

ORIGINAL ARTICLE

Promoting early management of frailty in the new normal: An updated software tool in addressing the need of virtual assessment of frailty at points of care

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Abstract

Introduction: Frailty is a state of diminished physiological reserve and can be assessed using the frailty index. Early management of frailty is crucial for preventing adverse outcomes. Intended for assessing home-living older adults, the initial release of the eFI-CGA software was prior to the coronavirus disease 2019 (COVID-19) pandemic.

Methods: In addressing the increased need of virtual assessment, the eFI-CGA was upgraded to version 3.0. In this paper, we introduce the updated electronic frailty assessment tool, reporting the newly developed features and validating its use.

Results: End-user experiences with the previous versions are discussed. The updated features include a search function to resume disrupted assessments. The improved user interface enabled clinicians to record care management details.

Conclusion: This study represents an example of software solutions in moving from disruption to transformation, benefiting healthcare for older adults during this challenging time.

KEYWORDS

eFI-CGA, electronic comprehensive geriatric assessment, electronic frailty index, standalone software tool, virtual assessment

1 | INTRODUCTION

People aged 65+ years of age in the world population is expected to double from now until 2050, and nearly a quarter of this population may be “frail.” As a state of diminished physiological reserve, frailty can impede one’s ability to recover from stressors, leading to increased adverse outcomes.¹ Frailty can be screened using the Frailty Phenotype and the Clinical Frailty Scale (CFS).^{2,3} The deficit accumulation based frailty index (FI) is widely used to assess frailty as the ratio of the number of health deficits present over those considered.⁴ An FI can be generated using items from a Comprehensive

Geriatric Assessment (CGA), which thoroughly overviews a patient’s health in the context in which health impairments may arise and appropriate care plans can be created.⁵ A CGA-derived FI (FI-CGA) that was initiated from the Canadian Study of Health and Aging’s data,⁶ has been validated based on CGA evaluations in geriatric care.⁷

The CGA is traditionally paper-based: the large number of items can make the data entry, recoding, and the FI calculation time-consuming and error-prone. The electronic frailty index (eFI) approaches have enabled more effective frailty assessments by busy frontline clinicians.⁸ Before the pandemic, our team released the eFI-CGA software that takes user input through the electronic CGA

Guarantor: The guarantor is the CIHR eFI-CGA Research Project Team.

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form and automates data recording, storage, processing, and eFI calculation.⁹ The standalone eFI-CGA allows uptake of the eFI-CGA in the electronic medical record system feasible and transparent.¹⁰

The current distancing measures due to the coronavirus disease 2019 (COVID-19) pandemic have resulted in demands for virtual assessments and care, presenting new challenges for software solutions. Challenges include connection interruptions, disturbance at patient homes (vs in-person appointments), and barriers with use of tele-care technologies.

We upgraded the standalone eFI-CGA with several new features addressing the challenges and released the eFI-CGA version 3.0. Here, we introduce the updated software tool and discuss its use at the point of care.

2 | METHODS

The standalone software and all additional updates use the WinForms library and are coded in C# programming language. Upon download, the software runs on any Windows machine.

From its initial release (version 1.0)⁹ through the current version 3.0, requirements were obtained and evaluated with the research partners and clinical end-users. Upgrades included search and retrieval functions and improved usability, as detailed below.

3 | RESULTS

Table 1 provides a summary of the various improvements made in version 3.0 (Table 1, Figure 1A,B,C) on top of the previous release.¹⁰

3.1 | Data search

3.1.1 | User requirement

Users were previously unable to make further changes to assessments after closing the software. This concerned the users if an assessment session was interrupted due to disruptions associated with remote access. Further, clinics adopting a team-based care approach can request one provider from the patient's care team to complete some assessment items prior to another provider completing other assessment portions. Having the option of reopening saved assessment forms would make this process seamless.

3.1.2 | Upgrade

The updated data search, retrieval, and edit functions (Figure 1A) enabled the users to reopen and make changes to an assessment after the assessment form had been closed, by searching for an existing "Patient ID". The algorithm performs a reverse sequential search of the patient ID in the data file and retrieves the latest saved record associated with the specific ID. Then, the software loads the

data into the user interface, enabling editing and resaving the record. This updated implementation prevents read/write conflict and data loss by adapting automatic saving every 5 minutes. Users can perform the search as demonstrated in Figure 1A.

3.2 | Data entry

3.2.1 | User requirement

Users could not make edits to text boxes, such as "specify occupation," once moving on from the initial page to the main page of the software. Allowing adjustment of specifics on the assessment form can help the user input the needed information more conveniently.

3.2.2 | Upgrade

The text fields, such as "specify occupation," were added to the main assessment page and made editable (Figure 1B – Top section). Users have the option of making modifications to this field rather than facing fixed values carried out from the initial page. Other items in the top section of the page were re-arranged for a clear layout.

3.3 | Item labeling

3.3.1 | User requirement

Users commented that the meaning of certain assessment items were ambiguous and requested clearer labeling.

3.3.2 | Upgrade

Labeling was clarified with several assessment items. For example, "Lower Proximal – Hip Flexor" was clarified as "Isolated Lower Proximal – Hip Flexor." Similarly, "Problems" was clarified as "Medical Problems" (Figure 1B).

3.4 | Record medications

3.4.1 | User requirement

Users hoped that the software could help facilitate a more comprehensive way of documenting medications and changes in medication status.

3.4.2 | Upgrade

New text boxes were added alongside the existing fields. "Added Medications" and "Stopped Medications" fields were added

TABLE 1 Summary of the Key updates to the software – the Electronic Frailty Index based on Comprehensive Geriatric Assessment (eFCGA version 3.0)

Number	Update	Description	User requirement addressed
1	Data Search	Patient ID search; reopen and edit previously saved and closed assessments	To allow pre-entering and post-updating information in the assessment form and to accommodate for interrupted/stopped assessments
2	Data Entry	“Specify occupation” text field added to main assessment page	To allow users to make modifications to this field on the main page
3	Item Labeling	a. “Lower Proximal- Hip flexor” → “Isolated Lower Proximal – Hip Flexor” b. “Problems” → “Medical Problems”	To reduce ambiguity
4	Record Medications	New free-text boxes for detailed medication records: “Added Medications” and “Stopped Medications”	To support medication management
5	Record Care Plans	Free-text box for detailed care planning	To support care planning
6	Data Saving	Converting special symbols for compatibility with data saving	To increase data input flexibility and program robustness
7	Care Plan Saving	All the sections relating to clinical management are displayed in the text file	To provide an easily readable summary of key facets of the required and planned actions

alongside the associated “Medication Names” (Figure 1B - Bottom section). These new text fields enabled users to specify more details for managing medications and to keep a timeline of each medication for individual patients.

3.5 | Record care plans

3.5.1 | User requirement

Previous versions of the software did not provide a designated area for the user to record care planning notes. Entering the information via the software can encourage detailed care plan making.

3.5.2 | Upgrade

A new “Care Planning” textbox was added to the assessment form (Figure 1B – bottom section). This field further enabled end-users to record detailed care plans for individual patients in relation to the frailty assessment and management for effective follow-up to benefit multidisciplinary team-based care.

3.6 | Input compatibility

3.6.1 | User requirement

Users requested more flexibility in text-data inputted in text-boxes, without any imitation with using special symbols. For example, in the previous release, when the user pressed the return key, the inputs would be saved as a new line by the inherited defaults of the text file.

Rather than being limited to a number of compatible symbols, users wished to input any sensible text.

3.6.2 | Upgrade

The requirement was addressed through an upgraded data saving function, which allowed the special symbols to be typed into the text fields. To facilitate this, the updated function searches the original user input and converts any incompatible characters to text-file friendly ones. The function then reconverts the characters to the original user input during retrieval, which appears as the original user input.

3.7 | Data saving

3.7.1 | User requirement

Users expressed wanting to be able to easily review, edit, and download the care planning notes that were inserted into the form, for the convenience of monitoring the patients’ health problems.

3.7.2 | Upgrade

A text file that records the care plan is now saved (Figure 1C). The updated Care Plan file has multiple sections including Action Required Items (A list of checked “action required” items indicating care and follow-up are needed); Medical Problems; Care Planning; Medication Names; Added Medications; Stopped Medications (Figure 1C). The Care Plan file was linked with the patient ID and saved when the user

FIGURE 1 Screenshots demonstrating the key updates with the Electronic Frailty Index based on Comprehensive Geriatric Assessment (eFI-CGA version 3.0) release. Panel A, The new search function allows for retrieving, editing, and re-saving previously saved assessments. Several simple steps involved: (1) user creates a new patient record and inputs the patient ID; (2) user inputs data into the eFI-CGA form and closes the program or saves the data; (3) user reopens the program and inputs the previously created patient ID; (4) the patient data is retrieved from the data file and the user can continue editing and saving. Panel B, Updates to the standalone eFI-CGA version 3.0 with explanation (boxes in green). Panel C, The action required text file is linked to the patient ID and allows for a quick access to the care plan. Data presented were adapted from de-identified real-world CARES patient assessments with modifications

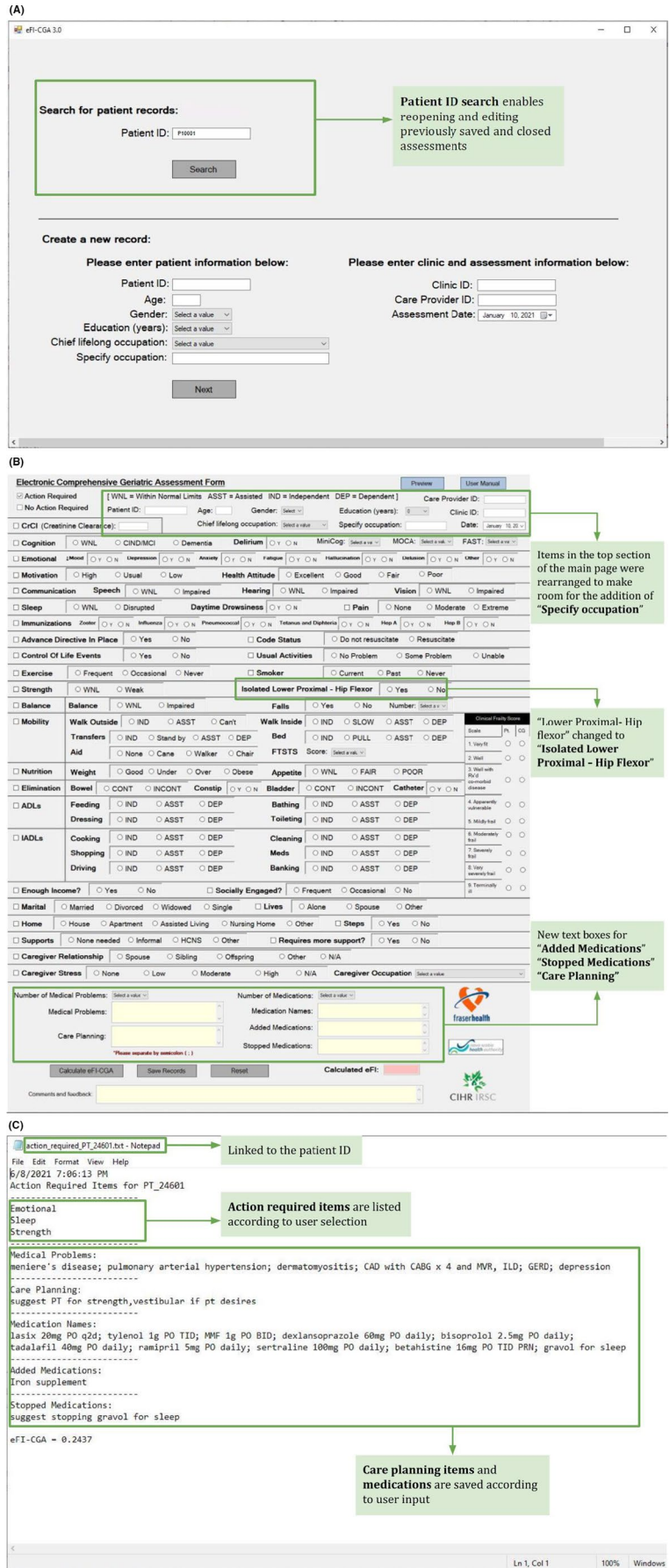


TABLE 2 Validation of the software updates to the Electronic Frailty Index based on Comprehensive Geriatric Assessment (eFI-CGA version 3.0)

Panel A, The data set				
Sample size (cases)				80
Mean age (years)				82.6
SD of mean age (years)				5.1
Sex (% female)				72.5
Median of FI (score)				0.271
Mean of FI (score)				0.260
SD of FI (score)				0.111
Panel B, The eFI-CGA score in relation to the Clinical Frailty Scale (CFS)				
Clinical Frailty Scale (CFS)	Sample Size, <i>n</i>	Mean Frailty Index (SD)	Statistics, F-value	Significance, P value
3	37	0.203 (0.08)	19.55	<0.001
4	22	0.288 (0.08)		
5	14	0.352 (0.09)		
6	7	0.419 (0.12)		

Abbreviation: FI, frailty index.

TABLE 3 Summary of the research contributions

What was already known on the topic:

- Operationalization of the Frailty Index based on deficit accumulation.
- Establishment of the software tool: Standalone eFI-CGA version 1.0.
- Use of the eFI-CGA in patient care under the CARES health initiative

What this the study added to our knowledge:

- Addressed COVID-19 related challenges using eFI-CGA with remote care.
- Developed new features to improve software usability and user experience.
- Promoted frailty detection and care planning through software advancement.

Abbreviations: CARES, community actions and resources empowering seniors; COVID-19, coronavirus disease 2019; eFI-CGA, electronic frailty index based on comprehensive geriatric assessment; FI, frailty index.

clicks on "Save Records," or automatically at 5-minute intervals, or at the closure of the assessment form.

3.8 | Testing and validation

All the features were thoroughly tested using the test cases and validated by applying a set of assessment data (Table 2A,B).

Table 2 summarizes the basic demographics of the sample and the characteristics of the eFI-CGA assessment outcome (Table 2A), and shows the mean values of the eFI-CGA differed by

the CFS (Table 2B), confirming FI characteristics documented in the literature.^{1,4}

4 | DISCUSSIONS AND CONCLUSION

In this paper, we introduced the newly updated software tool - the standalone eFI-CGA version 3.0. The software was developed to promote the early assessment and management of frailty.¹⁰ Users can perform the eCGA assessment and produce the e-FI calculation either in person or virtually.

The updates addressed the new challenges of physical distancing and the increased demands for adaptive digital health solutions to support virtual care in the upcoming new normal. The user-friendly interface enables care providers to record detailed care and management plans more efficiently. In addition, the summary of the individualized care plan allows high-level evaluation and monitoring of patient's health, for linking information in the electronic medical records (Table 3).¹⁰

As a Windows standalone application, the software tool has several limitations. First, the software only runs on Microsoft Windows computers and excludes other machines running MacOS and Linux. In addition, assessment data are stored on the local machine with simple text file format. Although this makes data security and retrieval easy to achieve, it can prevent widespread data access. Creating web applications of the frailty assessment tool can be an effective solution to this problem, which is being addressed in our ongoing efforts.

In conclusion, we have enabled eFI-CGA version 3.0 software tool, which can assist frontline care providers to more conveniently acquire CGA data digitally, automate the deficit accumulation-based frailty

measurement, and develop care plans. Upgrading the eFI-CGA during this challenging time represents an example of successfully moving from disruption to transformation for continued older adult care.

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CONFLICT OF INTEREST

The authors declare that the research and the manuscript preparation were conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

K.S. coded the new features of the software application and drafted the technical aspects of the manuscript. H.L. helped with new feature identification and the manuscript preparation. J.H. conducted data processing and analysis, and proofread the manuscript. G.P. provided clinical rational and feedbacks about the new features and edited the manuscript. X.S. conceptualized and supervised the creation and updates of the software, obtained research funding, and co-drafted the manuscript. All authors reviewed and approved the submission of the paper for publication.

ETHICAL APPROVAL

This study was approved by Fraser Health Human Research Ethics Board (FHREB2018-080).

RESTRICTIONS FOR USE

The Standalone eFI-CGA application (versions 1.0 through 3.0) was initiated and developed as part of the research project "Frailty assessment for older adults at point of care: Validating the Electronic Comprehensive Geriatric Assessment / Frailty Index (eFI-CGA)". The software development was in collaboration with the Fraser Health Authority (FHA) Community Actions and Resources Empowering Seniors (CARES) program, a community-based initiative to manage frailty in at-risk older adults and Nova Scotia Health Authority (NSHA) Geriatric Medicine Research Unit (GMRU). The eCGA was developed using the paper CGA form (Capital Health CD0184MR_06_09). All rights are reserved to the Stand-Alone eFI-CGA Project Team (CIHR Grant # CIHR-PJT-156210 2018–2022). The Standalone eFI-CGA software is not for sale, nor for commercial distribution. The released software product is available for research,

academic, and clinical purposes, only with prior written permission of the project's primary investigator (X.S., the corresponding author) or designate. Parties interested in using the software tool should contact the principal investigator (xiaowei.song@fraserhealth.ca) to receive a Standalone eFI-CGA Research Agreement Form. After signing the research agreement, the party will receive a link to the encrypted application. Use of the Stand-Alone eCGA should state the following in the publications and media communications: "Stand-Alone eFI-CGA Project Team (CIHR Grant CIHR-PJT-156210) 2018–2024: Frailty assessment for older adults at points-of-care: Validating the electronic Comprehensive Geriatric Assessment / Frailty Index (eFI-CGA)."

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