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A 10-MIN TARGETED GERIATRIC ASSESSMENT PREDICTS MORTALITY IN FAST-PACED ACUTE CARE SETTINGS: A PROSPECTIVE COHORT STUDY

M.J.R. ALIBERTI[1,2,3], K.E. COVINSKY[2,3], D. APOLINARIO[1], S.J. LEE[2,3], S.Q. FORTES-FILHO[1], J.A. MELO[1], S.S.C. VIANA[1], C.K. SUEMOTO[1], W. JACOB-FILHO[1]

1. Division of Geriatrics, University of Sao Paulo Medical School, Sao Paulo, Brazil; 2. Division of Geriatrics, University of California, San Francisco (UCSF), California, USA; 3. Veterans Affairs Medical Center, San Francisco, California, USA. Corresponding author: Márlon J. R. Aliberti, Hospital das Clinicas da Faculdade de Medicina da Universidade de Sao Paulo, Av. Dr. Eneas de Carvalho Aguiar 255, 8º Andar, Bloco 8—Nucleo de Apoio a Pesquisa e Ensino em Geriatria e Gerontologia / Sao Paulo (SP), 05403-000, Brazil. Phone and fax: +551126616236. Email: maliberti@usp.br. Twitter: @marlon_aliberti

Abstract: *Objectives:* To estimate whether a 10-minute Targeted Geriatric Assessment (10-TaGA) adds utility to sociodemographic characteristics and comorbidities in predicting one-year mortality in busy acute care settings. We have also compared the performance of 10-TaGA with the Identification of Seniors at Risk (ISAR) scale. *Design:* Prospective cohort study. *Setting:* Geriatric day hospital specializing in acute care in Brazil. *Participants:* 751 older adults aged 79.4 ± 8.4 years (64% female), presenting non-surgical, medical illness requiring hospital-level care (e.g., intravenous therapy, laboratory test, radiology) for ≤ 12 hours. *Measurements:* The 10-TaGA, an easy-to-administer screening tool based on the comprehensive geriatric assessment (CGA), provided a measure of cumulative deficits ranging from 0 (no deficits) to 1 (highest deficit) on admission. Standard risk factors, including sociodemographics (age, gender, ethnicity, income) and the Charlson comorbidity index, were evaluated. The ISAR, a well-validated screening tool, was used for comparison. *Results:* During one year of follow-up, 130 (17%) participants died. Compared to the ISAR, 10-TaGA offered better accuracy in identifying older patients at risk of death (area under the receiver operating characteristic curve: [AUC] 0.70 vs 0.65; P = 0.03). In a Cox regression model adjusted for sociodemographics and comorbidities, each 0.1 increment in the 10-TaGA score (range 0–1) was associated with increased mortality (hazard ratio = 1.42, 95% confidence interval 1.27–1.59). The addition of 10-TaGA markedly improved the discrimination of the model, which already incorporated standard risk factors (AUC 0.76 vs 0.71; P = 0.005); adding ISAR (AUC 0.73 vs 0.71; P = 0.09) did not have this marked effect. *Conclusion:* The 10-TaGA is an independent predictor of one-year mortality in acute care patients. This multidimensional screening tool offers better accuracy than ISAR when differentiating between older people at low and high risk of death in healthcare settings where providers have limited time and resources.

Key words: Comprehensive geriatric assessment, screening tool, acute care, geriatric day hospital, prognosis.

Introduction

Predicting the risk of death in older adults at the time of admission to an acute care setting is challenging because the trajectories of the multiple health conditions affecting such patients vary widely (1-3). Previous prognostic studies have shown that a comprehensive geriatric assessment (CGA), combined with standard risk factors such as sociodemographic characteristics and comorbidities, can predict mortality (4-6). However, most CGA-based measures are time-consuming to administer and require specific skills not available in fast-paced healthcare settings (7-9). Given the escalating number of older people requiring acute care, there is an urgent need for efficient CGA-models to inform prognoses in settings where healthcare providers have limited time and resources (10-13).

The 10-minute Targeted Geriatric Assessment (10-TaGA) is a CGA-based tool developed to screen geriatric syndromes and estimate the global impairment of patients, using the cumulative deficit model (14). It combines self-reported items with objective measures in a practical method that evaluates different health domains (social support, recent hospitalizations, falls, number of medications, basic activities of daily living, cognition, self-rated health, depression, nutritional status, and gait speed). In previous research, 10-TaGA provided adequate validity and good accuracy in discriminating between frail and non-frail individuals (14).

In the present study, our objectives were 1) to estimate whether the 10-TaGA adds utility to the standard risk factors in predicting one-year mortality after acute care and 2) to determine whether the 10-TaGA can predict one-year mortality with higher discrimination than the ISAR, a simple and widely validated screening tool for identifying older patients at risk of adverse outcomes in acute settings (11, 15).

Methods

Design, setting, and participants

This prospective cohort study involved participants aged 60 years and older who were admitted to a geriatric day hospital (GDH) presenting non-surgical, acute disease or exacerbated chronic disease. The GDH, located in a teaching hospital in Sao Paulo, Brazil, is open 12 hours per day and offers short-term treatment, free of charge, focused on acute care (e.g., intravenous therapy, laboratory test, radiology),

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as an alternative to emergency department treatment or hospitalization (16). The primary reasons for referral include infections, symptomatic congestive heart failure, decompensated diabetes, acute anemia, and uncontrolled hypertension. The GDH approach typically requires a 6-hour visit. Decisions on additional evaluations are based on the individual's health problem. Clinical severity, including hemodynamic instability, acute respiratory failure, and low levels of consciousness demanding full-time hospitalization, are contra-indications to this setting. Further details about the GDH can be found in previous work (16).

All patients (n = 833) referred consecutively to the GDH between May 2014 and December 2016 were screened for eligibility on admission. Individuals in palliative care (n = 26) and those who required hospitalization (n = 41) or refused to participate (n = 15) were excluded. The final sample comprised 751 participants. Signed informed consent was obtained from the patients or, in the case of participants with severe dementia, from their proxies.

Investigators blinded to the baseline assessment made monthly telephone calls to confirm patient status for one year after the first GDH visit. All participants were contacted until death or censored at the end of the one-year follow-up. In case of death, information about the date, place, and leading cause of death was obtained from the participant's next of kin.

Baseline assessment

A research team composed of geriatricians, registered nurses, social workers, and pharmacists conducted the baseline assessment during the first GDH visit. Sociodemographic characteristics (age, gender, ethnicity, and income) and the Charlson comorbidity index (17), a measure of overall disease burden, were assessed using each patient's report and medical chart review.

The 10-TaGA was administered by a team member (14). This multidomain screener quickly assessed the participants' cumulative deficits based on ten health domains: cohabitation status and availability of assistance, emergency department visits and hospitalizations during the previous six months, the number of falls in the last year, the number of medications, dependence in activities of daily living (Katz index) (18), a 10-point Cognitive Screener (19), self-rated health, the 4-item Geriatric Depression Scale (20), nutritional status (weight loss during the previous year; body mass index), and gait speed. Each domain was classified into three levels: normal (0 points), mild impairment (0.5 points), and severe impairment (1 point). A single numerical score ranging from 0 (no deficit) to 1 (highest deficit) was calculated by dividing the total number of points by the number of evaluated domains (14). The application and scoring guidelines for 10-TaGA are presented in Supplementary Figure 1.

The ISAR (range 0–6), one of the tools most commonly used to screen older adults in acute care settings, was also administered (15). This scale comprises six "yes" or "no" questions that concisely investigate functional status, previous hospitalization, the presence of cognitive and visual impairments, and polypharmacy (15). In this study, we applied a cutoff of 6 drugs in the polypharmacy item (11, 21).

All data were managed using research electronic data-capture (REDCap) software (22). The research team in the field was blinded to the specific aims of the study. Staff members responsible for the patients' clinical management had no access to the study protocol information.

Statistical analysis

Logistic regression analysis was performed to estimate the one-year probability of death for each 0.1 increment in 10-TaGA score. A goodness-of-fit test based on fractional polynomial functions indicated that nonlinear models were not superior to a linear model in fitting the association between 10-TaGA and mortality (23). A Hosmer-Lemeshow goodness-of-fit test verified the model calibration by comparing the predicted and observed risk of death in deciles of predicted risk. The area under the receiver operating characteristic curve (AUC) evaluated the performance of the screening tools. The sensitivity, specificity, predictive values, and likelihood ratios were computed for each 0.1 increment in the 10-TaGA score. The Youden index determined the 10-TaGA threshold with optimal discriminative performance (24). We calculated differences between the AUC of 10-TaGA and ISAR using nonparametric methods (25).

Kaplan-Meier curves were plotted to illustrate the survival estimates for different levels of the 10-TaGA score (each 0.25 increase), adopting an analytical approach previously used with multidimensional instruments (4, 26). Nested Cox regression models were fit to determine whether the addition of ISAR or 10-TaGA provided better predictive utility for the risk of death after considering sociodemographic measures and comorbidities. We also added each screening tool to the model using a standardized format to compare their hazard ratios for mortality. The Schoenfeld residual test indicated that the proportional hazard assumption was met. Finally, using differences between the AUC, we compared the impact on accuracy obtained by adding 10-TaGA with that obtained by adding ISAR.

Analyses were carried out using Stata version 14.0 (Stata Corp., College Station, TX). The statistical tests were two-tailed; an alpha level of 0.05 indicated significance.

Results

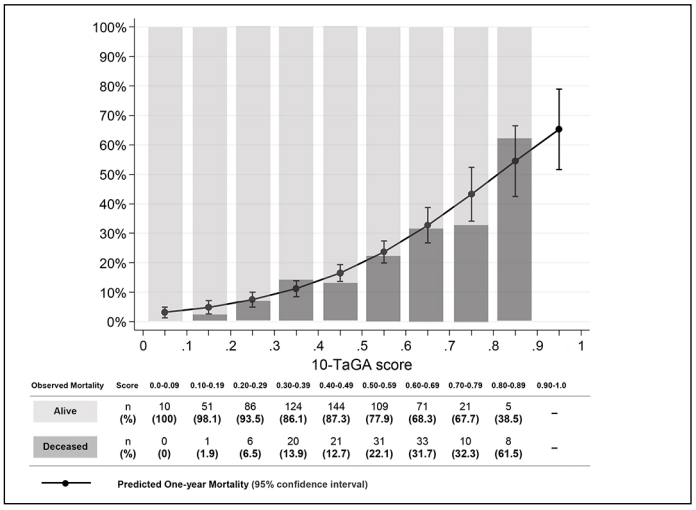
Participants had a mean age of 79.4 ± 8.4 years; 64% were female, 61% were white, and 83% had an annual household income per capita less than or equal 8,000 USD (Supplementary Table 1). The primary causes of referral to the GDH were decompensated diabetes (17%), acute anemia (16%), symptomatic congestive heart failure (12%), and infections (12%) (Supplementary Table 2). During the one-year follow-

up, there were 130 (17%) deaths. The leading causes of death were heart disease and infections (Supplementary Table 3). The majority of patients (83%) died in the hospital. Mortality was associated with older age, male gender, more comorbidities, and higher ISAR and 10-TaGA baseline scores (Supplementary Table 1).

Figure 1 shows the observed and predicted risk of death for each 0.1 increment in the 10-TaGA score, highlighting the rising mortality rate as the score increased. A Hosmer-Lemeshow test indicated that this model was well-calibrated ($\chi 2 = 5.4$; $P = 0.72$). The 10-TaGA presented good accuracy for identifying those patients at risk of death within one year (AUC 0.70; 95% confidence interval [CI] 0.65–0.75). The cutoff with the best Youden index was 0.50 (sensitivity: 63% and specificity: 67%) (Supplementary Table 4). In comparison to ISAR, the discriminant ability of 10-TaGA was significantly superior (AUC 0.70 vs 0.65; $P = 0.03$) (Supplementary Figure 2).

Figure 1

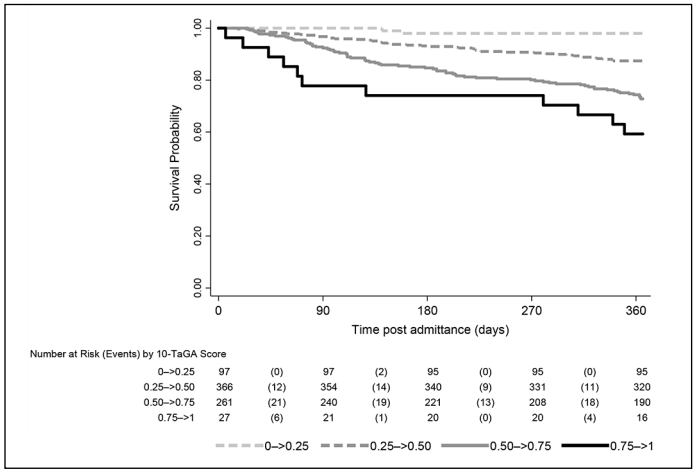
Observed and predicted one-year mortality according to the 10-minute Targeted Geriatric Assessment (10-TaGA) score (n = 751)



The Kaplan–Meier survival curves confirmed that the risk of death became progressively higher among patients with higher-level 10-TaGA scores (Figure 2), with a significant log-rank test for trend ($\chi 2(1) = 50.4$; $P < .001$). After adjustment for sociodemographic characteristics and comorbidities, each 0.1 increment in the 10-TaGA score increased the hazard of death (hazard ratio [HR] 1.42, 95% CI 1.27–1.59) (Table 1). The ISAR scale was also an independent predictor of death. In the standardized format, the HR per standard deviation increase was 1.81 (95% CI 1.49–2.20) for 10-TaGA and 1.37 (95% CI 1.14–1.65) for the ISAR (Table 1). Adding 10-TaGA markedly improved the discrimination of the model, which already included standard risk factors (AUC 0.76 vs 0.71; P = 0.005); adding ISAR did not produce such a marked result (AUC 0.73 vs 0.71; P = 0.09) (Table 1).

Figure 2

Kaplan-Meier survival curves associated with different levels of the 10-minute Targeted Geriatric Assessment score (n = 751)



Discussion

This study demonstrated that a quick and easy-to-administer CGA-based measure designed for busy healthcare settings was an independent predictor of one-year all-cause mortality in older adults with acute disease or exacerbated chronic disease at baseline. The 10-TaGA added predictive utility to sociodemographic characteristics and comorbidities in stratifying the risk of death in the real-world context of acute care admission. This easy-to-administer instrument provided information on a wide range of geriatric syndromes and expressed patients' global impairment. Our study indicates that 10-TaGA has better accuracy than ISAR in identifying individuals at risk of death.

Previous studies have examined the value of using geriatric information to predict mortality after acute care (6, 11, 21, 27). Instruments developed to evaluate inpatient prognoses have achieved solid results in favor of CGA (5, 6). However, these multidimensional tools are usually time-consuming and difficult to implement in environments with high patient volume, scant resources, and rapid turnover of care spaces (7-9).

Among the available faster screening tools, the ISAR scale is the most widely validated (11, 15, 21, 28, 29). Our results confirm previous research, indicating that the ISAR predicts mortality after acute care (11, 29). However, our findings also suggest that a quick and easy-to-administer CGA-based measure is a stronger predictor of mortality than ISAR. When compared to more extended multidimensional instruments, 10-TaGA presented similar discriminatory power in predicting one-year all-cause mortality (6).

Despite the usefulness of 10-TaGA in predicting death, the best strategy for assessing prognoses combines geriatric

Table 1
Association of risk factors with one-year mortality and the impact of screening tools on model discrimination (n = 751)

	Hazard Ratio (95% confidence interval)		
	Base Model	**Base Model + ISAR**	**Base Model + 10-TaGA**
Sociodemographic measures			
Age (years)	1.05 (1.03–1.07)	1.04 (1.02–1.06)	1.04 (1.01–1.06)
Men	1.57 (1.11–2.23)	1.64 (1.15–2.33)	1.86 (1.30–2.65)
Ethnicity			
White	1 (reference)	1 (reference)	1 (reference)
Black	0.66 (0.34–1.27)	0.65 (0.34–1.26)	0.62 (0.32–1.20)
Mixed	0.67 (0.41–1.10)	0.63 (0.39–1.02)	0.64 (0.40–1.05)
Asian	1.30 (0.63–2.69)	1.20 (0.58–2.49)	1.07 (0.52–2.23)
Annual household income per capita			
> 8.000 USD	1 (reference)	1 (reference)	1 (reference)
4.000 – 8.000 USD	1.09 (0.65–1.81)	1.01 (0.61–1.69)	0.97 (0.58–1.62)
< 4.000 USD	1.51 (0.87–2.64)	1.29 (0.73–2.26)	1.32 (0.76–2.30)
Comorbidities			
Charlson comorbidity index			
0 points	1 (reference)	1 (reference)	1 (reference)
1 – 2 points	4.11 (1.48–11.43)	3.55 (1.27–9.92)	3.29 (1.18–9.17)
≥ 3 points	6.97 (2.55–19.07)	5.20 (1.88–14.44)	4.47 (1.62–12.33)
Screening tools			
ISAR scale score (0 – 6)			
Each 1-point increment		1.25 (1.10–1.42)	–
Per SD increase (standardized format)		1.37 (1.14–1.65)	–
10-TaGA score (0 – 1)			
Each 0.1-point increment		–	1.42 (1.27–1.59)
Per SD increase (standardized format)		–	1.81 (1.49–2.20)
Area under the ROC curve (AUC)	0.71 (0.67–0.76)	0.73 (0.69–0.78)	0.76 (0.72–0.80)
P value for AUC model comparison	(reference)	0.09	0.005

Estimates were calculated using nested Cox proportional hazard regression models that associated sociodemographic measures, the Charlson comorbidity index, and screening tools (ISAR or 10-TaGA) with time to death in one year; Base Model = sociodemographic measures (age, gender, ethnicity, and income) + Charlson comorbidity index; Base Model + ISAR (per each 1-point increment in the original scale score or SD increase in the standardized format); Base Model + 10-TaGA (per each 0.1-point increment in the original instrument score or SD increase in the standardized format).; The area under the ROC curve examined the impact of adding ISAR or 10-TaGA on model discrimination; ISAR = Identification of Seniors at Risk; SD = standard deviation; 10-TaGA = 10-minute Targeted Geriatric Assessment; ROC = receiver operating characteristic curve.

measures with other predictors available in general clinical practice (5, 27). Our study confirmed that integrating 10-TaGA with standard information can predict mortality more accurately than either approach alone. This early identification of death risk can help clinicians to guide discussions with individuals and families about the goals of care (1, 12). For example, a 70-year-old woman, without comorbidities, and presenting low score in 10-TaGA (< 0.25) could be discharged to home safely after short-term acute care. Identifying this lower risk profile also supports decisions favoring more aggressive treatments if the health condition deteriorates. On the other hand, an 85-year-old man, with multimorbidity, and presenting high score in 10-TaGA (≥ 0.50) should be prioritized for multidisciplinary home care assistance and palliative care.

The 10-TaGA also has potential advantages for use in acute care. A pragmatic multidimensional instrument may promote a culture of assessing geriatric conditions in time-constrained environments (10, 12). In addition, 10-TaGA may help clinicians develop care plans that take into account key geriatric syndromes and not only the acute problem (3).

This study has some strengths such as obtaining completed follow-up information from all participants, and the ability

to directly compare the performance of 10-TaGA with ISAR. Some limitations should also be noted. The focus of this research was to investigate predictors in the context of patients being discharged to home after short-term acute care. The results cannot be translated to patients with clinical severity requiring full-time hospital treatment. Our findings should be validated in different populations and healthcare settings.

In conclusion, this research supports the predictive validity of 10-TaGA in differentiating between older people at low and high risk of death after acute care. Further studies are needed to confirm the properties of 10-TaGA in other settings and to examine whether the instrument helps to improve the care of older adults.

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Ethical standards: The authors declare that the study procedures comply with current ethical standards for research involving human participants and follows the principles outlined in the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of the University of Sao Paulo Medical School (Brazil).

Conflict of interest: All authors declare no conflict of interest to disclose.

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