

Poster

Feasibility of Using a Game-Based Cognitive Assessment for Older Adults in Emergency Care

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Abstract

Background: Developed nations are currently facing a demographic shift towards a higher proportion of elderly people and increasing age-related health concerns. Elderly adults often enter into the health care system through emergency services. As a result, emergency departments (EDs) are an opportune environment for cognitive screening to improve patient outcomes. Existing methods are not designed for use in EDs and require administration by a trained test administrator. As an alternative, we suggest serious games as screening tools that can be self-administered or used with minimal assistance in emergency care. The use of validated and reliable serious games can encourage more efficient and engaging cognitive screening.

Objective: Our objective was to investigate the feasibility and usability issues identified in the process of evaluating the validity and reliability of a game-based cognitive screening tool administered on an interactive tablet, for use by elderly adults in emergency care.

Methods: We carried out a study in a hospital ED to evaluate the validity of the serious game with elderly adults over the age of 70 years (N=146). Validity was assessed in terms of the correlation of game performance with outcomes of current assessment methods. Comparative assessments included the Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), and the Confusion Assessment Method (CAM). We also assessed the reliability of our game-based assessment tool in a hospital ED for a large subset of the patients who underwent a revised protocol involving follow-up sessions at a minimum of every 8 hours (n=127). In both studies, research personnel (RP) administered the standard cognitive assessments and then asked the patients to play the serious game. Recruitment for the reliability study overlapped with our validation study, with 56 potential overlap cases.

Results: In our validation group, 141 of 146 patients consented to play the serious game. Performance on the serious game correlated significantly with the MoCA ($r=-0.339$, $P<.001$), MMSE ($r=-0.558$, $P<.001$), CAM ($r=0.565$, $P<.001$), and other cognitive assessments. In our reliability study of 127 adults, we obtained data from 126 people. We observed good test-retest reliability with Pearson correlation r values between 0.5 and 0.7. These results supplement findings from our validation study that the assessment was correlated with MMSE, MoCA, and CAM scores. Usability feedback suggested that the game was too easy and the need to use a stylus for users with dry skin. All patients were able to play the serious game administered on a tablet

either independently or with minimal assistance from RP. In the latter case, RP would assist by holding the tablet as some patients found it heavy.

Conclusions: This research demonstrates the feasibility, validity, and reliability of using a game-based cognitive assessment in a clinical setting. Elderly users in an ED can use our screening tool by improving on the usability of the system by incorporating their feedback in our design process. This research shows that appropriately designed serious games can be self-administered or used with minimal assistance in a clinical setting repeatedly for each person.

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KEYWORDS

cognitive assessments; cognitive screening tools; computerized assessments; games; human computer interaction; human factors; neuropsychological tests; screening; serious games; tablet computers; technology assessment; usability; validation studies; video games

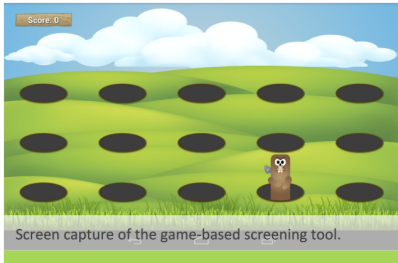
This poster was presented at the Connected Health Symposium 2016, October 20-21, Boston, MA, United States. A photo of the poster is displayed as an image in [Figure 1](#) and as a higher resolution image in [Multimedia Appendix 1](#).

Figure 1. Poster.

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Screen capture of the game-based screening tool.

Methods

- We carried out a study in a hospital ED to evaluate the validity of the serious game with elderly adults over the age of 70 years (n = 146).
- Validity was assessed in terms of the correlation of game performance with outcomes of current assessment methods. Comparative assessments included the Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), and the Confusion Assessment Method (CAM).
- We also assessed the reliability of our tool in a hospital ED involving follow-up sessions at a minimum of every 8 hours (n = 127).

	Initial Enrollment	Follow Up 1	Follow Up 2	Follow Up 3
Initial Enrollment	1	.775 <i>p</i> < .001	.594 <i>p</i> = .003	.862 <i>p</i> < .001
Follow Up 1		1	.821 <i>p</i> < .001	.821 <i>p</i> = .001
Follow Up 2			1	.560 <i>p</i> = .037
Follow Up 3				1

Table 2. Relationships between sessions on serious game median RT, was determined using two-tailed Pearson's *r* correlations from the reliability study. Shaded grey areas highlight adjacent sessions.

Background

- Elderly adults often enter into the healthcare system through emergency services. As a result, emergency departments (EDs) are an opportune environment for cognitive screening to improve patient outcomes. We suggest serious games as screening tools that can be self-administered or used with minimal assistance in emergency care. The use of validated and reliable serious games can encourage more efficient and engaging cognitive screening.

Objective

- The objective is to investigate the feasibility and usability issues identified in the process of evaluating the validity and reliability of a game-based cognitive screening tool administered on an interactive-tablet, for use by elderly adults in emergency care.

	Game RT	Game Acc	MMSE	MoCA	CAM	DI	RASS	DVT
Game RT	1	.132 <i>p</i> = .12	-.558 <i>p</i> < .001	-.229 <i>p</i> < .001	.565 <i>p</i> < .001	.280 <i>p</i> < .001	-.296 <i>p</i> < .001	-.122 <i>p</i> = .48
Game Acc		1	-.104 <i>p</i> = .22	-.042 <i>p</i> = .67	.071 <i>p</i> = .40	.048 <i>p</i> = .46	-.108 <i>p</i> = .12	.432 <i>p</i> = .008
MMSE			1	.630 <i>p</i> < .001	-.693 <i>p</i> < .001	-.689 <i>p</i> < .001	.339 <i>p</i> < .001	.200 <i>p</i> = .24
MoCA				1	-.505 <i>p</i> < .001	-.339 <i>p</i> < .001	.193 <i>p</i> = .01	.192 <i>p</i> = .28
CAM					1	.515 <i>p</i> < .001	-.644 <i>p</i> < .001	.a
DI						1	-.418 <i>p</i> < .001	-.037 <i>p</i> = .79
RASS							1	.a
DVT								1

Correlations involving the CAM were calculated using point-biserial correlations. Correlations involving the DI and RASS (and not involving the CAM) were assessed using Spearman *rho*. All other correlations were calculated using Pearson *r*.
 .aCannot be computed because at least one of the variables is constant.

Table 1. Correlations comparing game performance to the standard cognitive assessments from the validation study.

Results

- In our validation group, of 141/146 patients consented to play the serious game. Performance on the serious game correlated significantly with the MoCA (*r* = -0.339, *p* < .001), MMSE (*r* = -0.558, *p* < .001), CAM (*r* = 0.565, *p* < .001), and other cognitive assessments (see Table 1).
- In our reliability study of 127 adults, we obtained data from 126 people. We observed good test-retest reliability with Pearson correlation *r*-values between 0.5–0.7 (see Table 2). These results supplement findings from our validation study that our game-based screening tool was correlated with MMSE, MoCA, and CAM scores.

Conclusion

- This research demonstrates the feasibility, validity, and reliability of using a game-based cognitive assessment in a clinical setting. Elderly users in an ED can use our screening tool by improving on the usability of the system by incorporating their feedback in our design process.

Multimedia Appendix 1

Poster.

[\[PDF File \(Adobe PDF File\), 1MB-Multimedia Appendix 1\]](#)

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