Effectiveness of the VA-Geriatric Resources for Assessment and Care of Elders (VA-GRACE) program: An observational cohort study

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Abstract

Background: As the Department of Veterans Affairs (VA) healthcare system seeks to expand access to comprehensive geriatric assessments, evidence-based models of care are needed to support community-dwelling older persons. We evaluated the VA Geriatric Resources for Assessment and Care of Elders (VA-GRACE) program’s effect on mortality and readmissions, as well as patient, caregiver, and staff satisfaction.

Methods: This retrospective cohort included patients admitted to the Richard L. Roudebush VA hospital (2010–2019) who received VA-GRACE services post-discharge and usual care controls who were potentially eligible for VA-GRACE but did not receive services. The VA-GRACE program provided home-based comprehensive, multi-disciplinary geriatrics assessment, and ongoing care. Primary outcomes included 90-day and 1-year all-cause readmissions and mortality, and patient, caregiver, and staff satisfaction. We used propensity score modeling with overlapping weighting to adjust for differences in characteristics between groups.

Results: VA-GRACE patients (N = 683) were older than controls (N = 4313) (mean age 78.3 ± 8.2 standard deviation vs. 72.2 ± 6.9 years; p < 0.001) and had greater comorbidity (median Charlson Comorbidity Index 3 vs. 0; p < 0.001). VA-GRACE patients had higher 90-day readmissions (adjusted odds ratio [aOR] 1.55 [95%CI 1.01–2.38]) and higher 1-year readmissions (aOR 1.74 [95%CI 1.22–2.48]). However, VA-GRACE patients had lower 90-day mortality (aOR 0.31 [95%CI 0.11–0.92]), but no statistically significant difference in 1-year mortality was observed (aOR 0.88 [95%CI 0.55–1.41]). Patients and caregivers reported that VA-GRACE home visits reduced travel burden and the
INTRODUCTION

The US Veteran population is aging; by 2028 one-third of the Veteran population is expected to be ≥75 years old. Older Veterans are more likely to use Department of Veterans Affairs (VA) health services than younger Veterans, often have functional impairments and high multimorbidity, and are at high risk of adverse health outcomes. The 1999 Veterans Millennium Benefits and Healthcare Act (the Mill Bill) required that Veterans’ healthcare provide access to geriatric assessment. As the VA healthcare system seeks to expand access to comprehensive geriatric assessments for the Veteran population, evidence-based models of care are needed to support community-dwelling older persons.

The Geriatric Resources for Assessment and Care of Elders (GRACE) program is a collaborative, multidisciplinary care model which provides home-based geriatric care management. In a randomized controlled trial, GRACE improved quality of care and reduced healthcare utilization compared to usual care. The VA-GRACE model has been associated with 7.1% fewer Emergency Department (ED) visits, 14.8% fewer 30-day readmissions, 37.9% fewer hospital admissions, and 28.5% fewer bed-days of care, saving the VA hospital which implemented this program an estimated $200,000/year after program costs in the first 14 months. The prior study of the VA-GRACE program was limited to a 16-month period (April 2010–July 2011) and included a comparison group that was drawn entirely from an internal medicine teaching clinic. Other published studies of the GRACE model have been similarly limited by relatively short follow-up periods (e.g., 6-months post-enrollment).
through December 31, 2019). We compared outcomes among patients who received VA-GRACE services after discharge and a control group of Veterans who were potentially eligible for VA-GRACE but who did not receive services (Figure 1). VA-GRACE and control patients were limited to individuals who survived at least 7-days post-discharge. Intervention patients were those who had any VA-GRACE services post-discharge. Control patients were identified from the cohort of patients who were discharged alive from the hospital and who met inclusion criteria for VA-GRACE but did not receive VA-GRACE services (i.e., age \( \geq 65 \) years old, residing at home [not discharged to rehabilitation or skilled nursing facilities], lived within 20 miles of the facility, no hospice, no dialysis, did not receive home-based primary care, had a VA primary care visit within the prior 2 years, and the hospitalization was not for a substance abuse issue).

The analyses were performed on two samples. The primary sample included \( N = 683 \) VA-GRACE patients who received any contact from the VA-GRACE team in the 1-year post-discharge. The secondary sample included \( N = 634 \) VA-GRACE patients who received at least one home visit; we excluded patients who did not receive a home visit (e.g., patients who spoke with VA-GRACE team members [e.g., to schedule a visit or discuss details of the program] but had an intervening event which prevented them from receiving VA-GRACE team care [e.g., patients who died before receiving a home visit]). The secondary sample included control patients who survived at least 30-days post-discharge.

**VA-GRACE program description**

The VA-GRACE team includes three dyads of a nurse practitioner paired with a social worker who conduct home visits with eligible older Veterans as well as caregivers and family members. The home visits include screenings for common geriatric syndromes, focused physical examination, comprehensive medication reconciliation, and psychosocial assessment. The nurse practitioner and social worker present their findings to the VA-GRACE multidisciplinary team during weekly VA-GRACE rounds which are led by a geriatrician (CCS) and include a mental health psychologist and a pharmacist. A care plan is established during the team rounds and is shared via the electronic medical record with the patient's primary care provider. The VA-GRACE nurse practitioner and social worker return to the patient's home and ensure that the patient and their caregivers agree with, and understand, each element of the care plan. Thereafter, communications between the patient and their VA-GRACE dyad take place monthly and on an as-needed basis (generally via telephone) but always include assessments after any Emergency Department visit or inpatient stay. Home visits are also conducted annually to assess for changes in condition or social supports. Patients remain enrolled in VA-GRACE until one of the following discharge criteria are met: (1) death; (2) long-term care placement; (3) patient or caregiver request discharge; (4) persistent nonadherence to VA-GRACE recommendations; or (5) functional and clinical

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**FIGURE 1** provides the flow diagram indicating how the primary and secondary samples were constructed.
Improvement such that VA-GRACE support is no longer needed.

Outcomes and data sources

The effectiveness outcomes were: all-cause readmissions at 90-days and 1-year post-discharge from the index hospitalization; 90-day and 1-year mortality; and the combined endpoint of readmission or death at 90-days or 1-year. Zero-time was the day of discharge from the index hospitalization. Baseline characteristics and effectiveness outcome data were obtained from VA Corporate Data Warehouse (CDW) which included: inpatient and outpatient data files (with diagnostic and procedure codes) in the five-years pre-event to identify past medical history, and healthcare utilization. Fee-Basis Data (which includes care that was provided at non-VA hospitals but that was paid for by the VA) were also used to identify inpatient and outpatient healthcare utilization and medical history. All-cause mortality was obtained from the VA Vital Status File. We also used information from the VA Master Patient Index (MPI), which is updated daily and is considered the authoritative source for date of death within the VA. More than 96% of deaths are captured in the MPI dataset within four months; the remainder are captured in subsequent months. Patient, caregiver, primary care provider, and VA-GRACE team member satisfaction were obtained from semi-structured interviews and included both questions with Likert scale responses (e.g., where 1 represented “disagreement” and a 5 represented “agreement”) and open-ended qualitative data. Chart review was conducted on all VA-GRACE patients to identify the extent of services that were received; 10% of charts received double-abstraction to ensure high-quality data collection (the inter-observer agreement was 99.7% across collected data fields).

Statistical analyses: effectiveness evaluation using propensity scores with overlapping weighting

The VA-GRACE program was designed to provide services for high-risk older persons; therefore, we expected VA-GRACE patients to be older and have higher comorbid burden than control patients. When, in routine clinical practice, the characteristics of a patient are associated with the choice of an intervention and with the outcome (e.g., older patients are more likely to be offered VA-GRACE services and are also at increased risk of mortality), then confounding is likely to be present. We sought to evaluate the effectiveness of VA-GRACE despite anticipated differences in patients’ baseline characteristics between groups (VA-GRACE vs. usual care controls) using propensity score analysis. The propensity score is the probability of receiving the VA-GRACE intervention for each individual with given baseline characteristics and can be used to adjust for differences in baseline characteristics between groups allowing for causal inference making in non-clinical trial studies.

We first used logistic regression with backward selection to construct a parsimonious model for the propensity score. The candidate baseline characteristics included age, race, gender, comorbid conditions, prior utilization, and index hospitalization diagnosis (Table S3). We used the model to estimate the probability of receiving the VA-GRACE intervention.

There were multiple admissions per eligible control patient during the study period. Because we sought to examine outcomes following admission, we chose one admission per control patient. For the primary analysis, we chose the admission with the highest probability of receiving VA-GRACE services. In sensitivity analyses, we chose an admission at random, and results were similar. After the control admission was selected, we reran the propensity score model to obtain updated probabilities of receiving VA-GRACE.

Matching and weighting on propensity scores are two commonly used approaches for addressing imbalance in baseline characteristics that may confound the assessment of treatment effects on outcomes. We found that we could not match intervention patients with high propensity scores with controls because there were very few control patients with high propensity scores (probability of receiving VA-GRACE). Including only the very few VA-GRACE patients for whom there was a matched control in the analysis would have markedly altered our target population and would have limited our assessment of the effectiveness of VA-GRACE in a routine clinical setting, which was our primary objective. Therefore, instead of using matching, we applied a propensity score weighting method for all analyses.

The most popular propensity score (PS) weighting approach is the inverse probability weighting (IPW) method, which weights 1/PS for intervention patients and 1/(1-PS) for control patients. In other words, if the probability of patient $i$ receiving treatment equals $p_i$, then patient $i$ has the weight $1/p_i$ for intervention and the weight $1/(1 – p_i)$ for control. However, IPW is likely to produce numerically unstable results when some outlier observations in baseline characteristics result in a PS close either to 0 or 1 which inflates the impact of the outlier observations. This phenomenon was observed in the initial analyses of the VA-GRACE data. Therefore, we
adopted an alternative PS weighting method, the overlap weighting (OW) approach, to overcome the numerical instability issues. The overlapping weight equaled $1-p_i$ for VA-GRACE patients and equaled $p_i$ for control patients. Unlike IPW weights, overlapping weights are bounded by 0 and 1, and therefore minimize issues related to extreme propensity scores. The OW method not only eliminated the dominating factor by outlier observations in the IPW approach, but also enhanced the precision of estimating the treatment effects. Therefore, we present the results of the OW approach.

For comparison, we reported the results that did not include any weighting to demonstrate the necessity of propensity score weighting in making unbiased inferences in this non-clinical trial study. We also compared the unadjusted and risk-adjusted analyses to assess whether the parsimonious propensity score included all of the potential confounding variables covered by the baseline characteristics. Standardized differences were calculated for the non-weighted and overlapping weighted analyses; an absolute mean standardized difference $\leq 0.10$ indicates balance of the measured covariates between groups. All analyses were performed using SAS Enterprise Guide, version 7.11 (SAS Institute Inc.).

**Qualitative analysis: satisfaction evaluation**

The interviews with patients, caregivers and staff were recorded and transcribed. We used Microsoft Excel to calculate descriptive statistics for the Likert-type scale items (response range: 1–5). We conducted a rapid, thematic analyses of qualitative data which supported the Likert-type scale participant responses. The themes were presented to the clinician evaluation team who confirmed thematic saturation.

**RESULTS**

A total of $N = 683$ VA-GRACE patients and $N = 4313$ control patients had an admission and survived at least 7-days post-discharge. VA-GRACE patients were older than control patients: mean age 78.3 (±8.2 standard deviation) versus 72.2 (±6.9) years ($p < 0.001$; Table 1). The overwhelming majority of patients were male (97.6% of the whole cohort) and white (VA-GRACE, 73.5% and control, 76.4%; $p = 0.336$). VA-GRACE patients had a much greater comorbidity burden than control patients: 70.7% VA-GRACE versus 49.0% control with hyperlipidemia ($p < 0.001$), 78.6% versus 40.3% with hypertension ($p < 0.001$), 54.6% versus 31.0% with diabetes ($p < 0.001$), 39.8% versus 22.7% with chronic kidney disease ($p < 0.001$), 44.2% versus 21.2% with chronic obstructive pulmonary disease (COPD; $p < 0.001$), 43.5% versus 18.2% with vascular disease ($p < 0.001$), 25.2% versus 17.6% with obstructive sleep apnea ($p < 0.001$), 25.9% versus 17.4% with depression ($p < 0.001$), and 7.6% versus 4.2% with anxiety ($p < 0.001$; Table 1). Control patients were more likely than VA-GRACE patients to have alcohol abuse (VA-GRACE, 3.2% vs. control, 6.6%; $p < 0.001$), liver disease (VA-GRACE, 4.0% vs. control, 6.1%; $p = 0.22$), post-traumatic stress disorder (PTSD) (VA-GRACE, 3.7% vs. control, 5.7%; $p = 0.029$). The greater degree of comorbidity was reflected in a higher Charlson Comorbidity Index among VA-GRACE patients: median 3 (interquartile range [IQR] 2–4) versus 0 (IQR 0–1; $p < 0.001$). The primary discharge diagnosis category for the index hospitalization varied between the VA-GRACE and control patients (Table 1), with COPD/pneumonia/respiratory failure being more common among VA-GRACE patients (20.1% vs. 10.7%; $p < 0.001$). VA-GRACE patients had both more hospitalizations in the year prior to the index admission (median 3 [IQR 1–2] vs. 0 [IQR 0–0]; $p < 0.001$) and more ED visits in the year prior to the index admission (median 3 [IQR 2–5] vs. 2 [IQR 1–4]; $p < 0.001$).

**Effectiveness**

Given that VA-GRACE patients were older and had substantially greater comorbidity than usual care control patients, we expected that the unadjusted outcome rates would be higher among VA-GRACE patients for the non-weighting method, which is what was observed (Table 2). In the primary sample of patients who survived at least 7-days post-discharge from the index admission, VA-GRACE patients had a higher unadjusted readmission rate at 90-days post-discharge from the index hospitalization (29.4% vs. 16.2%; unadjusted odds ratio [OR] 2.19 [95%CI 1.80–2.59]), and at 1-year (58.1% vs. 32.4%; OR 2.49 [95%CI 2.46–3.42]). No statistically significant difference in unadjusted 90-day mortality was observed between VA-GRACE and control patients (OR 0.66 [95% CI 0.38–1.16]), but VA-GRACE patients had higher unadjusted 1-year mortality (OR 1.76 [95%CI 1.42–2.19]).

In adjusted analyses using overlapping weights (Table 2), VA-GRACE patients had higher 90-day readmissions (adjusted odds ratio [aOR] 1.55 [95%CI 1.01–2.38]) and higher 1-year readmissions (aOR 1.74 [95%CI 1.22–2.48]). However, in adjusted analyses, VA-GRACE patients had lower 90-day mortality (aOR 0.31 [95%CI 0.11–0.92]), but no statistically significant difference in 1-year mortality was observed (aOR 0.88 [95%CI 0.55–1.41]).
| Baseline characteristics | Total (N = 4996) | Controls (n = 4313) | VA-GRACE (n = 683) | p value |
|--------------------------|------------------|---------------------|--------------------|---------|
| **Demographics**         |                  |                     |                    |         |
| Mean age (SD)*           | 73.0 (7.4)       | 72.2 (6.9)          | 78.3 (8.2)         | <0.001  |
| Male, n (%)              | 4875 (97.6)      | 4210 (97.6)         | 665 (97.4)         | 0.696   |
| Race, n (%)              |                  |                     |                    | 0.336   |
| African-American         | 1074 (21.5)      | 909 (21.1)          | 165 (24.2)         |         |
| Other                    | 26 (0.5)         | 23 (0.5)            | 3 (0.4)            |         |
| Unknown                  | 100 (2.0)        | 87 (2.0)            | 13 (1.9)           |         |
| White                    | 3796 (76.0)      | 3294 (76.4)         | 502 (73.5)         |         |
| **History of conditions: n (%)** |                 |                     |                    |         |
| Hyperlipidemia           | 2594 (51.9)      | 2111 (49.0)         | 483 (70.7)         | <0.001  |
| Hypertension             | 2276 (45.6)      | 1739 (40.3)         | 537 (78.6)         | <0.001  |
| Diabetes                 | 1708 (34.2)      | 1335 (31.0)         | 373 (54.6)         | <0.001  |
| Chronic kidney disease   | 1252 (25.1)      | 980 (22.7)          | 272 (39.8)         | <0.001  |
| Chronic obstructive pulmonary disease (COPD) | 1216 (24.3) | 914 (21.2) | 302 (44.2) | <0.001 |
| Vascular disease         | 1082 (21.7)      | 785 (18.2)          | 297 (43.5)         | <0.001  |
| Obstructive sleep apnea  | 933 (18.7)       | 761 (17.6)          | 172 (25.2)         | <0.001  |
| Depression               | 927 (18.6)       | 750 (17.4)          | 177 (25.9)         | <0.001  |
| Cancer                   | 890 (17.8)       | 778 (18.0)          | 112 (16.4)         | 0.298   |
| Bleeding                 | 317 (6.4)        | 266 (6.2)           | 51 (7.5)           | 0.196   |
| Alcohol abuse            | 309 (6.2)        | 287 (6.6)           | 22 (3.2)           | <0.001  |
| Liver disease            | 291 (5.8)        | 264 (6.1)           | 27 (4.0)           | 0.022   |
| Dementia                 | 270 (5.4)        | 223 (5.2)           | 47 (6.9)           | 0.066   |
| Post-traumatic stress disorder | 270 (5.4) | 245 (5.7) | 25 (3.7) | 0.029  |
| Stroke                   | 232 (4.6)        | 192 (4.4)           | 40 (5.9)           | 0.105   |
| Anxiety                  | 233 (4.7)        | 181 (4.2)           | 52 (7.6)           | <0.001  |
| **Index hospitalization diagnostic category: n (%)** |                 |                     |                    |         |
| Bronchitis/COPD/pneumonia/respiratory failure | 600 (12.0) | 463 (10.7) | 137 (20.1) | <0.001 |
| MI/angina/chest pain/CAD | 406 (8.1)        | 361 (8.4)           | 45 (6.6)           |         |
| Malignancy               | 308 (6.2)        | 299 (6.9)           | 9 (1.3)            |         |
| Heart failure            | 193 (3.9)        | 137 (3.2)           | 56 (8.2)           |         |
| Stroke/transient ischemic attack (TIA) | 177 (3.5) | 165 (3.8) | 12 (1.8) |         |
| Sepsis                   | 164 (3.3)        | 136 (3.2)           | 28 (4.1)           |         |
| Kidney failure           | 102 (2.0)        | 76 (1.8)            | 26 (3.8)           |         |
| Psychiatric              | 88 (1.8)         | 87 (2.0)            | 1 (0.2)            |         |
| Syncope                  | 84 (1.7)         | 74 (1.7)            | 10 (1.5)           |         |
| UTI                      | 84 (1.7)         | 64 (1.5)            | 20 (2.9)           |         |
| Diabetes                 | 79 (1.6)         | 66 (1.5)            | 13 (1.9)           |         |
| Cellulitis               | 73 (1.5)         | 60 (1.4)            | 13 (1.9)           |         |
| Fracture/trauma          | 73 (1.5)         | 57 (1.3)            | 16 (2.3)           |         |
| Dementia/encephalopathy  | 70 (1.4)         | 53 (1.2)            | 17 (2.5)           |         |
| Clostridoides difficile infection | 10 (0.2) | 7 (0.2) | 3 (0.4) |         |
| Fall                     | 5 (0.1)          | 3 (0.1)             | 2 (0.3)            |         |

(Continues)
Table S1a provides the risk adjustment models for the primary sample and Table S1b provides the results for the secondary sample.

When comparing the unadjusted to the adjusted results for the non-weighting analysis, we observed substantial shifts in the odds ratios. For example, for the 1-year
readmission outcome, the unadjusted OR was 2.90 (95% CI 2.46–3.42) whereas the adjusted OR was 2.05 (95% CI 1.67–2.52). However, the overlapping weighting method appeared to account for key confounders because the unadjusted and adjusted ORs were similar (note: the same risk adjustment variables were included in both analyses; Supplement S1a). For example, for the 1-year readmission outcome, the unadjusted OR was 1.75 (95% CI 1.25–2.45) and the adjusted OR was 1.74 (95% CI 1.22–2.48). Standardized differences were substantial in the non-weighted analysis but zero for the overlapping weighting analysis indicating that balance was achieved in the mean baseline characteristics between groups in the overlapping weighting analysis (Tables S1a and S1b).

The results for the overlapping weighting analysis in the secondary sample who survived at least 30-days post-discharge from the index admission are provided in Table S2. In general, the odds ratios were similar between the primary and secondary samples, however the confidence intervals shifted. In the analysis of the secondary sample, VA-GRACE patients had no difference in 90-day readmissions (aOR 1.45 [95% CI 0.93–2.28]), higher 1-year readmissions (aOR 1.71 [95% CI 1.18–2.48]), and no differences in mortality at either 90-days (aOR 0.28 [95% CI 0.08–1.05]) or 1-year (aOR 0.85 [95% CI 0.51–1.41]).

**Satisfaction**

We interviewed five VA-GRACE participants (4 males and 1 female) and two caregivers. Both patients and caregivers who received VA-GRACE services reported that they were very satisfied with the program with the majority of ratings equal to 5, the highest rating on the Likert scale response (Table 3). The results of the thematic analysis of the interviews are provided in Table 4. Patient and caregiver satisfaction was based on the VA-GRACE staff expertise, engagement, and sense of genuine caring; reduced Veteran and caregiver travel burden; and the VA-GRACE team’s assistance with linking Veterans and caregivers to needed and often unknown resources, like home healthcare or durable medical equipment.

We interviewed seven primary care providers (PCP) who had at least one patient enrolled in the VA-GRACE program. They reported an average of 14.7 years working with the VA (standard deviation, 8.3, range 0.8–22 years). Overall, the PCPs reported high satisfaction with VA-GRACE and indicated that the VA-GRACE team helped to somewhat alleviate their workload by caring for patients with complex geriatric syndromes (Table 3). PCPs highlighted the helpful role VA-GRACE played in improving medication management for their patients and how home visits provided the primary care team with a view into the patient’s daily living situation. Some PCPs reported that communication with the VA-GRACE team was facilitated by using View Alerts in the medical records and Microsoft TEAMS. One PCP stated that they perceived a VA-GRACE nurse had overstepped their clinical boundary regarding patient management.

| Question                                                                 | Veteran (N = 5) | Caregiver (N = 2) |
|--------------------------------------------------------------------------|-----------------|-------------------|
| VA-GRACE helped me to better manage my condition/illness at home.       | 5.0 (0.0)       | 4.5 (0.71)        |
| The VA-GRACE team had a good understanding of my condition after our visits. | 4.8 (0.45)     | 5.0 (0.0)         |
| The VA-GRACE team explained my conditions and treatment in a way that was easy to understand. | 5.0 (0.0)       | 5.0 (0.0)         |
| The VA-GRACE team helped me organize and understand my medications.     | 4.8 (0.45)      | 5.0 (0.0)         |
| I was satisfied with how my caregiver was included in VA-GRACE visits.  | 5.0 (0.0)       | 5.0 (0.0)         |
| I feel comfortable discussing sensitive or emotional topics with my VA-GRACE team. | 4.8 (0.5)       | 5.0 (0.0)         |
| Overall, how satisfied were you with your experience with VA-GRACE?     | 5.0 (0.0)       | 4.5 (0.71)        |

| Question                                                                 | Primary care providers (N = 7) |
|--------------------------------------------------------------------------|-------------------------------|
| The assessment of my patients by the VA-GRACE team helped me to manage my patients’ medications. | 4.57 (0.53) |
| The assessment of my patients by the VA-GRACE team helped me to manage my patients’ condition. | 4.71 (0.49) |
| VA-GRACE has greatly decreased your workload or greatly increased your workload* | 2.57 (0.79) |
| On average, how clear were the VA-GRACE plans for ongoing care with your patients? | 4.71 (0.76) |
| Overall, how satisfied were you with your experience with VA-GRACE?     | 4.71 (0.49)                   |

* Ratings on a 5-point Likert scale are provided as mean score and standard deviation; higher numbers indicate greater satisfaction with the exception of the clinician workload question where a lower number reflects VA-GRACE reduction in the primary care physician workload.
VA-GRACE team members reported: high satisfaction with their VA-GRACE clinical experiences and confidence in their abilities to execute the VA-GRACE program for their patients; a strong sense of teamness; the perception that the home visit provided opportunities to see the patients' context to identify concerns for condition management, to provide medication management support, and to facilitate conversations about sensitive topics with patients. VA-GRACE team members reported that challenges included: interacting with PCPs who are unaware of the VA-GRACE team's scope of practice or confused VA-GRACE with other services (e.g., home-based primary care), and when PCPs did not respond to their documented suggestions related to patient care. Despite these challenges, VA-GRACE clinical staff reported a sense of professional satisfaction from gaining better understandings of and providing valuable, patient-centered support for Veterans in their homes.

### TABLE 4 Qualitative data about satisfaction with the VA-GRACE Program

| Theme                                                                 | Illustrative quotation                                                                                           |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| VA-GRACE staff expertise, engagement, and sense of genuine caring   | “I liked the nurse and the social worker that come out [to my home]. They're very easy to talk to, they're so knowledgeable, and they care about what they do which really means a lot to my husband and I. I almost feel like they're part of the family.” (Caregiver) |
| Reduced travel burden                                               | “First of all, [VA-GRACE] came to my home...As somebody who doesn’t get around really well, that was greatly appreciated.” (VA-GRACE Patient) |
| VA-GRACE team link Veterans and caregivers to resources (e.g., home healthcare, durable medical equipment) | “[VA-GRACE] were the ones that recommend that I use a nursing agency to come out and do his medications because he takes a lot of medications, and I'm uncomfortable with putting all of that together because I made a mistake—I had too many in one night and that was really frightening for me...I didn’t even know they had an agency to do something like that. It's really been a blessing for us both.” (Caregiver) |
| Medication management                                               | “’They [VA-GRACE] always remind [me] of what the patient is actually taking [medication]...when VA-GRACE goes and looks at the pillbox and say, ‘well actually the patient is taking this and this...that's the actual count of what the patient is taking,’ and I thought this was very helpful.” (PCP) |
|                                                                      | “We have their medication right there. If they're using a pillbox, we can look in the pillbox and see if it's properly placed where it's supposed to be. We're able to count the pills in the bottle if need be...Sometimes they let us in their bathroom cabinets and we're able to see all the different medications they have in there.” (VA-GRACE Patient) |
| Insight into patient’s daily living situation                       | “I think [VA-GRACE] is able to see things in the home that maybe they [patients] don’t tell us in clinic which is helpful.” (PCP) |
| Primary care satisfaction                                           | “I'm very supportive of the VA-GRACE team and what they do. I think they provide much needed services for some very difficult geriatric syndromes.” (PCP) |
|                                                                      | “Sometimes I feel that the nurse that’s with the VA-GRACE team oversteps with their interpretations or speculations...Overall, the VA-GRACE has been helpful and it’s a good service.” (PCP) |
| Communication between primary care and VA-GRACE                      | “[VA-GRACE] notes are good. We have TEAMS now so a lot of times if I have a question or they want to ask me something or have me sign something, VA-GRACE will put it on TEAMS and say, ‘Can you check this?’” (PCP) |
| Role of home visits in patient care                                 | “We’ve had a lot of conversations ranging from PTSD, things back if they served during wartimes, some information that the family didn’t even know about that the patients never told them that they’ve confided in us...We also talk a lot about palliative care versus hospice care and end of life conversations.” (VA-GRACE Patient) |

*PCP, primary care provider; PTSD, post-traumatic stress disorder; VA-GRACE, VA-GRACE team members.*
DISCUSSION

These findings demonstrate that the VA-GRACE program is serving the intended patient population: high-risk, community-dwelling older persons. The VA-GRACE patients were older and had a much greater comorbidity burden than control patients receiving usual care. Patients, caregivers, primary care providers, and VA-GRACE team staff members were very satisfied with the program.

The observed differences in baseline characteristics between VA-GRACE patients and usual care controls presented a substantial challenge in evaluating program effectiveness given concerns about residual confounding (the expected direction of the potential bias would lead to greater mortality among VA-GRACE patients). In addition, patients needed to be alive to receive VA-GRACE services (the expected direction of the potential bias would lead to lower mortality among VA-GRACE patients). We sought to mitigate these methodological problems by using a propensity score weighting method and two samples. The overlapping weighting method is an analytical tool for making unbiased inference of treatment effects and was critical in analyzing our study data. It balanced mean differences in baseline characteristics between groups and also appeared to account for key potential confounding variables because the unadjusted and adjusted odds ratios were similar. The secondary sample included patients who had survived at least 30-days post-discharge (and hence would be expected to have a lower observed mortality than the primary sample which included patients who had survived at least 7-days post-discharge). The finding that VA-GRACE patients had an increased adjusted risk of long-term readmissions (1-year) was consistent across samples. The finding that VA-GRACE patients had a decreased risk of short-term mortality (90-days) was statistically significant in the primary sample but not the secondary sample; however, the adjusted odds ratios were of similar magnitude—which was substantial. In a randomized controlled trial, the GRACE model of care was associated with a reduction in hospitalizations among high-risk patients after they had been in the program for 2-years (396 [n = 106] vs. 705 [n = 105] per 1000; p = 0.03). Neither the prior GRACE nor VA-GRACE evaluations reported about mortality nor included multivariate risk analyses (where the multivariate risks of mortality and readmissions are considered jointly). A future prospective randomized controlled trial is required to identify the potential benefits of VA-GRACE in terms of mortality, readmissions, and healthcare system cost-savings.

A core element of the GRACE model of care is the home visit. Home visits for community-dwelling older persons have been demonstrated to identify new safety concerns, caregiver burden, and psycho-behavioral difficulties. A meta-analysis of 8 studies reported a mortality benefit of geriatric home visiting programs: pooled OR of 0.76 (95%CI 0.64–0.89) overall and OR 0.72 (95%CI 0.54–0.97) for high-risk older persons. During the COVID-19 pandemic, some healthcare programs which typically provide home visits converted to virtual care models to minimize in-person contact with the high-risk community-dwelling elderly. However, older persons may experience physical (e.g., hearing impairment) or technological barriers to implementing video-based telehealth care. The inability to conduct physical exam assessments and generate the rapport needed to discuss sensitive topics have also been identified as problems with video-based visits. Future studies should examine how best to implement virtual home visits given the potential to increase access to comprehensive geriatric assessments.

Several limitations merit description. First, this was a retrospective cohort study, therefore—as described above—differences in outcomes between VA-GRACE and usual care control patients may reflect, in part, unmeasured confounding. Second, this program evaluation included the only site within the VA healthcare system nationwide that is currently implementing the GRACE model; results may vary at other VA hospitals. Future research should evaluate the effectiveness of the GRACE program when implemented in non-VA sites where the healthcare infrastructure (e.g., electronic health record and availability of clinical pharmacists and health psychologists) may vary. Third, our qualitative interview sample represented a small proportion of potential stakeholders with a more recent experience with VA-GRACE. Finally, although we included both short and long-term hospitalizations and mortality, another relevant outcome among high-risk older persons is the need for long-term institutionalization. We did not have valid data on this outcome. Future studies should evaluate the potential role programs like VA-GRACE play in the prevention, or delay, of transitions to long-term care.

CONCLUSIONS

The VA-GRACE program provides comprehensive geriatric assessments and ongoing care management to high-risk, community-dwelling older persons with very high rates of satisfaction from patients, caregivers, and
providers. Widespread deployment of programs like VA-GRACE will be required to support the Veteran population to age in place.

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CONFLICT OF INTEREST
The authors have no conflicts of interest to report.

ETHICS STATEMENT
This project was conducted as a program evaluation and was considered quality improvement and not research. Therefore, no human subjects research approval was sought.

AUTHOR CONTRIBUTIONS
All authors participated in the revision of the manuscript and read and approved the final manuscript.
Cathy C. Schubert and Dawn M. Bravata: obtained funding, were responsible for the design and conduct of the study including data collection, data analysis, interpretation of the results, and drafting and revising the manuscript.
Laura J. Myers, Anthony J. Perkins, Ying Zhang: were instrumental in the design of the analysis, data collection, data analysis, edits to the manuscript, and interpretation of the results.
Teresa M. Damush, Lauren S. Penney, Alaina K. Preddie: designed the qualitative data collection, conducted the interviews, analyzed the qualitative data, interpreted results, and edited the manuscript.
Ashley L. Schwartzkopf and Tetla Menen: participated in data collection, interpretation of results, and edited the manuscript.
Dawn M. Bravata and Anthony J. Perkins had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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The sponsor had no role in the design, methods, data collections, analyses, or preparation of this manuscript.

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**SUPPORTING INFORMATION**

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**Figure S1.** Visual abstract.

**Table S1a.** Risk adjustment variables: all VA-GRACE patients and controls survived at least 7-days post-discharge.

**Table S1b.** Risk adjustment variables: VA-GRACE patients receiving care and controls survive at least 30-days post-discharge.

**Table S2.** Outcomes for VA-GRACE patients receiving care and controls survived at least 30-days post discharge.

**Table S3.** Propensity for VA-GRACE.

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