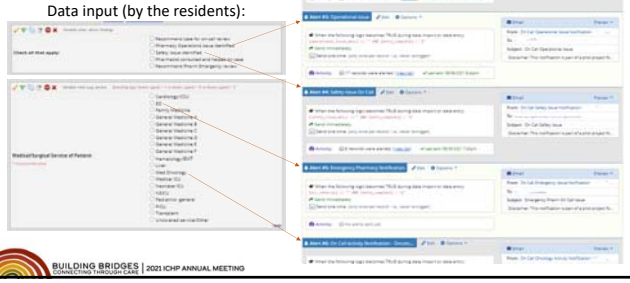
On-call Notification Process



Automated Notifications

Programming of automated notifications:

Data input (by the residents):



Methods

Qualitative survey:

- Data from July 01, 2020 – October 31, 2020 (4 months)
- Inclusion criteria: all pharmacists who are recipients of automated notifications as a result of on-call interventions
- Data collected:
  - Demographics (e.g., years in practice, service area, preceptor experience, prior residency training)
  - Overall satisfaction
  - Frequency and volume of notifications
  - Likert Scale (pre- vs. post-implementation) assessing the impact on patient care and resident leading/feedback
  - Suggestions, comments, or anecdotes related to the use of automated notifications

Results - Demographics

- Participation rate: 67.3%
  - Eligible participants (n = 49)
  - Completed surveys (n = 33)

Baseline characteristics (total n = 33, unless stated otherwise)		
	Average +/- STD	Range
Years as a pharmacist	14.3 (+/- 11.2)	2.0 – 40.0
Years as a pharmacist at UI Health/UIC	11.1 (+/- 10.2)	1.0 – 37.0
Years as a preceptor for the UIC residency program	9.9 (+/- 10.86)	0.0 – 35.0
	Percentage	**n-value**
Primary practice area:		
Administration	6.1%	2
Cardiology	9.1%	3
Clinical staff pharmacist	9.1%	3
Critical care - adult (e.g., medical ICU, NSICU)	9.1%	3
Emergency department	6.1%	2
Infectious disease	9.1%	3
Internal medicine	15.2%	5
Oncology, Hematology, BMT	9.1%	3
Other (unspecified)	6.1%	2
Pediatrics (e.g., neonatal ICU, general pediatrics, PICU)	9.1%	3
Solid Organ Transplant	12.1%	4
Post-graduate pharmacy training experience:		
No formal post-graduate training	12.1%	4
1 year of post-graduate training (e.g., PGY1)	18.2%	6
2 years of post-graduate training (e.g., PGY1 and PGY2)	60.6%	20
3 or more years of post-graduate training	9.1%	3
Completed post-graduate training at UI Health/UIC: (n = 29)		
Yes	79.3%	23
No	20.7%	6
Participated in on-call program during post-graduate training (n = 29)		
Yes	86.2%	25
No	13.8%	4
Number of residents overseen on rotation by participant per year:		
0 – 2	36.4%	12
3 – 4	27.3%	9
5 – 7	21.2%	7
8+	15.2%	5

Results – Communication Volume

Increase in communication frequency with the implementation of automated notifications

Communication prior to implementation (n = 33)		
	Percentage	n-value
Frequency of communication about on-call interventions:		
Never	6.1%	2
Rarely (notifications are not received every week)	45.5%	15
Infrequently (1-2 notifications per week)	39.4%	13
Sometimes (3-6 notifications per week)	9.1%	3
Daily (7+ notifications per week)	0.0%	0
Communication methods used:		
Email	69.7%	23
Page	15.2%	5
Call	27.3%	9
MIS (Word Document)	54.5%	18
Forwarded note within EMR	12.1%	4
Other:	12.1%	4
- In-person communication	(6.1%)	(2)
- Text message	(3.0%)	(1)
- Note in EMR, not forwarded	(3.0%)	(1)
Information was not shared	6.1%	2

Communication using automated notifications (n = 33)		
	Percentage	n-value
Frequency of communication about on-call interventions:		
Never	9.1%	3
Infrequently (1-2 notifications per week)	45.5%	15
Sometimes (3-6 notifications per week)	21.2%	7
Daily (7+ notifications per week)	24.2%	8

*When daily, notifications per day ranged from 1 – 3 notifications (average 1.71, range 1-3)

Results – Effects of Automated Notifications

Effects of automated notifications on patient care (n = 33)		
	Percentage	n-value
Automated notifications increased participant's knowledge of patient-care delivery on participant's clinical service in real-time:		
Yes	81.8%	27
No	18.2%	6
Participant intervened in real-time as a result of receiving an automated notification:		
Yes	60.6%	20
No	39.4%	13
Received a notification regarding a patient being transitioned to participant's service:		
Yes	42.4%	14
No	57.6%	19

Effects of automated notifications on resident learning (n = 33)		
	Percentage	n-value
Participant provided feedback to the resident on-call as a result of receiving an automated notification:		
Yes	84.4%	28
No	15.2%	5
How has the implementation of automated notifications affected the frequency of the participant in providing feedback to residents about their on-call activities:		
Much less likely to provide feedback	0.0%	0
Slightly less likely to provide feedback	3.0%	1
Has not affected the provision of feedback	15.2%	5
Slightly more likely to provide feedback	48.5%	16
Much more likely to provide feedback	33.3%	11

Results – Likert Scale: Patient Care

Impact of automated notifications on patient care services (compared to the experience prior to implementation) (n = 33)					
	Significantly worse	Worse	No change	Improved	Significantly Improved
Quality of care			24.2% (n = 8)	65.6% (n = 21)	12.1% (n = 4)
Continuity of care			15.2% (n = 5)	57.6% (n = 19)	27.3% (n = 9)
Timeliness of care			21.2% (n = 7)	57.6% (n = 19)	21.2% (n = 7)
Relationship with the healthcare team			48.5% (n = 16)	39.4% (n = 13)	12.1% (n = 4)

*Blank indicates 0% of participants selected that answer choice

Results – Likert Scale: Residency Teaching

Impact of automated notifications on preceptorship/involvement with residents (compared to the experience prior to implementation) (n = 33)					
	Significantly worse	Worse	No change	Improved	Significantly Improved
Ability to provide timely feedback			15.2% (n = 5)	57.6% (n = 19)	27.3% (n = 9)
Ability to provide case-specific feedback/teaching moments			18.2% (n = 6)	54.5% (n = 18)	27.3% (n = 9)
Ability to develop relationships with residents			15.2% (n = 5)	51.5% (n = 17)	15.2% (n = 5)

*Blank indicates 0% of participants selected that answer choice

Results – Overall Satisfaction

Overall satisfaction with automated notifications (total n = 33, unless stated otherwise)		
	Percentage	n-value
Participant's rating of overall satisfaction with the implementation and use of automated notifications:		
Very dissatisfied (e.g., dislike automated notifications and unhappy with its impact)	0.0%	0
Mostly dissatisfied	0.0%	0
Mixed (e.g., equally satisfied and dissatisfied)	15.2%	5
Mostly satisfied	30.3%	10
Very satisfied (e.g., pleased with automated notifications and its impact)	54.5%	18

Results – Thematic Analysis of Comments

Common themes found:

- Improvements/suggestions
  - Identified user education needs
  - Request to improve the targeting of notifications
  - Request to modify formatting/content
  - Additional documentation/routing of feedback
- Anecdotes – patient care
  - Ensuring continuity of care
  - Study enrollment
  - Interventions in modifying therapy
    - Preventing unnecessary medication use
    - Changing dose
- Anecdotes – residency teaching
  - Facilitated workflow/procedure education and review of therapeutics
- Additional comments
  - Overall positive comments on how the notifications improved communication, information accessibility, and resident feedback

Limitations

- Participants' recall bias upon answering the survey
  - No survey administered prior to implementation
- Did not collect PGY1 resident feedback on improvements, anecdotes, and comments to their experience with automated notifications and web-based documentation
- Small sample size, utilizing pharmacists and PGY2 recipients
- Applicability to other health systems and residency on-call programs

Potential Applications for Automated Notifications

- Other residency on-call programs
- Pharmacy intervention/event reporting
- Facilitating trigger tool follow-up
- Communication between clinical services (e.g., sign-out, hand-offs)

Conclusion

- The implementation of automated notifications to communicate pharmacy resident on-call services showed positive impact in regards to patient care services and residency learning in this research survey
- While the research on utilizing automated communication in pharmacy practice is limited, the beneficial experiences of the pharmacist receiving notifications may suggest that an automated notification system of this type may be adapted at other institutions for improved communication of on-call interventions

Special thanks to my PGY2 research preceptors:

Adam Bursua, PharmD, BCPS, CPPS

&

Kirsten Ohler, PharmD, BCPS, BCPPS

Thank you for listening!

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Questions

Residency Project Pearls 2021

Assessment Questions

1. What is an example of implementing automated communication?
    a. Calling a pharmacist on the phone
    b. Writing a note that is then delivered by a robot
    c. Setting up predetermined communication chains that send information triggered by an event
    d. Leaving a hand-off in a note on the patient's chart and messaging it to relevant healthcare providers

2. According to this research survey, automated notifications showed improvements in:
    a. Patient care services
    b. Residency teaching opportunities
    c. A&B
    d. Clinical outcomes

Answer key: 1. D, 2. C