Event Dispatch Performance and Cognitive Load in Collegiate EMS

Evan Passalacqua, EMT[1,2]; Ivan Zhang, EMT[1,2]; Sophia Levin, BS, EMT[1]; Deren Bog, EMT[1]

[1]Berkeley Medical Reserve Corps, [2]University of California, Berkeley Department of Statistics

Abstract

Background: Collegiate EMS agencies staff event dispatch with EMTs who lack formal dispatch training and rely on improvised tools to manage call traffic and unit assignment. The impact of these conditions on dispatcher performance is poorly understood.

Objectives: To evaluate dispatch performance, error rates, usability, and cognitive load among novice collegiate EMS dispatchers using three systems.

Methods: EMT-B volunteers without prior dispatch experience (n=12) completed dispatch simulations using three dispatch tools: a Google Sheets (GS) template, BrutalCAD (BC), and CrowdCAD (CC). Dispatch latency and errors were derived from annotated audio and system logs. Usability and cognitive load were assessed using self-report instruments.

Results: Tools showed no difference in call or equipment dispatch latency ($p \geq 0.19$) or error rates ($p = 1.00$). Usability and cognitive load differed significantly, with higher usability and lower perceived workload reported for CrowdCAD compared to the other tools ($p \leq 0.017$ usability, $p \leq 0.008$ cognitive load).

Conclusion: Among novice collegiate EMS dispatchers in simulated event standby, dispatch speed and accuracy were similar across tools, while cognitive burden and usability varied substantially. These findings suggest dispatcher performance in collegiate EMS is constrained more by human factors than by tool capabilities alone, underscoring the importance of usability and dispatcher preparation.

Introduction

Collegiate EMS agencies commonly provide on-site medical coverage for campus events and mass gatherings, offering rapid care and reducing reliance on municipal EMS systems[1]. Prior work in mass gathering medicine shows that robust on-site medical operations can substantially reduce downstream burden on local EMS resources and hospitals[2]. Additionally, increased call volume during mass-gathering events has been correlated with factors such as crowd size, temperature, and alcohol use, making efficient team and equipment coordination critical during peak periods[3].

Computer-Aided Dispatch (CAD) Systems in Event Medicine

- Dispatch systems and their effects on operations in collegiate event medicine are understudied.
- Field and institutional experience suggests lack of formal training and use of improvised, unrefined tools by EMT volunteers that could contribute to inefficient dispatching.
- Traditional CAD system designs, such as those used by 911 dispatch, are misaligned with collegiate event workflows.

Human factors research indicates that usability and cognitive workload can affect performance sustainability, even when objective speed and accuracy appear similar. Accordingly, this study evaluated whether dispatch tools used in collegiate event medicine differ in objective performance, perceived usability, and cognitive workload among novice dispatchers.

Methods

Within-subjects simulation study comparing dispatch performance, usability, and cognitive workload across three event medicine dispatch tools. Usability was measured using the System Usability Scale (SUS); cognitive workload was assessed using the NASA Task Load Index (NASA-TLX).

Internal system usability testing with written informed consent; Institutional Review Board review was not required.

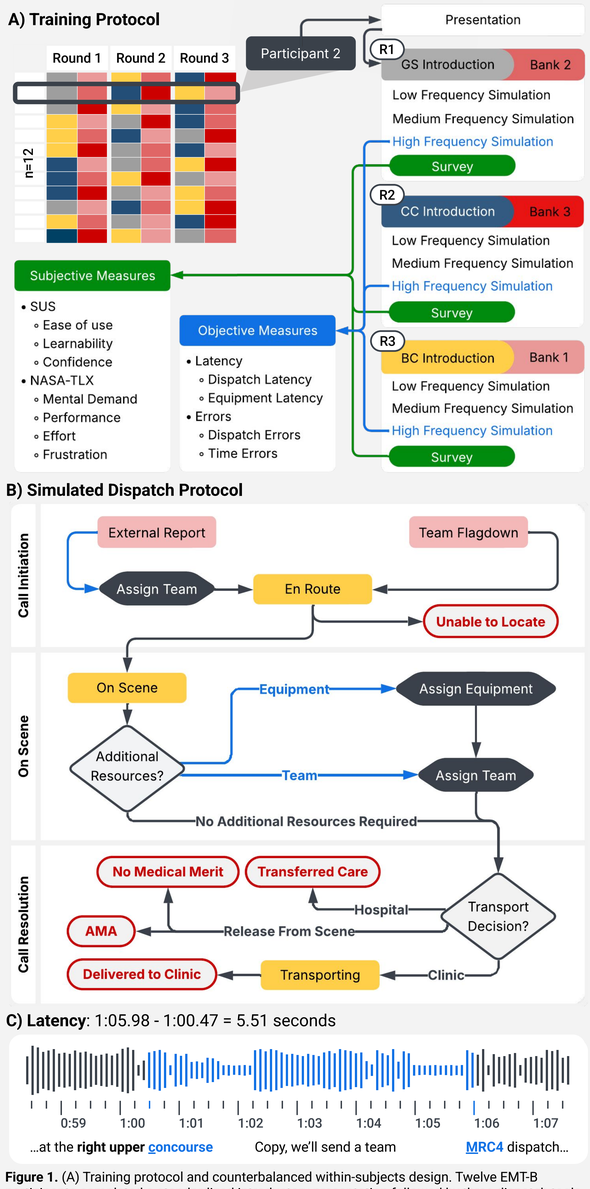

Figure 1. (A) Training protocol and counterbalanced within-subjects design. Twelve EMT-B participants completed a standardized introductory presentation followed by three dispatch tools in counterbalanced order, each paired to a unique scenario bank. For each tool, participants completed multi-stage dispatch simulations, followed by a post-tool survey. Objective performance measures were derived from high-frequency simulations; subjective measures were derived from surveys. (B) Simulated dispatch protocol defining inputs, decision points, and outcomes. (C) Dispatch latency definition, measured from the beginning of the final word of the location description to the beginning of the team name assigned.

Results

Objective dispatch performance did not differ meaningfully between tools, while subjective usability and cognitive workload showed clear separation.

Objective Performance: Latency and Errors

- Call and resource latency were similar across all tools
- Dispatch and time errors were both infrequent and comparable between platforms

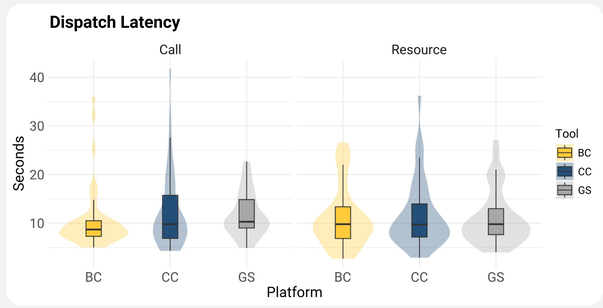

Figure 2. Objective dispatch latency distributions for BrutalCAD (BC), CrowdCAD (CC), and Google Sheets (GS) across call and resource request types. Violin plots show kernel density estimates overlaid with boxplots. Data points beyond [Subject Median + 3 × Subject MAD] were removed as outliers for each subject. Both request types exhibit similar right-skewed distributions with median latencies concentrated around 10 seconds across all three platforms .

Subjective Performance: Usability and Cognitive Workload

- CrowdCAD demonstrated highest usability (SUS 87.3).
- Google Sheets (69.8) and BrutalCAD (59.6) scored significantly lower in pairwise comparisons.
- Perceived cognitive workload was lowest with CrowdCAD.
- Usability and cognitive workload were consistent for each tool across all three session blocks.

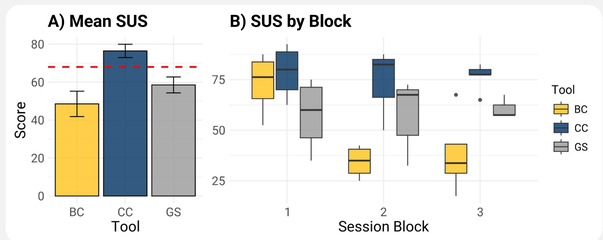

Figure 3. System Usability Scale scores across platforms and experimental blocks. (A) Mean SUS scores with dashed red line indicating the acceptability threshold of 68 (scores above 68 are considered acceptable usability). CrowdCAD achieved the highest usability rating. (B) SUS score distributions by experimental block, showing CrowdCAD maintained consistently high scores across blocks while BrutalCAD and Google Sheets exhibited slight downward trends in later blocks.

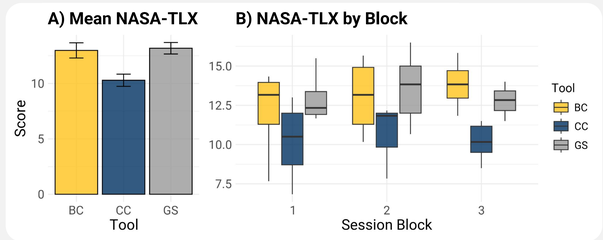

Figure 4. NASA-TLX workload ratings across platforms and experimental blocks (lower scores indicate better performance). (A) Mean NASA-TLX scores showing CrowdCAD had significantly lower perceived workload. (B) NASA-TLX distributions by experimental block, demonstrating CrowdCAD's consistent low workload across all three sessions while BrutalCAD and Google Sheets maintained comparably higher workload levels throughout.

Discussion

Objective dispatch performance alone did not distinguish between tools, while measures of cognitive workload and usability revealed meaningful human factors differences.

Key Findings

- **Objective measures** of dispatch speed and error rates were **similar across all three tools**.
- **Subjective measures** of perceived workload and usability **differed significantly between tools**, with CrowdCAD demonstrating highest usability and lowest perceived workload.

These findings are consistent with human factors literature showing that performance degradation often appears through fatigue, not immediate errors.

Operational Implications

- Tools requiring significant manual text input or visual scanning across interfaces may allow for adequate performance at low call volume.
- During prolonged operations or high call volume, higher cognitive demand may reduce dispatcher performance.
- Evaluations based only on speed or errors may underestimate real-world operational risk.

Limitations

- Simulation based study with short operational periods.
- All subjects lacked prior dispatch experience.

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Taken together, the results suggest that the measured objective dispatch performance metrics may fail to capture meaningful differences in dispatcher cognitive demand. For collegiate EMS agencies, tool selection and training programs may benefit from greater emphasis on cognitive workload and usability, particularly for prolonged or high-demand event operations. Future studies should examine longer operational periods, real events, and dispatcher fatigue to better understand how dispatch tool design influences performance sustainability over time.

Acknowledgement & References

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Contact

Evan Passalacqua: evanqua@berkeley.edu

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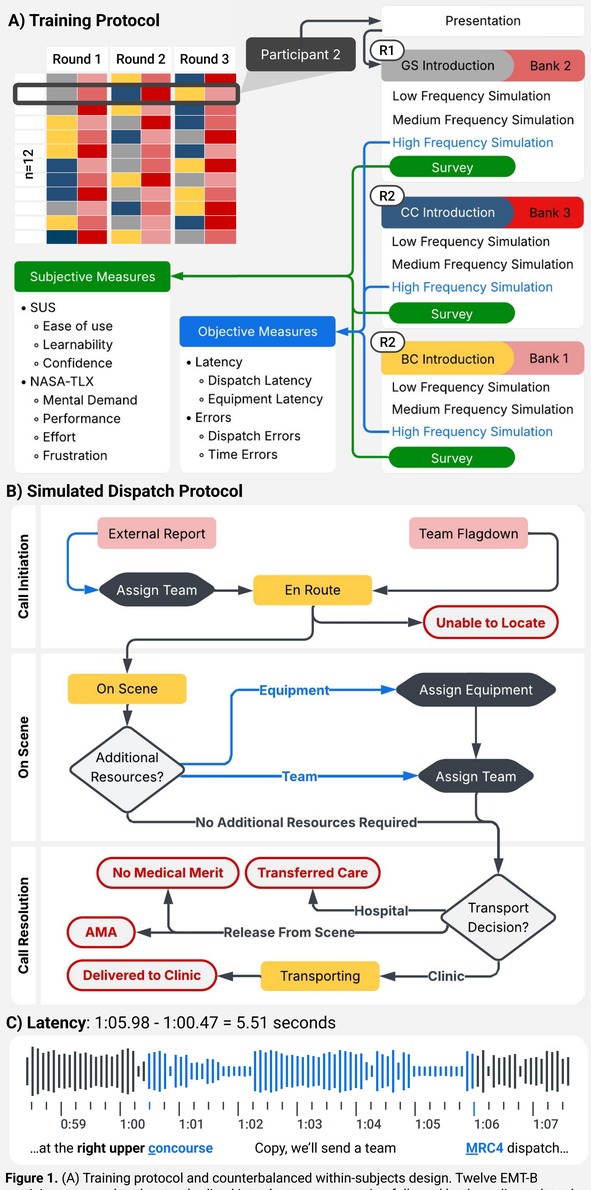

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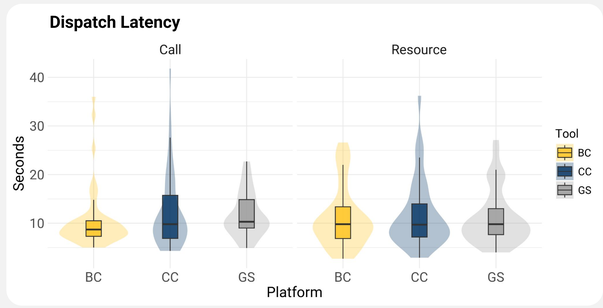

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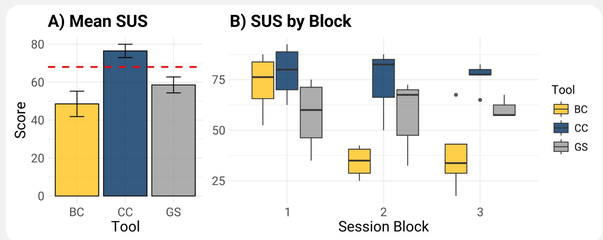

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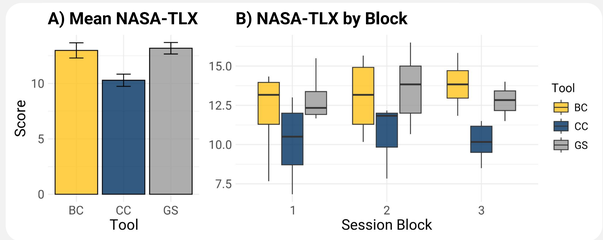

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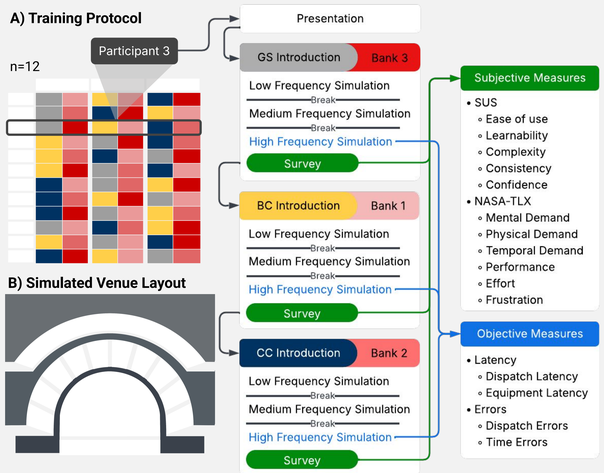

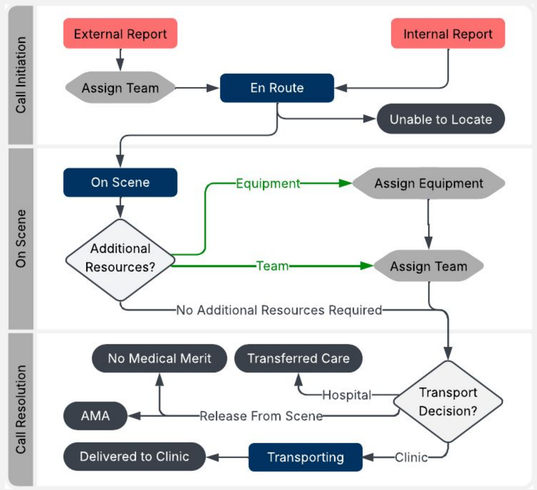

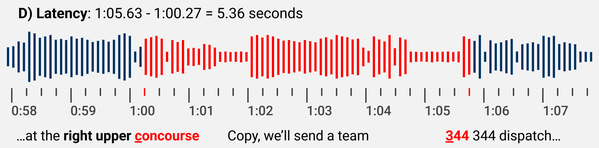

Figure 1. (A) Training protocol and counterbalanced within-subjects design. Twelve EMT-B participants completed a standardized introductory presentation followed by three dispatch tools in counterbalanced order, each paired to a unique scenario bank. For each tool, participants completed tool exploration, low-, medium-, and high-frequency dispatch simulations, followed by a post-tool survey. Objective performance measures (dispatch latency and errors) were derived from high-frequency simulations; subjective measures (SUS and NASA-TLX) were derived from surveys. (B) Simulated outdoor venue layout used across all scenarios, comprising six foot teams (Teams 341–346) distributed across lower, upper, and lawn sections on stage left and right. (C) Simulated dispatch protocol defining allowable inputs, decision points, and non-transport outcomes. (D) Dispatch latency definition, measured from the beginning of the final spoken word of the location description to the beginning of the first verbalized team identifier assigned to the call.

Methods

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~~Participants completed standardized simulated event dispatch scenarios modeled after a multi-level outdoor venue with multiple foot teams and limited transport resources. Scenarios were designed to produce periods of overlapping calls and peak dispatch workload while maintaining comparable difficulty across tools. Dispatchers were assessed on decision making and communication rather than documentation completeness.~~

Objective outcomes included dispatch latency and dispatch errors, derived from annotated audio recordings and system logs during high-frequency scenario segments. Subjective outcomes included usability (System Usability Scale) and perceived cognitive workload (NASA-TLX). Analyses used mixed-effects models to account for repeated measures within participants.

This project was conducted as internal dispatch system usability testing with written informed consent. Institutional review board review was not required.

Figure 1. Insert caption

Participant	Block 1	Block 2	Block 3
P1	Tool A, Bank 1	Tool B, Bank 2	Tool C, Bank 3
P2	Tool A, Bank 2	Tool C, Bank 3	Tool B, Bank 1
P3	Tool A, Bank 3	Tool B, Bank 1	Tool C, Bank 2
P4	Tool B, Bank 1	Tool A, Bank 3	Tool C, Bank 2
P5	Tool B, Bank 2	Tool C, Bank 1	Tool A, Bank 3
P6	Tool B, Bank 3	Tool A, Bank 2	Tool C, Bank 1
P7	Tool C, Bank 1	Tool A, Bank 2	Tool B, Bank 3
P8	Tool C, Bank 2	Tool B, Bank 3	Tool A, Bank 1
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P10	Tool A, Bank 1	Tool C, Bank 2	Tool B, Bank 3
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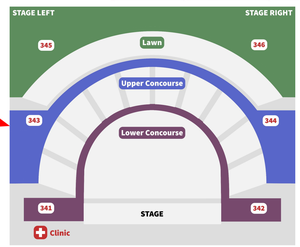
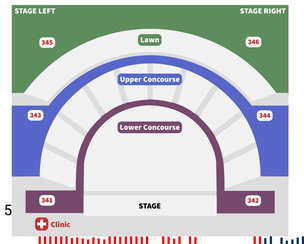
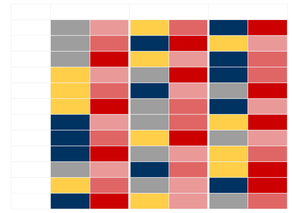
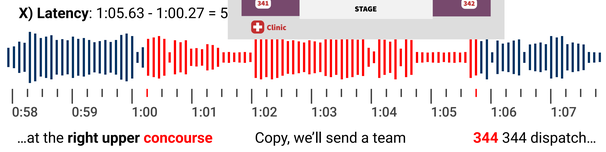
P12	Tool C, Bank 3	Tool B, Bank 1	Tool A, Bank 2









Block 1	
GS	Bank 1
GS	Bank 2
GS	Bank 3
BC	Bank 1
BC	Bank 2
BC	Bank 3
CC	Bank 1
CC	Bank 2
CC	Bank 3
GS	Bank 1
BC	Bank 2
CC	Bank 3

Subject	Block 1		Block 2		Block 3	
1		Bank 1	BC	Bank 2	CC	Bank 3
2		Bank 2	CC	Bank 3	DG	Bank 1
3		Bank 3	BC	Bank 1	CC	Bank 2
4		Bank 1	GS	Bank 3	CC	Bank 2
5		Bank 2	CC	Bank 1	GS	Bank 3
6		Bank 3	GS	Bank 2	CC	Bank 1
7		Bank 1	GS	Bank 2	DG	Bank 3
8		Bank 2	BC	Bank 3	GS	Bank 1
9		Bank 3	GS	Bank 1	DG	Bank 2
10		Bank 1	CC	Bank 2	DG	Bank 3
11		Bank 2	GS	Bank 1	CC	Bank 3
12		Bank 3	GS	Bank 1	GS	Bank 2

Subject	Block 1		Block 2		Block 3	
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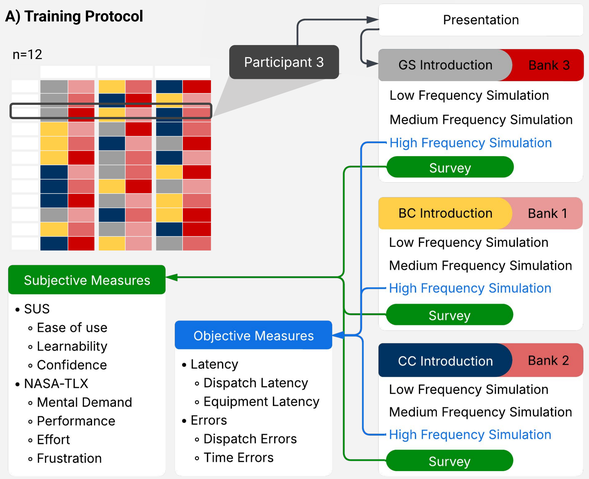

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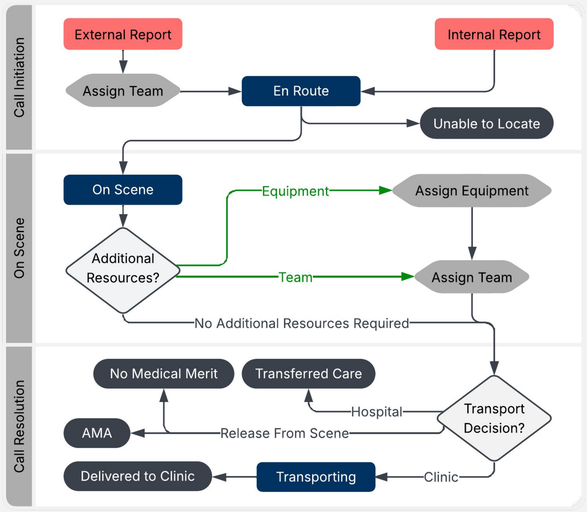

C) Latency: 1:05.63 - 1:00.27 = 5.36 seconds

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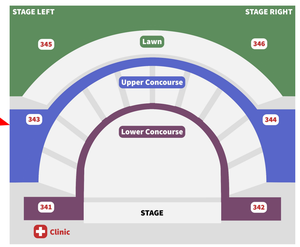
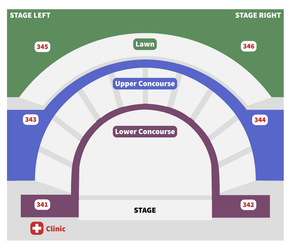
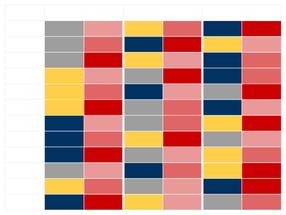
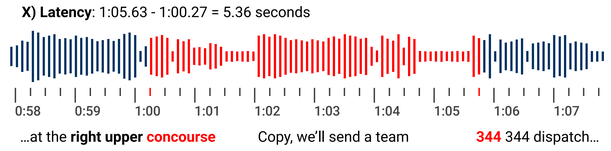






X) Latency: 1:05.63 - 1:00.27 = 5.36 seconds



Block 1	
GS	Bank 1
GS	Bank 2
GS	Bank 3
BC	Bank 1
BC	Bank 2
BC	Bank 3
CC	Bank 1
CC	Bank 2
CC	Bank 3
GS	Bank 1
BC	Bank 2
CC	Bank 3

Subject	Block 1		Block 2		Block 3	
1		Bank 1	BC	Bank 2	CC	Bank 3
2		Bank 2	CC	Bank 3	DG	Bank 1
3		Bank 3	BC	Bank 1	CC	Bank 2
4		Bank 1	GS	Bank 3	CC	Bank 2
5		Bank 2	CC	Bank 1	GS	Bank 3
6		Bank 3	GS	Bank 2	CC	Bank 1
7		Bank 1	GS	Bank 2	DG	Bank 3
8		Bank 2	BC	Bank 3	GS	Bank 1
9		Bank 3	GS	Bank 1	DG	Bank 2
10		Bank 1	CC	Bank 2	DG	Bank 3
11		Bank 2	GS	Bank 1	CC	Bank 3
12		Bank 3	GS	Bank 1	GS	Bank 2

Subject	Block 1		Block 2		Block 3	
1	GS	Bank 1	BC	Bank 2	CC	Bank 3
2	GS	Bank 2	CC	Bank 3	DG	Bank 1

Participant	Block 1	Block 2	Block 3
P1	Tool A, Bank 1	Tool B, Bank 2	Tool C, Bank 3
P2	Tool A, Bank 2	Tool C, Bank 3	Tool B, Bank 1
P3	Tool A, Bank 3	Tool B, Bank 1	Tool C, Bank 2
P4	Tool B, Bank 1	Tool A, Bank 3	Tool C, Bank 2
P5	Tool B, Bank 2	Tool C, Bank 1	Tool A, Bank 3
P6	Tool B, Bank 3	Tool A, Bank 2	Tool C, Bank 1
P7	Tool C, Bank 1	Tool A, Bank 2	Tool B, Bank 3
P8	Tool C, Bank 2	Tool B, Bank 3	Tool A, Bank 1
P9	Tool C, Bank 3	Tool A, Bank 1	Tool B, Bank 2
P10	Tool A, Bank 1	Tool C, Bank 2	Tool B, Bank 3
P11	Tool B, Bank 2	Tool A, Bank 1	Tool C, Bank 3
P12	Tool C, Bank 3	Tool B, Bank 1	Tool A, Bank 2

Subject	Block 1	Block 2	Block 3
1			
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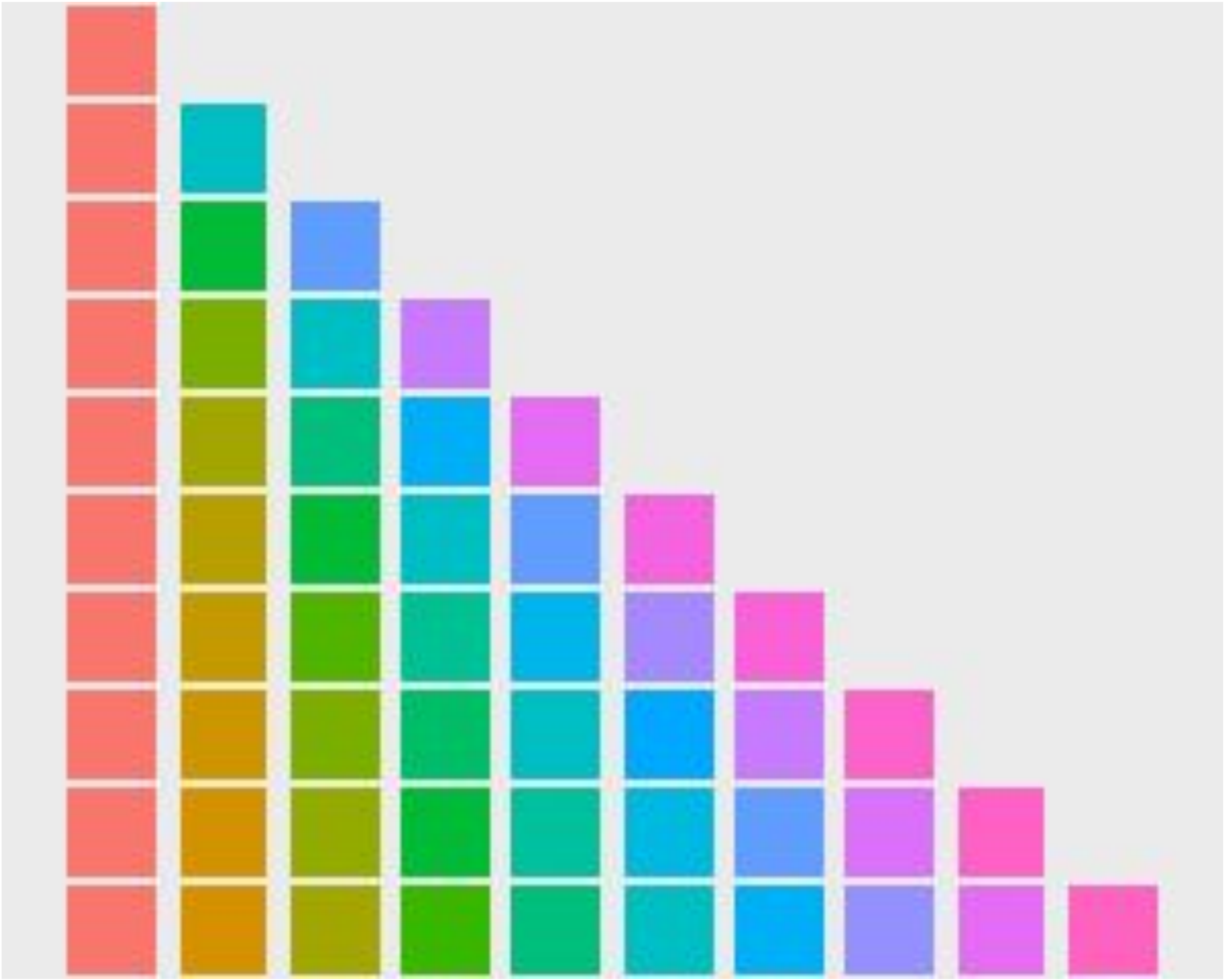
9			



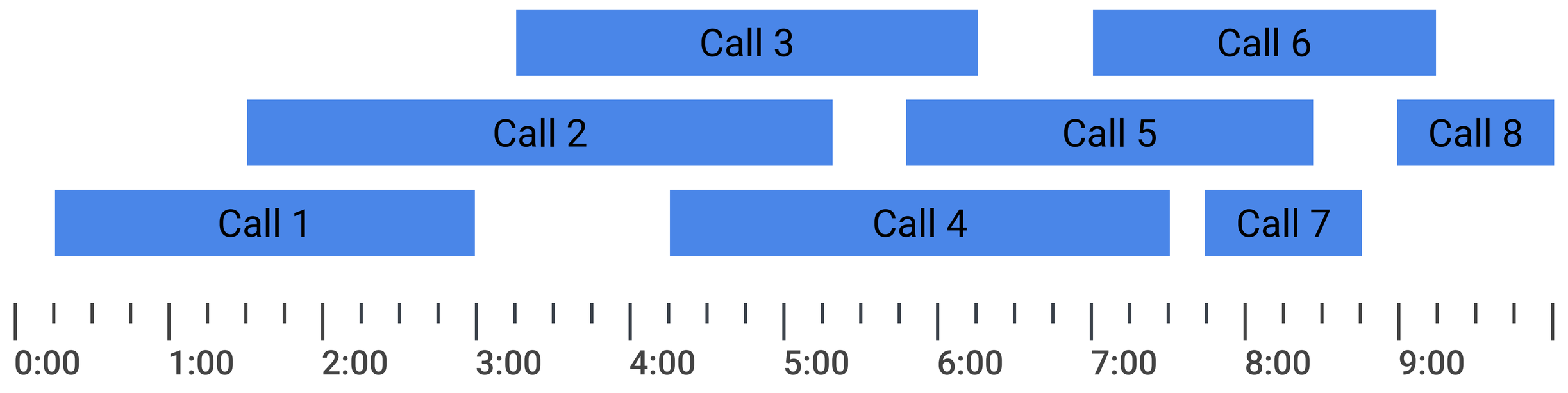
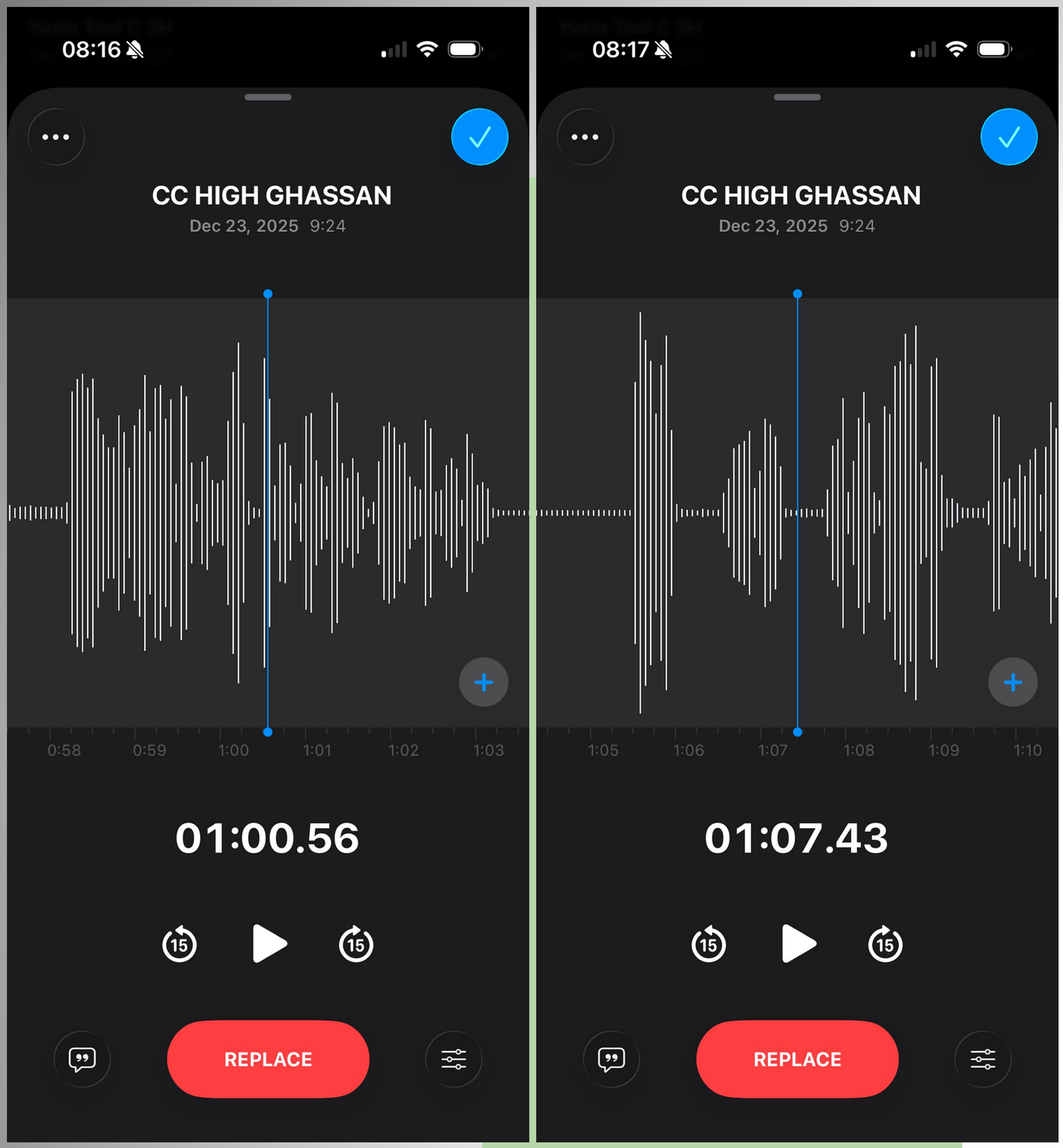
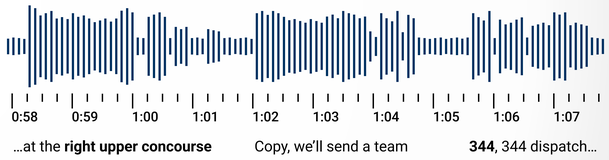


Figure 1. Insert caption



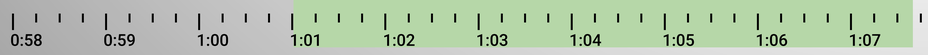


…we need medical at the **right upper concourse**

Copy that, we'll send a team

344, 344 dispatch

Go for 344….



Introductory presentation

Tool 1 exploration
Tool 1 easy simulation
Break to ask questions
Tool 1 medium simulation
Break to ask questions
Tool 1 hard simulation
Survey

Tool 2 exploration
Tool 2 easy simulation
Break to ask questions
Tool 2 medium simulation
Break to ask questions
Tool 2 hard simulation
Survey

Tool 3 exploration
Tool 3 easy simulation
Break to ask questions
Tool 3 medium simulation
Break to ask questions
Tool 3 hard simulation
Survey

Subject	Block 1		Block 2		Block 3	
1	GS	Bank 1	BC	Bank 2	CC	Bank 3
2	GS	Bank 2	CC	Bank 3	DG	Bank 1
3	GS	Bank 3	BC	Bank 1	CC	Bank 2
4	BC	Bank 1	GS	Bank 3	CC	Bank 2
5	BC	Bank 2	CC	Bank 1	GS	Bank 3
6	BC	Bank 3	GS	Bank 2	CC	Bank 1
7	CC	Bank 1	GS	Bank 2	DG	Bank 3
8	CC	Bank 2	BC	Bank 3	GS	Bank 1
9	CC	Bank 3	GS	Bank 1	DG	Bank 2
10	GS	Bank 1	CC	Bank 2	DG	Bank 3
11	BC	Bank 2	GS	Bank 1	CC	Bank 3
12	CC	Bank 3	GS	Bank 1	GS	Bank 2

Participant	Block 1	Block 2	Block 3
P1	Tool A, Bank 1	Tool B, Bank 2	Tool C, Bank 3
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P5	Tool B, Bank 2	Tool C, Bank 1	Tool A, Bank 3
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P7	Tool C, Bank 1	Tool A, Bank 2	Tool B, Bank 3
P8	Tool C, Bank 2	Tool B, Bank 3	Tool A, Bank 1
P9	Tool C, Bank 3	Tool A, Bank 1	Tool B, Bank 2
P10	Tool A, Bank 1	Tool C, Bank 2	Tool B, Bank 3
P11	Tool B, Bank 2	Tool A, Bank 1	Tool C, Bank 3
P12	Tool C, Bank 3	Tool B, Bank 1	Tool A, Bank 2

Dispatch Performance in Collegiate EMS Event Standby

Evan Passalacqua, EMT[1,2]; Ivan Zhang, EMT[1,2]; Sophia Levin, EMT[1]; Deren Bog, EMT[1]; Megan Foy, MD[3]

[1]Berkeley Medical Reserve Corps, [2]University of California, Berkeley Department of Statistics,
[3]University of California, San Francisco Department of Emergency Medicine

Abstract

Copy and paste accepted abstract here.

Introduction

Briefly describe rationale for conducting study, background literature, study objectives, and hypotheses (if applicable).

Methods

Briefly describe research methodology. Note whether Institutional Review Board (IRB) approval was obtained (if applicable).

Results

Briefly describe the main research findings. Include figures and tables as needed.

Discussion/Conclusion

Briefly discuss the most important findings, implications of the findings, limitations of the study, and future plans to continue the research.

References

1. Format in American Medical Association (AMA) style.
2. Cite references in the body of the poster with a superscript.
3. Up to 5 references max.

Acknowledgments

Acknowledge all contributors who are not listed as authors. Acknowledge any funding sources and any potential conflicts of interest.

Contact

List contact information for corresponding author/presenter.

University of Science
Knowledge Grows
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A Scientific Case Study on Enhancing Water Access in Developing Nations (AMET) 2029

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Introduction

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Methods

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1. Literature Review

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2. Laboratory Experiments

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3. Data and Findings

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Conclusion

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Reference

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Acknowledgements

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