



Introduction of an Electronic Mobile Device Version of an Alcohol Impairment Scale (the Hack's Impairment Index Score) Does Not Impair Nursing Assessment of Patients in Emergency Departments [☆]

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ABSTRACT

Background: There is no formal assessment to determine level of disability in the millions of patients with alcohol-induced impairment who present to emergency departments annually. Hack's Impairment Index (HII) is a standardized, serializable clinical tool designed to quantify ability. Nursing staff members at this center perform the HII and determine a score using paper prompts.

Objective: We developed an HII electronic application and investigated whether or not an electronic version on a mobile device would affect nursing performance.

Methods: A chart review-based quality improvement project compared the number, repetitions, and completeness of HII score documentation performed by nurses over 6.5 months. Group 1: paper-based HII scores for the 90-day period before intervention; group 2: iPad-based HII scores for the 90 days after intervention. There was a 2-week period for staff training and electronic version feedback between groups. Informal, ad hoc interviews were performed with nurses at investigation termination.

Results: Group 1: 476 emergency department patients with alcohol-induced impairment had HII scores ordered; 339 (71.2%; 95% CI, 67.1, 75.3%) had HII assessments with a total of 539 HII scores documented. An average (SD) 1.60 (0.01) serial assessments occurred per patient, 5 (1.1%; 95% CI, (0, 2.2%)) scores were incomplete. Group 2: 569 alcohol-induced impairment emergency department patients were seen and had HII scores ordered; 420 (73.8%; 95% CI, (70.2, 77.4%)) had HII assessments with a total of 639 HII scores documented. An average (SD) 1.52 (0.03) serial assessments occurred per patient, 4 (0.9%; 95% CI, (0.81, 0.99%)) had incomplete HII scores.

Conclusions: Although our study took place at 1 center, was a chart review, and not directly observed, we found that the mobile device-based HII application to determine a score did not interfere with nursing performance. Specifically, the repetition and completeness of nursing assessments of emergency department patients with impairment from alcohol use was not altered when comparing paper chart documentation with electronic format documentation. (Curr Ther Res Clin Exp. 2021; 82:XXX-XXX)

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Introduction

Care of patients with alcohol-induced impairment (AI) presents a significant challenge to emergency department (ED) providers.

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Across the United States, an estimated 24% to 31% of patients seen in EDs screen positive for alcohol problems.^{1–3} These patients come from all walks of life and socioeconomic backgrounds and EDs provide safety-net health care for people without access to primary care physicians. Reports suggest almost half of homeless adults have an alcohol dependence disorder.⁴ There are more than 5 million AI patients presenting to EDs annually.⁵ The presence of alcohol is a recognized confounder in diagnosing critically important significant medical etiologies,⁶ including intercranial bleeding,^{7,8} cervical spine injuries,^{9,10} stroke,^{11,12} and other severe ill-

nesses^{13–16} that are hidden by concurrent alcohol impairment. Previous research reports that diagnosis of intracranial hemorrhage was often delayed because it was obscured by clinical intoxication and by inconsistent examinations.^{17,18}

Methodological laboratory or bedside alcohol testing can provide a quantitative result indicating the presence and concentration of alcohol in a biological reservoir (eg, breath, blood, or saliva). These tests give no information as to the person's physiologic response to the presence of alcohol. Currently, there is no formal assessment to determine the level or degree of alcohol induced functional impairment at ED presentation, or to determine when a patient with AI is ready for disposition. Identifying the window when a patient is least compromised (ie, no longer grossly impaired and before they experience withdrawal symptoms) could prompt and allow re-engagement with the patient to determine his or her interest in seeking help for an alcohol-use disorder.

Hack's Impairment Index (HII) is a clinical tool designed to quantify a standardized, serializable evaluation of patients with AI.^{19–21} It was developed and is used daily at a high-volume, academic, university center in the Northeast to evaluate patients with AI presented at an ED. Nurses routinely perform HII evaluations using paper prompts; these evaluations are repeated as needed to serially assess and document degree of clinical impairment.

We converted the HII's paper scoring system into an electronic application (app) (known as the HII Score App) for use on computer and mobile device platforms with the goals of increasing the thoroughness and ease of the tool's use at the bedside. Introduction of electronic procedures into clinical environments has to be done carefully, with input from clinical shareholders for it to have a successful implementation, which is often defined as actual use on the clinical floor.²²

Our initiative to improve nursing documentation and assessment of patients presenting with AI sought to explore the feasibility of the introduction of an electronic mobile-device based HII Score App and whether it would interfere with the usual paper-based practice and be accepted by nursing staff.

Methods

Project design

This was an institutional review board reviewed/approved, retrospective, chart review quality initiative project that examined documentation performed by nurses on patients with AI presenting to an ED within 2 time frames over a 6.5-month period from April to October 2019. An ad hoc analysis of the annual ED visits for alcohol-related issues in our institution revealed minimal seasonal variance.

The 90-day time frame, both pre- and postintroduction of the app was to ensure that all nursing staff members had sufficient experience with the tool to develop familiarity, that we could assess usual use as use of the tool became routine, and that the data set pre- and postintroduction was sufficiently large for statistical analysis.

The rationale for this investigation was designed to compare the number, frequency, and completeness of the HII scores being performed by nursing using a paper-based charting system for their documentation with their charting for comparable patients using an electronic version of the HII Score App on an iPad. We additionally performed informal ad hoc interviews with nurses to assess their acceptance of the electronic format app.

Setting

The project's site is a busy (>103,000 adult visits/year), high acuity, urban, tertiary care center that has a behavioral health unit

(D-Pod) that is a 24-bed unit with >3500 visits annually for AI after initial screening for demonstrable illness or injury. During their time in the ED, these patients are under direct observation and are serially assessed by a dedicated team of nurses who routinely perform and record HII scores until disposition.

Participants

Any active duty ED nurses working in the D-Pod who routinely evaluated patients with AI using the HII during the enrollment period were eligible to voluntarily participate. There are approximately 20 nurses who routinely staff the D-Pod with credentials that include registered nurse, Bachelor of Science in Nursing, Certified Emergency Nurse, and nurse practitioner. Orientation and education about the project was performed face to face over a period of 2 weeks to engage as many participants as possible. Posters were hung in the D-Pod clinical area to remind potential participants of the project, also with instructions on how to use the iPad app. Decision to participate was not logged or shared with anyone, including nursing leadership. There were no foreseen risks with participation in this project because nursing assessment includes the routine use of the HII score in the ED. There were no costs or compensation for the participating nurses.

Scoring

Specifics for the HII score evaluation assessment have been previously published.^{19,20} Briefly, the HII is made up of 5 task-completion activities, each is scored from 0 to 4. These 5 tasks include speech quality and mentation (best response and content), gross motor skills (stability on sitting upright, standing, and walking), eye movement (accuracy of tracking an object and nystagmus), coordination with target pursuit (touching a finger to a target), and fine motor skills (ability to trace a line between 2 preprinted curves). Broadly, each task is scored 4 if a patient is unable to comply, 3 if a patient could try to comply but not complete the task, 2 if a patient could do the task poorly, 1 if the patient could do the task but not perfectly, and 0 if a patient could do the task perfectly. If a patient refused to participate in a task, this was documented and the section was unscored. The final HII score is the sum of scored tasks and the index is obtained by dividing the sum of all subscores by the number of completed tasks. The HII score is ordered by the initial examining health care provider. The frequency of test repetition during a patient's time in the ED is selected by the provider. The HII assessment is performed by 1 nurse who guides the patient through the 5 activities using either paper prompts or the electronic prompts from the iPad app. The assessment takes approximately 2 to 4 minutes to perform.

Data abstraction

Data were abstracted from the electronic health records for patients presenting to the ED who were admitted for observation to the behavioral health unit with an alcohol-related chief complaint. The study period was April to October 2019. Patient encounters were included if any HII assessment was ordered by an ED physician.

Protocol

This quality initiative project was quasi-experimental design using a pre-post approach that compared the number, repetitions, and completeness of HII score documentation performed by nurses on patients with AI ED visits over 6.5 months in 2 grouped time frames.

Group 1, preintervention

Ninety-day chart review of paper-documented HII scores for behavioral unit patients with a primary discharge diagnosis of alcohol intoxication, alcohol use disorder, or a related etiology was retrospectively reviewed by our business intelligence and information technology department (D.F.) for the adherence to protocol, number, frequency, and completeness of HII score assessments to establish a preintervention baseline. The 90-day aggregate data set was anonymized with regard to both the health care provider and the patient from whom the chart was assessed. The anonymous data were reported to the quality initiative project leaders, and only in aggregate.

Group 2, postintervention

Ninety-day chart review of iPad app-based HII scores from charts with identical inclusion and anonymized as occurred with Group 1. This group was also evaluated for adherence to the protocol, and number, frequency, and completeness of HII score assessments.

There was a 2-week period for staff training and app feedback between intervals. At the end of the study, informal, ad hoc conversations were had with nurses who used the HII Score App.

Training

The behavioral unit nursing staff was in-serviced to the iPad-based electronic version of the HII score by the project leader (J.H.) over a 2-week period. During the training period, meetings were held with nursing where they were oriented to the project using a standardized, approved script that described what would be involved. During these meetings they were introduced to the app on the iPad, and had the opportunity to use it and ask questions. A station for the 1 iPad was created within the nursing station on the main desk as a centralized location and charging place so it was easily located and continuously available for them to explore the app. This was also where the iPad was located for the intervention phase of the initiative. This occurred over 2 weeks to ensure providers had a chance to see and use the app for familiarization and to ask and submit questions. During the training period, any perceived issues or suggestions were evaluated for incorporation into the app for optimization. For example, 1 of the nurses made the suggestion to change the order of the results to align better with other documentation. This adjustment was immediately applied to enhance ease of use.

Equipment

One iPad, fifth generation, 9.7 in, iOS 13.6.4 (Apple Inc, Cupertino, California) was employed. The HII Score App version 2.0 developed by Oleander Inc (Providence, RI) was installed on the iPad.

Data analysis

For each of the extracted electronic medical records, the number of patients who had an HII score ordered by the provider both pre- and postimplementation of the app were counted. The proportion of patients with impairment related to their alcohol use who had any HII scores recorded, and the total number of HII scores documented by nurses, were calculated at each time period. The proportion of scores ordered with 95% CI and mean (SE) number of HII scores was reported.

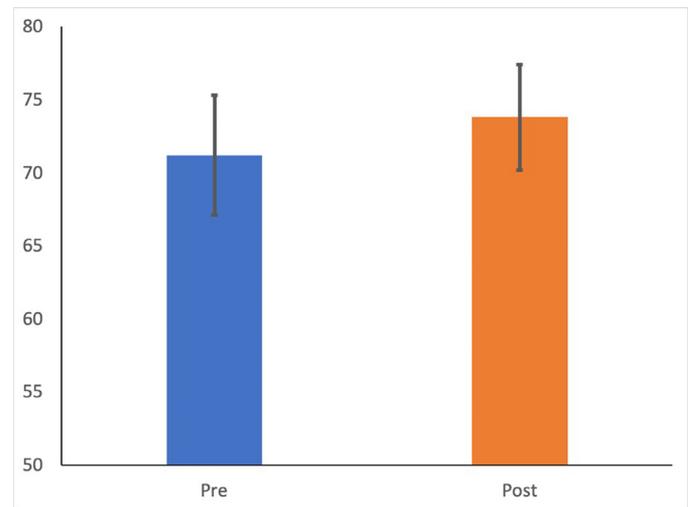


Figure. Percent of patients assessed by nursing staff members with Hack's Impairment Index score: paper format (Pre) and electronic format (Post).

Results

For group 1, where the HII was administered and recorded on paper, 476 patients with AI presenting to our ED had HII scores ordered by an ED physician; 339 (71.2%; 95% CI, $\pm 4.1\%$) patients had HII assessments performed, with a total of 539 HII scores documented. There was an average (SE) of 1.60 (0.01) serial assessments per patient, with 5 (1.1%; 95% CI, $\pm 1.1\%$) scores that were incomplete (Figure).

During the implementation time period, group 2, where the HII app was used to administer and record the results, 569 patients with AI presenting to our ED had HII scores ordered; 420 (73.8%; 95% CI, $\pm 3.6\%$) patients had HII assessments performed with a total of 639 HII scores documented. An average (SE) of 1.52 (0.03) serial assessments occurred per patient, with 4 (0.9%; 95% CI, $\pm 0.09\%$) scores that were incomplete (Figure).

Qualitative data

Postassessment, informal, ad hoc discussions were held with individuals and small groups of nurses who participated in the initiative. These free-form discussions encouraged and engaged participants to describe in subjective terms how they believed their workflow was influenced and their overall impression of the app compared with their prior use of paper prompts. The common theme was the iPad app version was described as "easier," "quicker," and "preferred to use it" over the paper version.

Discussion

Currently, the assessment of patients with AI in EDs primarily relies on serial evaluations over an extended time period by bedside providers (usually nursing) and often involves different providers during and between shifts. The documentation of these assessments is typically unformatted and subjective (eg, "still drunk" or "ready for discharge"). Statements like these have limited ability to convey clinical description of a patient's impairment and change of it through time. The lack of an objective tool can result in irregular evaluations and documentation. Additionally, evaluation variability likely extends between providers who have different levels of familiarity with patients with AI. With no standard evaluation tool, there is limited ability for a provider to objectively estimate degree of impairment and its resolution through time; the documentation of serial examinations and examinations from

1 provider to the next may also be inconsistent. These issues suggest the need for a clinically relevant, objective, and easily administered at the bedside, functional assessment of patients' level of AI. HII score is a published, unique, standardized, serializable clinical assessment tool that was developed to evaluate patients with impairment related to their alcohol use in the ED.^{19,20}

With current trends being away from paper and toward electronic formats, we sought data and insight on how introduction of an app version of the HII score at a center already determining HII score on paper would affect practitioner performance with the tool. This e-tool introduction gives actionable clinical use data on whether the complicated next step of electronic medical record integration is warranted.

An iPad with the app was introduced into our clinical environment with specific attributes designed to assist the bedside providers perform the evaluation. Attributes of the app included clear graphic and written descriptions for the scores for each of the 5 sections¹⁹; had onscreen, interactive, self-scoring, animated graphics for both the line tracing and target pursuance sections; help screens for each section with detailed descriptions of how to perform each test; and a summary screen that calculated and displayed the HII score, index, and estimated time of resolution of the clinical impairment.

HII Score App's effect on workflow and subjective information on user experience are recommended first steps to assessing its (or any app's) ultimate acceptance.²³ The Technology Acceptance Model's attempt to describe "whether an information system is successful or not." And, this "is decided on the work floor."²⁴ This information is important because objective evaluations of electronic interventions may anticipate providers' use of the proposed functional technology and study of electronic interventions' acceptance predicts likelihood that it will actually be used in clinical settings.²⁵

Our results show that there was no loss in patient assessment data moving from paper to app based administration of the HII, and provider feedback suggested that this was the preferred method to assess function of AI patients presenting to the ED.

The limitations of this quality initiative project include that our data are from 1 center only. Results from other institutions might be different and should be explored. Although the app version of the HII score contains many enhancements designed to assist first-time users and people less familiar with performance of this clinical assessment, the present study introduced the app in a center familiar with the tool. Future study should investigate ease of integration and acceptance at centers not currently using the tool. Additionally, although training and introduction of the HII Score App initiative into nursing workflow occurred over a 2-week period, there may have been nurses who missed this information because of scheduling.

Conclusions

We found that the introduction of an app version of the HII score clinical assessment tool did not interfere with nursing documentation when compared with the institution's standard protocol of using a handwritten format. Specifically, the repetition and completeness of nursing assessments of patients with impairment from alcohol use in our ED was not altered when comparing paper chart documentation with electronic format documentation.

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J. Hack and J. Baird were responsible for study concept and design, interpretation of the data, acquisition of the data, and critical revision of the manuscript for important intellectual content. J. Baird was responsible for providing statistical expertise, whereas J. Hack was responsible for acquisition of funding. Drafting of the manuscript was undertaken by J. Hack, J. Baird, and D. Ferrante.

Conflicts of Interest

The authors have indicated that they have no conflicts of interest regarding the content of this article.

References

- Li G, Keyl PM, Rothman R, Chanmugam A, Kelen GD. Epidemiology of alcohol-related emergency department visits. *Academic Emerg Medicine*. 1998;5(8):788–795.
- Gentilello LM, Donovan DM, Dunn CW, Rivara FP. Alcohol interventions in trauma centers. Current practice and future directions. *JAMA*. 1995;274(13):1043–1048.
- Soderstrom CA, Smith GS, Dischinger PC, et al. Psychoactive substance use disorders among seriously injured trauma center patients. *JAMA*. 1997;277(22):1769–1774.
- Fazel S, Khosla V, Doll H, Geddes J. The prevalence of mental disorders among the homeless in western countries: systematic review and meta-regression analysis. *PLoS Med*. 2008;5(12):e225 2.
- White AM, Slater ME, Ng G, Hingson R, Breslow R. Trends in alcohol-related emergency department visits in the United States: results from the nationwide emergency department sample, 2006 to 2014. *Alcohol Clin Exp Res*. 2018 Feb;42(2):352–359.
- Savola O, Niemelä O, Hillbom M. Alcohol intake and the pattern of trauma in young adults and working aged people admitted after trauma. *Alcohol Alcohol*. 2005;40(4):269–273 PMID:15870091.
- Weil ZM, Corrigan JD, Karelina K. Alcohol use disorder and traumatic brain injury. *Alcohol Res*. 2018;39(2):171–180.
- Corrigan JD. Substance abuse as a mediating factor in outcome from traumatic brain injury. *Arch Phys Med Rehabil*. 1995;76(4):302–309 PMID:7717829.
- Wales LR, Knopp RK, Morishima MS. Recommendations for evaluation of the acutely injured cervical spine: a clinical radiologic algorithm. *Ann Emerg Med*. 1980 Aug;9(8):422–428.
- Hoffman JR, Schriger DL, Mower W, Luo JS, Zucker M. Low-risk criteria for cervical-spine radiography in blunt trauma: A prospective study. *Ann Emerg Med*. 1992;21:1454–1460.
- Mostofsky E, Chahal HS, Mukamal KJ, Rimm EB, Mittleman MA. Alcohol and immediate risk of cardiovascular events: a systematic review and dose-response meta-analysis. *Circulation*. 2016 Mar 8;133(10):979–987.
- Arokszallasi T, Balogh E, Csiba L, et al. Acute alcohol intoxication may cause delay in stroke treatment – case reports. *BMC Neurol*. 2019;19(14). doi:10.1186/s12883-019-1241-6.
- Mehta AJ. Alcoholism and critical illness: a review. *Pediatr Crit Care Med*. 2016;5:27–35.
- Strate LL, Singh P, Boylan MR, et al. A prospective study of alcohol consumption and smoking and the risk of major gastrointestinal bleeding in men. *PLoS One*. 2016;11.
- Moss M. Epidemiology of sepsis: race, sex, and chronic alcohol abuse. *Clin Infect Dis*. 2005;41(Suppl 7):S490–S497.
- O'Brien Jr JM, Lu B, Ali NA, et al. Alcohol dependence is independently associated with sepsis, septic shock, and hospital mortality among adult intensive care unit patients. *Crit Care Med*. 2007;35:345–350.
- Todd K, Berk WA, Welch RD, et al. Prospective analysis of mental status progression in ethanol-intoxicated patients. *Am J Emerg Med*. 1992;10(4):271–273.
- Galbraith S. Misdiagnosis and delayed diagnosis in traumatic intracranial haematoma. *Br Med J*. 1976;1(6023):1438–1439.
- Hack JB, Goldlust EJ, Gibbs F, Zink B. The H-Impairment Index (HII): a standardized assessment of alcohol-induced impairment in the Emergency Department. *Am J Drug Alcohol Abuse*. 2014;40(2):111–117. doi:10.3109/00952990.2013.865034.
- Hack JB, Goldlust EJ, Ferrante D, Zink BJ. Performance of the Hack's Impairment Index Score: A Novel Tool to Assess Impairment from Alcohol in Emergency Department Patients. *Acad Emerg Med*. 2017;24(10):1193–1203.
- Benoit JL, Hart KW, Soliman AA, Barczak CM, Sibilla RS, Lindsell CJ, Ferrmann CJ. Developing a standardized measurement of alcohol intoxication. *Am J Emerg Med*. 2017 May;35(5):725–730.
- Berg M. Implementing information systems in health care organizations: myths and challenges. *Int J Med Inform*. 2001;64:143–156.
- Watson HA, Tribe RM, Shennan AH. The role of medical smartphone apps in clinical decision-support: A literature review. *Artif Intell Med*. 2019;100. doi:10.1016/j.artmed.2019.101707.
- Holden RJ, Karsh BT. The Technology Acceptance Model: Its past and its future in health care. *J of Biomed Inform*. 2010;43:159–172.
- Taherdoost H. A Review of Technology Acceptance and Adoption Models and Theories. *Procedia Manufacturing*. 2018;22:960–967.