Developing Methods to Perform Smartphone-based Studies of Trauma Survivors: Lessons from the AURORA Study

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Introduction

- Adverse posttraumatic neuropsychiatric sequelae (APNS) are common among civilian trauma survivors and military service members[1].
- Nearly 80% of the US population owns a smartphone; this percentage continues to rapidly increase[2].
- Smartphones offer tremendous opportunity to identify trauma survivors at high risk of posttraumatic neuropsychiatric sequelae and deliver preventive interventions.
- Realizing this opportunity requires the development of methods to obtain high quality smartphone data from trauma survivors.

Methods

- The AURORA Study enrolls 5,000 trauma survivors at dozens of emergency departments across the US.
- The Discovery by Mindstrong™ App is installed on participant's smartphone in the emergency department and collects passive and active data (smartphone interface, intermittent flash surveys, and audio recording) for 12 months.
- These data are used to gain improved understanding of individuals' experiences and behaviors during APNS development.
- Android devices collect passive data through their Accessibility feature whereas iOS devices collect passive data through the keyboard.

Table 1. Trauma Survivor Characteristics (n=1,407)

	Overall N	Overall (%)
Gender		
Male	509	(36)
Female	898	(64)
Age		
18 to 24 years	331	(24)
25 to 50 years	829	(59)
51 to 75 years	247	(18)
Education		
No High School	177	(13)
High School Diploma/GED	362	(26)
Some College/Associates	575	(41)
Bachelor's Degree	188	(13)
Postgraduate Degree	100	(7)
Race		
White	443	(31)
Black or African American	747	(53)
Other	148	(11)
Two or More Races	69	(5)
Ethnicity		
Not Hispanic	1228	(88)
Hispanic	173	(12)
Income		
0 - 35K	773	(66)
35K - 75K	259	(22)
75K +	142	(12)
Trauma Type		
Motor Vehicle Collision	1089	(77)
Physical Assault	136	(10)
Fall, less than 10 feet or from unknown	39	(3)
Animal-related	27	(2)
Other	116	(8)

Figure 1. Passive smartphone data assessments include touches (keystrokes, taps, and swipes), accelerometry (movement/activity), word cloud (daily word counts to apply algorithmic sentiment analyses), and GPS.

Figure 2. Passive smartphone data is consistently collected on an Android. On an iOS device, passive smartphone data is collected when participants use the Mindstrong keyboard.

Fig 3. Proportion of touches on >50% of study days

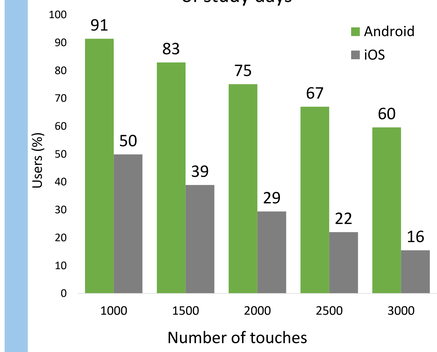


Fig 4. Proportion of touches on >75% of study days

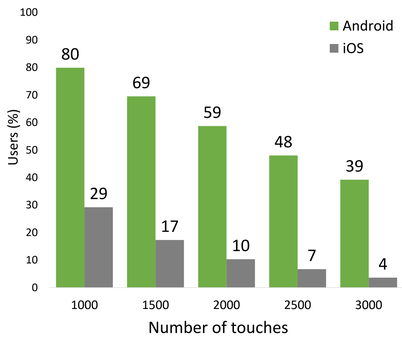
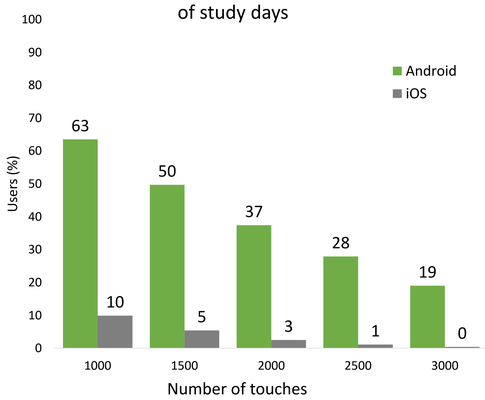


Fig 5. Proportion of touches on >90% of study days



Figures 3-5. Cumulative number of smartphone touches on Android vs. iOS devices at various AURORA study timepoints.

Table 2. Issues and Countermeasures

Issues	Countermeasures
Fragmented updates across operating systems during quarterly releases.	Sent out mass communications to participants in preparation for quarterly releases.
Participants unable to remotely download app.	Over the phone downloads with follow-up team .
(iOS) Unfriendly predictive auto-correct function in the keyboard.	(iOS) Improvements to emojis and autocorrect keyboard functions.

Results

- 80% of Android users recorded 1000 smartphone touches on 75% of days or more, 50% of iOS users recorded 1000 touches on 50% of days or more (Fig. 3-5).
- Methodologic improvements realized during the first 1,000 iOS/Android users enrolled include moving from unscheduled to quarterly app updates (86% data loss, n=229 vs. 6% data loss, n=356; p<0.001), sharing comprehensive user feedback early in the study with Mindstrong Health team, and instituting a range of countermeasures (Table 2).

Conclusions

- Smartphone-based passive and active assessments of trauma survivors are feasible.
- Sharing of methodologic improvements across studies will speed realization of the exciting potential of smartphone-based assessments to improve the lives of trauma survivors.

References

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Funding

Research reported in this presentation was supported by the National Institute of Health under Award Number R01 U01MH110925. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.