BMJ Open Quality

Pharmacy program to improve care for veterans with transient ischaemic attack: a pilot implementation evaluation

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To cite: Rattray N, Damush TM, Myers L, *et al*. Pharmacy program to improve care for veterans with transient ischaemic attack: a pilot implementation evaluation. *BMJ Open Quality* 2022;**11**:e001863. doi:10.1136/bmjoq-2022-001863

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjoq-2022-001863).

Received 15 February 2022
Accepted 23 August 2022

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ABSTRACT

Background Early evaluation and effective communication to manage transient ischaemic attacks (TIA) may lead to a reduction of up to 70% in recurrent events for patients with TIA/minor stroke, along with reduced costs and lengths of hospital stay.

Methods We conducted a single site pilot evaluation of a clinical pharmacy programme to improve medication management among TIA patients. The programme included a structured protocol, online identification tool, and a templated discharge checklist. Primary effectiveness measures were change in systolic blood pressure (SBP) 90 days post discharge and prescription of high/moderate potency statins. Contextual aspects and clinical perspectives on the implementation process were evaluated through prospective semistructured interviews with key informants.

Results The analysis included 75 patients in the preimplementation group and 61 in the postimplementation group. The mean SBP at 90 days post discharge was significantly lower in the post implementation period (pre implementation, 133.3 mm Hg (SD 17.8) vs post implementation, 126.8 mm Hg (16.6); p=0.045). The change in SBP from discharge to 90 days post discharge was greater in the postimplementation period (15.8 mm Hg (20.5) vs 24.8 mm Hg (23.2); p=0.029). The prescription of high/moderate potency statins were similar across groups (pre implementation, 66.7% vs post implementation, 77.4%; p=0.229). Front-line clinicians involved in the pilot study reported positively on the acceptability, appropriateness and feasibility of implementing the protocol without additional cost and within current scope of practice.

Conclusions Implementation of a clinical protocol outlining medication management and provider communication to ensure rapid postdischarge treatment of TIA patients was associated with SBP improvements. The pilot evaluation demonstrates how clinical pharmacists may play a role in treating low frequency, high stakes cerebrovascular events where early treatment and follow-up are critical.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Following a transient ischaemic attack (TIA) or minor stroke, medication management and blood pressure control are fundamental to reducing the risk of recurrent cerebrovascular events.

WHAT THIS STUDY ADDS

⇒ Few protocols exist for communication between pharmacists and health providers. This study offers pilot evidence about a feasible intervention that guides clinical pharmacists in improving care and outcomes for TIA patients through structured communication.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Clinical pharmacists may play an increasing role is treating low frequency, high-stakes cerebrovascular events where early treatment and follow-up are critical to improving outcomes.

INTRODUCTION

In the USA, a stroke occurs every 40 s. Among the 800 000 strokes that occur annually,[1] approximately 15% are preceded by a transient ischaemic attack (TIA).[2] Following a TIA, evidence suggests that a significant proportion of adverse events that follow discharge is drug related and may be preventable.[3 4] Because more than half of the recurrent events that occur within 3 months of an index TIA event actually occur in the first 2 days, preventive actions must be applied early to maximise the benefit.[5] Programmes that emphasise early evaluation and management may lead to a reduction of up to 70% in recurrent events for patients with TIA or minor stroke, along with reduced costs, reduced lengths of hospital stay, and improved vascular risk factor management.[6–8] The extant literature on recurrent TIA events suggests that communication about discharge and follow-up care represent opportunities to improve stroke/TIA outcomes.[9 10] Although the initial hospital episode and subsequent outpatient clinic visits are the most favourable opportunities to address vascular risk

reduction, appropriate treatment and management of cerebrovascular patients is frequently prolonged until patients receive primary care follow-up, which may be weeks or months later.[11–13] Discharge instructions and discharge orders are sometimes vague, inconsistent and incomplete; often little or no care coordination occurs between inpatient and outpatient providers.[14]

System level changes in the structure of acute stroke care include the formation of stroke units and/or stroke teams, which have demonstrated improvements in mortality and recovery from stroke.[15] Despite these improvements, evidence suggests that pharmacists are underused in transitions of care, particularly in the setting of stroke/TIA management.[4 16 17] Importantly, the inclusion of pharmacists in long-term management of secondary prevention measures and multidisciplinary stroke teams can improve patient outcomes.[17–26] Yet, in most medical centres, discharge communication specifically about stroke or TIA patients does not typically occur between inpatient pharmacists and the primary care team.[14] The Veterans Health Administration is an ideal setting to examine communication between inpatient and outpatient pharmacists because pharmacists are embedded within the primary care clinics and are tasked with managing medications, patient education and care coordination.

Given the importance of structured approaches to improving stroke outcomes through guideline-driven delivery processes, our team developed a formal protocol for inpatient–outpatient pharmacist TIA care coordination. This single site, pilot evaluation study was designed to assess the implementation of the pharmacy protocol aimed at improving clinical care and communication between inpatient pharmacists and primary care pharmacists involved in caring for TIA patients. The primary aim was to evaluate the efficacy of the programme by comparing TIA patients receiving care before versus after programme implementation. The specific research question was: did the clinical protocol lead to improvement in hypertension control for TIA patients? The second aim was a process evaluation of programme implementation focused on identifying critical elements that promoted successful adoption and determining which 'core components' enhanced programme effectiveness.

METHODS

Study design

We used a parallel mixed method study design.[27] Quantitative data were collected through retrospective chart review of electronic medical record (EMR) data on clinical outcomes for patients with TIA who received care before and after the protocol was implemented. To understand context for the intervention, we conducted a prospective evaluation of the perspectives of key clinical staff. The study protocol was approved by the institutional review board and VA Research and Development Committee. The study draws on the Consolidated Framework for Implementation Research (CFIR)[28] to understand the contextual factors that affect how the pharmacy programme was implemented.[29] We followed Standards for Quality Improvement Reporting Excellence V.2.0 guidelines.[30]

Study setting

This study was conducted at a VA Medical Center (VAMC) that delivers inpatient and outpatient healthcare services to approximately 200 000 veterans annually. The VAMC is a teaching hospital affiliated with a university medical school. It is a tertiary facility with medical and surgical intensive care, stepdown, inpatient rehabilitation units; one of the acute care areas is designated as the stroke care unit. Neurology is an admitting service with medical residents involved in inpatient care and consults.

Primary care services are provided through clinics, which are subdivided into patient-aligned care teams (PACT).[31] A PACT teamlet is composed of a primary care provider (MD or advanced practice nurse), the nurse case manager (registered nurse) and the health technician (licensed practical nurse). Other healthcare professionals are shared between teamlets, such as clinical pharmacists, social workers and health psychologists. The Veterans Affairs (VA) scope of practice defines the clinical pharmacist's prescriptive authority, routine duties, areas of responsibility and supervision by a physician; importantly, it includes lipid and hypertension management. PACT pharmacists encounter patients after they are seen by a primary care provider at a postdischarge follow-up visit and referred for hypertension, diabetes, hyperlipidaemia or anticoagulation related to atrial fibrillation.

Prior to implementing this intervention, pharmacists who were assigned to an inpatient medical team made medication-related recommendations but did not systematically document the recommendation in the EMR. The standard of care for TIA or stroke patients cared for in the emergency department (ED) and discharged did not routinely involve pharmacists. Communication between the inpatient pharmacist and the PACT pharmacist was infrequent and generally reserved for complex patients. When communication between inpatient and outpatient pharmacists occurred, it was typically informal, through email, phone calls or instant message rather than through cosignature of clinical notes. Delays occurred because patients saw primary care providers within 1–2 weeks of discharge, with pharmacy follow-up 4–8 weeks later.

Description of the intervention

The pharmacy intervention is part of a programme entitled 'Protocol-guided Rapid Evaluation of Veterans Experiencing New Transient Neurological Symptoms',[32] which seeks to improve care for TIA patients. The intervention addressed medication management for cerebrovascular disease risk factors including: hypertension, hyperlipidaemia, atrial fibrillation, diabetes and tobacco use. The written protocol was iteratively developed and refined by

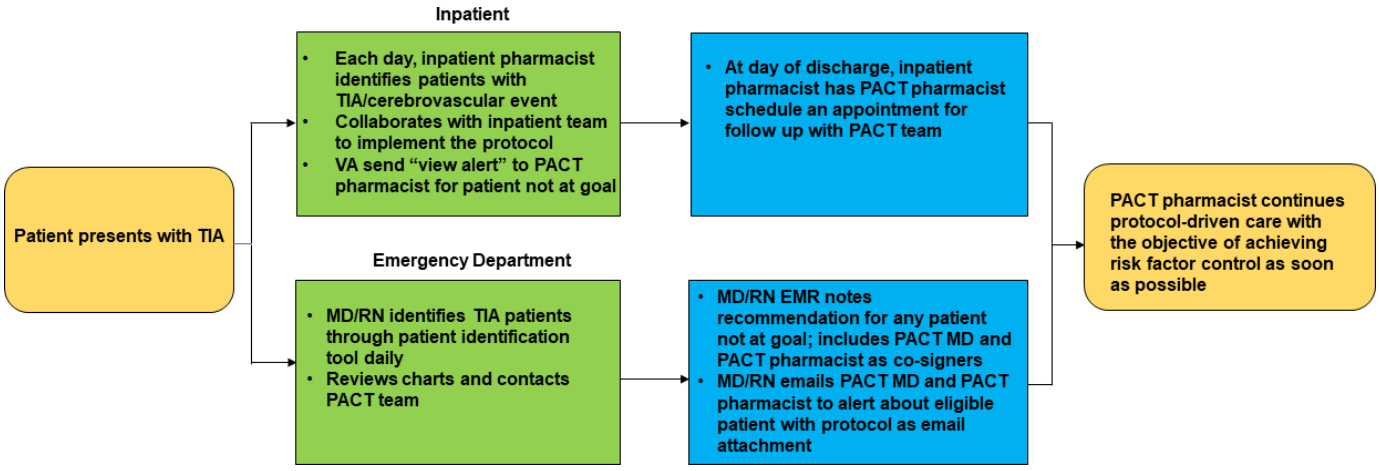

Figure 1 Diagram of protocol for tracking and communication about TIA patients. EMR, electronic medical record; PACT, patient-aligned care teams; RN, registered nurse; TIA, transient ischaemic attacks.

clinical champions from relevant services (ie, pharmacy, endocrinology, cardiology, vascular neurology, internal medicine). Every domain of care included a decision tree with an evidence-based clinical target and recommendations formatted as a table and as a flowchart (see online supplemental appendix A). The intervention sought to improve coordination of care for TIA patients by establishing communication pathways between inpatient and ambulatory care pharmacists. The protocol defined the roles and responsibilities of the ED, inpatient and PACT pharmacists, lists the PACT pharmacist assigned to each primary care team, provides directions on using an online tool for identifying TIA patients in real time and includes a templated TIA Discharge Checklist for documentation (see online supplemental appendix B).

The protocol called for a 'warm handoff' between inpatient and PACT teams prior to patient discharge (see figure 1). The inpatient pharmacist used the patient identification tool to identify inpatients with a TIA that were currently admitted or recently discharged and lists the patient's name, their primary care provider and their PACT pharmacist. The patient identification tool also identified patients who presented to the ED but who were not admitted. The inpatient pharmacist examined the medical record in conjunction with the protocol algorithm for each process of care for which the patient was eligible. The inpatient pharmacist then contacted the PACT pharmacist (generally by secure messaging them or adding them as cosigners to a note; rarely by calling them) with the goal of scheduling an appointment before the patient was discharged. Subsequently, the PACT pharmacist documented their communication in the EMR, scheduled an appointment if one had not already been made before discharge and addressed any further clinical issues (eg, discharging the patient home with a blood pressure cuff).

Data collection, outcomes and analysis

Eligible patients were those with an index TIA seen in the ED or inpatient setting at the VAMC from May 2016 through September 2018. The preimplementation phase was May–December 2016; the implementation phase was from January 2017 to September 2018.

Patient health data

EMR data elements extracted included status of index event, demographic factors and several relevant conditions in the patients' medical history (including prior stroke or TIA, medications, comorbidities; see table 1). Blood pressure and cholesterol measurements were extracted, along with key processes of care including discharge on high/moderate potency statins, hypertension control, antihypertensive medication intensification, timeliness of antithrombotic prescriptions, anticoagulation for atrial fibrillation, international normalised ratio measured, deep vein thrombosis (DVT) prophylaxis, glycosylated haemoglobin measurement and hypoglycaemic medication intensification. Healthcare utilisation included primary care and neurology visits within 30 and 90 days of discharge. We included incidence of mortality, stroke or TIA within 90 days of discharge.

Outcomes

Two effectiveness measures were evaluated: (1) the primary outcome was the difference in mean systolic blood pressure (SBP) at 90 days post discharge between the preimplementation and postimplementation groups and (2) the secondary outcome was the proportion of eligible patients who were prescribed high or moderate potency statins within 7 days of discharge. These two care processes were selected because they offered the greatest opportunities for improvement and conformed with existing studies.[5 6] A secondary hypertension outcome was the change in SBP from the day of presentation to either the inpatient setting or ED, to the average systolic measurement in the 90 days post discharge. Categorical data were presented as percentages (n) and compared across time periods using Fisher's exact test.

Continuous variables were reported as means with SD or ranges. Means were compared with two sample

Table 1 Baseline characteristics

Patient characteristics	Pre implementation (N=75)	Post implementation (N=61)	P value
Index event			
% Admitted for index event (n)	68.0 (51)	70.5 (43)	0.853
% Weekend presentation (n)	17.3 (13)	21.3 (13)	0.662
Demographics			
Mean age in years (SD)	66.2 (10.3)	67.7 (11.9)	0.444
Median age (range)	66 (39–95)	68 (33–95)	0.342
Race			0.377
% White (n)	81.3 (61)	75.4 (46)	
% Black (n)	14.7 (11)	23.0 (14)	
% Asian (n)	0.0 (0)	0.0 (0)	
% Other (n)	0.0 (0)	0.0 (0)	
% Unknown (n)	4.0 (3)	1.6 (1)	
% Hispanic ethnicity (n)	1.3 (1)	0.0 (0)	1.000
Past medical history			
% Prior transient ischaemic attacks (n)	61.3 (46)	60.7 (37)	1.000
% Prior stroke (n)	18.7 (14)	13.1 (8)	0.484
% Diabetes mellitus (n)	44.0 (33)	36.1 (22)	0.383
% Atrial fibrillation (n)	6.7 (5)	14.8 (9)	0.159
% Myocardial infarction (n)	2.7 (2)	1.6 (1)	1.000
% CABG, PTCA/PCI (n)	1.3 (1)	0.0 (0)	1.000
% Congestive heart failure (n)	10.7 (8)	16.4 (10)	0.446
% Pacemaker or AICD (n)	6.7 (5)	4.9 (3)	0.731
% Valvular heart disease: native or mechanical (n)	1.3 (1)	4.9 (3)	0.325
% CEA, carotid stent (n)	1.3 (1)	0.0 (0)	1.000
% COPD (n)	13.3 (10)	18.0 (11)	0.482
% PVD (n)	10.7 (8)	9.8 (6)	1.000
% Dementia (n)	6.7 (5)	11.5 (7)	0.373
% CKD (n)	14.7 (11)	18.0 (11)	0.644
% Dialysis (n)	1.3 (1)	0.0 (0)	1.000
% Cancer (n)	6.7 (5)	13.1 (8)	0.248
% Hypertension (n)	66.7 (50)	72.1 (44)	0.577
% Hyperlipidaemia (n)	58.7 (44)	67.2 (41)	0.374
% Arrhythmia (n)	5.3 (4)	3.3 (2)	0.691
% Speech deficit (n)	4.0 (3)	9.8 (6)	0.298
% Motor deficit, hemiplegia (n)	6.7 (5)	23.0 (14)	0.011
% Sleep apnea (n)	20.0 (15)	39.3 (24)	0.022
% Alcohol dependence (n)	2.7 (2)	4.9 (3)	0.657
% Depression (n)	14.7 (11)	32.8 (20)	0.014
% Liver disease (n)	2.7 (2)	6.6 (4)	0.408
% History of VTE: deep vein thrombosis, PE (n)	0.0 (0)	4.9 (3)	0.088
% Any major bleeding: emergency department, inpatient admission for bleeding (n)	0.0 (0)	1.6 (1)	0.449
% Intracranial haemorrhage (n)	2.7 (2)	4.9 (3)	0.657
% Migraine (n)	0.0 (0)	4.9 (3)	0.088

Continued

Table 1 Continued

Patient characteristics	Pre implementation (N=75)	Post implementation (N=61)	P value
Baseline medications prior to index event			
% Statin (n)	60.0 (45)	75.4 (46)	0.068
% Aspirin (n)	58.7 (44)	59.0 (36)	1.000
% Warfarin (n)	1.3 (1)	8.2 (5)	0.090
% Anticoagulant (n)	6.7 (5)	18.0 (11)	0.060
% Clopidogrel (n)	6.7 (5)	9.8 (6)	0.541
% Any antithrombotic (n)	64.0 (48)	68.9 (42)	0.589
Mean CHADVASC (SD)	2.8 (1.4)	3.0 (1.4)	0.648
Mean HASBLED (SD)	2.0 (1.2)	2.2 (1.1)	0.242
Charlson: mean±SD	2.6 (2.3)	2.8 (2.6)	0.515
Median Charlson (range)	2 (0–9)	3 (0–14)	0.563
% Smoker (n)	41.3 (31)	21.3 (13)	0.017

AICD, automatic implantable cardioverter-defibrillator ; CABG, coronary artery bypass grafting; CEA, carotid endarterectomy; CHADVASC, score that includes congestive heart failure, hypertension, age >75, diabetes, prior stroke or TIA ; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; HASBLED, Hypertension, Abnormal Renal/Liver Function, Stroke, Bleeding History or Predisposition, Labile INR, Elderly, Drugs/Alcohol Concomitantly; PCI, percutaneous coronary intervention; PCTA, percutaneous transluminal coronary angioplasty; PE, pulmonary embolism; PVD, peripheral vascular disease; VTE, venous thromboembolism .

t-tests while medians were tested using the Wilcoxon rank sum test. Two-sided p<0.05 was considered statistically significant and analyses were performed with SAS Enterprise V.7.13. Multivariable regression was used to adjust for differences in the baseline characteristics of the two groups. This pilot evaluation study was not powered to detect differences in patient outcomes; rather data were collected on all consecutive patients cared for at the medical centre during the pilot implementation phase.

Implementation evaluation

Behavioural change theories were used to establish working hypotheses that could explain how the communication protocol operated as an intervention. Drawn from organisational development theory, the framework of sense-making[33] would suggest when influential leaders endorse new protocol and reframe and model new procedures, clinical staff may consider integrating these new practices into their workflow as they 'rebalance' and respond to an intervention that offers a relative advantage.[34] Social network theory[35] offers evidence that disseminating through existing social networks can aid in implementing new evidence-based programmes. The aim was to examine how existing relationships based on shared training and common scope of practice for inpatient and outpatient pharmacists would affect implementation.

Eleven semistructured interviews were conducted (March 2017 to January 2018). A convenience sample was recruited for a single in-person interview (duration: 30–60 min). This purposive sample included each available provider involved in the pilot: inpatient and outpatient pharmacists, an ED physician, a neurologist and a nurse. The interview guide focused on key CFIR constructs (domains of intervention characteristics, inner setting and process) and selected implementation outcomes (acceptability, appropriateness, feasibility, fidelity, penetration). Fieldnotes were composed within 24 hours of the interview that summarised key themes and non-verbal behaviour in the interview encounter. Audio-recorded interviews were professionally transcribed. Transcripts were deidentified, checked for accuracy and imported into NVivo V.11 for data management and coding. A team of three analysts carried out an iterative thematic analysis. Open inductive coding in teams of two generated a codebook with definitions and inclusion/exclusion criteria. Refinement of the codebook continued until thematic saturation was reached (eg, no new codes emerged). Subsequently, each analyst separately applied the codes to the full set of interviews and then met to establish consensus on qualitative findings.

Patient and public involvement

The research question was aimed at improving TIA patient outcomes. Patients were not directly involved with the design or analysis of the study, primarily because the intervention is focused on pharmacists. Research results are intended to be disseminated through open access publication.

RESULTS

Overall, 75 patients were included in the pre implementation group, with 61 in the post implementation group. Table 1 describes patient characteristics, medical history

and medication use prior to index event. The majority were on statins and an antithrombotic prior to the index TIA event. The two groups did not differ demographically or in terms of inpatient admission or weekend presentation. There were some between-group differences on elements of medical history (ie, hemiplegia, sleep apnea, depression, history of DVT, and smoking). Except for a higher smoking rate in the preimplementation group, the postimplementation patients had similar or higher comorbidity burden. In both groups, approximately two-thirds of patients were admitted, with a minority presenting on weekends (17.3% pre implementation; 21.3% post implementation).

Table 2 summarises each group in terms of vital signs, processes of care, utilisation of health services and outcomes. Because the intervention was not designed to change hypertension management in the inpatient setting, the primary hypertension measures were 90 days post discharge. The mean SBP at 90 days post discharge was significantly lower in the pos timplementation period (pre implementation, 133.3 mm Hg (SD 17.8) vs post implementation, 126.8 mm Hg (16.6); p=0.045). The change in SBP was greater in the postimplementation period than the pre implementation period (mean difference in differences 9.0, p=0.029). After adjustment for differences in the baseline characteristics (in table 1) that were either marginally significant or statistically significant (ie, age, race, current smoker, embolism/DVT, depression, hemiplegia, sleep apnea, baseline anticoagulant, baseline statin and baseline warfarin), the results for both the mean SBP and change in SBP between the groups remained essentially unchanged (see online supplemental appendix C). While not significantly different, prescription of high or moderate potency statins and antihypertensive medication intensification tended to be higher in the postimplementation period. (pre implementation, 66.7% vs post implementation, 77.4%; p=0.229). Antithrombotics and DVT prophylaxis were similar across the groups.

Implementation outcomes and contextual factors

Analysis of interviews with front-line clinicians focused on the implementation outcomes of acceptability, appropriateness and feasibility of implementing the protocol. Additional themes that emerged included contextual factors such as culture, learning climate and intervention characteristics. Table 3 summarises participants' perspectives on implementation outcomes and with representative quotations.

Implementation outcomes

Clinicians reported satisfaction with how well the protocol matches with local workflow, emphasising the feasibility of implementation. Pharmacists discussed how the protocol fits with current practices, as one pharmacist (P102) explained: "I think it's pretty straightforward. It very much aligns with our usual job description for those disease states so it hasn't necessarily put any extra strain on our pharmacists in that department and they're all very familiar with diabetes, hypertension, smoking cessation management." Moreover, the protocol gained wide acceptance and later penetration among inpatient and outpatient pharmacists because it was seen as "very concrete with published evidence" (P101). A pharmacy supervisor (P103) expressed how pharmacy could play a crucial role, "TIAs are these low frequency but high stakes conditions where it seems like it is sort of this invisible role to some degree that pharmacists are playing."

Pharmacists expressed satisfaction with their close involvement in designing the protocol and having their work 'respected'. Pharmacists were unconcerned with additional workload and confident that the processes covered in the protocol would fit into their usual management. Pharmacists reported that use of the protocol had penetrated throughout the PACT teams. They indicated the primary modes of communication was through 'view alerts', which are EMR alerts that must be read. Other modes of communication required EMR cosigning and frequent instant messaging, which was common practice among facility pharmacists.

Context

Key factors that affected how the pilot study was implemented included the specific characteristics of the intervention, the learning climate and culture of the facility. Participants described how the dual format of the protocol in tabular and flowchart presentations made it easier to implement. Further, they described how early involvement in terms of synthesising the evidence and offering feedback on prototypes made them feel uniquely part of the process. Pharmacists appreciated how formal communication process and real-time patient identification tool offered advantage over current, ad-hoc practices. All interviewees emphasised that the medical facility emphasised a culture of quality improvement through reliance on lean techniques,[36] and that Quality Improvement (QI) projects were embedded in training programmes for pharmacists. One pharmacist (P108) expressed the appropriateness of the project:

> As a department, [we] are trying to figure out: what can we do to help prevent those readmissions, or you know to meet all of those [facility report card] reports? What can we do to not just do what we've been doing for the last 10 years as pharmacists, but how do we step outside the box and look at some of those measures and help improve care for the veterans? (P108)

Another primary care pharmacist described that awareness of protocol was high, but that the low patient load (2–4 patients/month) meant not all pharmacists used the protocol often. She further described both the importance of helping TIA patients with hypertension but the challenges of working across services:

Table 2 Group differences on vital signs, processes of care, utilisation and outcomes

Laboratory and vital signs	Pre Implementation (N=75)	Post Implementation (N=61)	P value
Presentation systolic blood pressure (BP) (mm Hg)			
Mean systolic (SD)	151.2 (25.1)	150.6 (25.4)	0.876
Median systolic (range)	151.5 (106–202)	154 (83–200)	0.982
Presentation diastolic BP			
Mean diastolic mm Hg (SD)	87.1 (13.6)	85.0 (14.5)	0.403
Median diastolic mm Hg (SD)	86.5 (56–120)	85 (52–123)	0.579
Systolic BP 90 days post discharge			
Mean systolic (SD)	133.3 (17.8)	126.8 (16.6)	0.045
Median systolic (range)	133 (98–196)	125.8 (77–186)	0.047
Diastolic BP 90 days post discharge			
Mean diastolic (SD)	77.4 (11.1)	76.3 (10.6)	0.571
Median diastolic (range)	76.5 (59.7–136)	76 (50–108.7)	0.855
Systolic BP change			
Mean change (SD)	15.8 (20.5)	24.8 (23.2)	0.029
Median change (range)	13 (-40–56)	25.3 (-45–75)	0.039
Diastolic BP change			
Mean change (SD)	7.6 (12.0)	9.1 (12.7)	0.526
Median change (range)	7 (-25–37)	9 (-31–35)	0.580
LDL cholesterol during index event or most recent visit within 180 days			
Mean LDL (SD)	94.3 (33.8)	85.2 (33.9)	0.146
Median LDL (SD)	91.6 (44–195.8)	77 (24.8–180)	0.091
Processes of care			
% High/moderate potency statin (n)	66.7 (46)	77.4 (41)	0.229
% Discharged on statin (n)	75.4 (52)	74.5 (38)	1.000
% Hypertension control (n)	68.4 (39)	79.6 (39)	0.269
% Antihypertensive medication intensification (n)	25.0 (6)	44.0 (11)	0.232
% Antithrombotic day 2 (n)	91.9 (68)	96.6 (57)	0.300
% Anticoagulation for atrial fibrillation (n)	100.0 (5)	100.0 (8)	
% International normalised ratio measured (n)	100.0 (1)	75.0 (3)	1.000
% Deep vein thrombosis prophylaxis (n)	94.7 (18)	100.0 (18)	1.000
% Glycosylated haemoglobin measurement (n)	97.1 (33)	95.5 (21)	1.000
% Hypoglycaemic medication intensification (n)	33.3 (2)	80.0 (4)	0.242
Healthcare utilisation			
% Primary care visit in 30 days post discharge (n)	54.7 (41)	62.3 (38)	0.388
% Primary care visit in 90 days post discharge (n)	74.7 (56)	80.3 (49)	0.539
% Neurology visit in 30 days post discharge (n)	16.0 (12)	21.3 (13)	0.506
% Neurology visit in 90 days post discharge (n)	57.3 (43)	52.5 (32)	0.606
% NEXUS* clinic visit in 30 days post discharge (n)	70.7 (53)	83.6 (51)	0.104
% NEXUS clinic visit in 90 days post discharge (n)	90.7 (68)	95.1 (58)	0.511
Outcomes			
% 90-day mortality rate (n)	0.0 (0)	1.6 (1)	0.449
% 90-day recurrent stroke rate (n)	9.3 (7)	5.0 (3)	0.511
% 90-day recurrent TIA rate (n)	2.7 (2)	1.7 (1)	1.000
% 90-day recurrent stroke or TIA rate (n)	10.7 (8)	6.7 (4)	0.548

Continued

Table 2 Continued

Laboratory and vital signs	Pre Implementation (N=75)	Post Implementation (N=61)	P value

*NEXUS visits are defined as any encounter in primary care, specialty care, or mental health clinic.
LDL, low-density lipoprotein (cholesterol); TIA, transient ischaemic attacks.

Table 3 Qualitative evidence on selected implementation outcomes and contextual factors

Implementation outcomes[29] and contextual factors	Exemplar quotations
Appropriateness/satisfaction ► Front-line staff expressed satisfaction that protocol had minimal effect on workload and fit scope of practice ► Pharmacists appreciated how the pilot study enabled them to improve patient care and collaborate ► Pharmacists were motivated that structured communication led to improvements in patient outcomes during early phase of pilot	'There's plenty of availability in our clinics to do (hand-offs), and since the management of these risk factors is already part of our scope; that's easy to add in' (P102) 'We're (pharmacy) kind of well-established throughout the facility so (implementing the protocol) has been basically a seamless transition.' (P102) 'This was a really good fit with some initiatives that we were trying to kind of break into. Historically, acute care pharmacies and the ambulatory care pharmacists were kind of in silos. Over time, as people start to recognise that these are more integrated activities than what people think, we were looking for opportunities to develop transition in care opportunities.' (P103) 'today the patient I said I saw was really exciting, because his last A1C was 10.8, we want less than 7, and today it was 7.7, so he was within like 3 months, so I was like 'okay so this is a really good referral process' (P108)
Adoption/feasibility ► The protocol is an evidence-based tool to support recommendations ► A relatively low volume of TIA patients makes implementation feasible ► A change in Veterans Affairs policy requiring medical support assistants to schedule patient visits forced pharmacists to adapt protocol	'As far as like implementing the protocol, a lot of this stuff it's kind of how we use it is more of just kind of more an evidence based tool that we can use… It's utilising the protocol as more evidence that we can use to support any recommendations that we make' (P101) 'know right now, (the protocol implementation is) not been a big deal. It's very easy to accommodate that… You know I get one or two people on a week that I call and it's not too bad' (P103) '…my initial thoughts is that now pharmacists no longer have scheduling capability, so we rely on other people to schedule our appointments' (P108)
Fidelity ► Pharmacists generally have followed guidelines through 'flowmaps' and tables according to intended protocol in figure 1 ► Some providers have followed up on recommendations with direct communication on blood pressure management to ensure patient care	'(INPATIENT PHARMACIST) is using the TIA tool to identify patients, especially inpatients who may have had a TIA. He is either reaching out to (hits table) the primacy care pharmacist or reaching out to the primary pharmacist on the inpatient team… to get the patient scheduled for an appointment before discharge. That's our goal.' (P102) 'She wasn't able to find a pharmacist because the (community-based outpatient clinics) don't have a pharmacist assigned to them like the outpatient teams here, and so I made a call to the nurse there to try to find out…they were supposed to pick up a blood pressure cuff, and it wasn't clear to me from the consult or the notes whether that had occurred, and this nurse also had done a post follow-up call, and so when I asked her about it … she said that she would call the patient again' (P106)
Inner Setting Factors ► Learning climate: pharmacists tend to be current with recent evidence-based medicine, receive Quality Improvement training have patient communication and motivational interviewing incorporated into their training ► Culture: the medical facility promotes an ethos of continuous quality improvement across services	'We embrace the "Lean" model. I think people are very accustomed to those kinds of things. Acute care pharmacists are probably a little more nimble than the ambulatory care pharmacists and just because things in the acute care world change every day.' (P103) '(They) presented compelling data … 'You know, this is the patient population that we're missing.' … We do a lot of process improvement type projects in our department. It's something that is kind of ingrained into all of us in training.' (P101)
Intervention characteristics ► Design quality and packaging and source of intervention: appreciate the range of presentations (algorithm vs table) ► Intervention source participants discussed their involvement in designing the protocol, viewing it as internally developed and pilot tested ► Evidence strength and quality ► Relative advantage: compared with usual care, wide recognition that patient tracking tool enables identification of on-site patients	'I feel really proud about the protocol, even though my part was small. It was a really good collaborative effort, and I learnt a lot from the way that (PI) approached it, and again, it was very I guess encouraging to see (laughter) a discipline like pharmacy be ready to just jump in on that.' (P106) 'I think we were surprised that people thought that we were the group that people thought would be helpful in this … And it was surprised in a good way, not a bad way… like, well, we must be doing something right if they think that we would do a good job at doing this.'(P108) 'It all looked very well researched and very literature backed--it's all very concrete with published evidence. So I think from that standpoint, it's gone well.' (P101) 'The real key to it working is that real time report of patients that are in the hospital, and that's always been kind of a difficult thing.' (P106)

TIA, transient ischaemic attacks.

> I think it seems like a good idea, catching those patients, because I have one right now I just started following, and her blood pressure's still high. She's been admitted to the hospital on the outside multiple times, so trying to catch that seems like a really good thing if we can catch it … It's hard to implement things across multiple avenues of the hospital. (P111)

During active implementation, a VA-wide policy change occurred that stipulated that medical support assistants must schedule outpatient appointments. This external change technically prevented pharmacists from following the protocol, but as one pharmacist described, they continued to attempt to call patients on the phone to discuss treatment.

DISCUSSION

This study adds to the literature the importance of pharmacists in treating vascular disease and hypertension.[18 25 37] Results suggest that this pilot clinical programme focused on deploying pharmacists to provide medication management for patients with TIA lead to improved hypertension control. These results align with other studies in hypertension and hyperlipidaemia management where the timely addition of a pharmacist within a team-based care model is associated with significant improvement in clinical outcomes.[37 38] Several systematic reviews confirm the efficacy of the addition of a pharmacist to team-based care in conditions such as diabetes, hypertension and hyperlipidaemia.[39–41]

Few prior studies about pharmacist care for vascular disease offer a detailed evaluation of how contextual elements may interact during programme implementation that includes clinicians' perspective as well as data on clinical effectiveness. Evaluation of qualitative data on implementation indicated that front-line clinicians and leadership found the programme to be an appropriate, feasible and efficient use of existing resources. Due to shared professional norms and common training experience, inpatient and primary care pharmacists are well-positioned within local social networks to communicate in a timely, accurate way about TIA patients as they transition through the hospital and into the outpatient setting. The standardised procedures enabled improved consensus of treatment and monitoring through co-signing of electronic health records, real-time messaging and the scheduling of follow-up visits during or immediately after hospitalisation.

The capability to detect at-risk patients in near-real time is a welcome development for conditions such as TIA that require rapid identification and treatment. However, distinct challenges remain with using information not documented in the EMR or related technological tools including the challenge of recording decision-making that takes place verbally or through other information channels.[42] Evidence suggests that deliberate action may be necessary to effectively track patients as they transition through hospital services, a practice that has been labelled 'chart stalking'.[43] In this pilot programme, designated clinicians (inpatient pharmacist, internist, nurse, all with experience working with the neurology service) closely monitored all admitted TIA patients during and after hospital discharge.

The team sought to improve early post-TIA management in order to improve outcomes assessed in the 90-day postevent period in order to promote guideline-based medication prescription as soon as possible after the index–TIA event and to provide continuity in care as patients transitioned from the ED or inpatient setting into the outpatient setting. The two key processes of care varied in terms of the time period over which they were assessed: SBP at 90 days post discharge, and the prescription of high or moderate potency statins within 7 days of discharge. The blood pressure metric was assessed later post TIA for two main reasons: (a) clinical concerns about blood pressure lowering in the acute event period are reflected in current guidelines which emphasise getting patients to goal blood pressure only after the acute event period and (b) for patients with poorly controlled blood pressure post discharge, stepwise approaches to increasing antihypertensive intensity require some time to be implemented and to be reflected in clinic-based blood pressure measurements. In other words, the goal of the programme—with regard to hypertension management—was to meet goal blood pressure targets as quickly as possible post discharge. Given that primary care pharmacy visits are often conducted via telephone, the intention was for the pharmacists to engage with patients in the postdischarge period. However, only clinic-based blood pressure measurements are considered as 'vital signs' within the VA data systems. Therefore, the process measure was assessed over the 90-day period allowing patients time to return for follow-up assessments.

Although there was an observed improvement in SBP in the 90 days post discharge after implementation of the programme, a statistically significant change in the prescription of guideline-concordant high or moderate potency statins at discharge was not observed. To observe significant changes, 138 patients per group would have been needed to see a difference in rates between 65% and 80%. Most TIA patients were on a low-potency statin prior to the index event and it may have been that clinical inertia (not wanting to change an existing medication)[44] or patient preferences (eg, wanting to stay on the medication that they perceived was 'working' for them) contributed to a lack of a statistically significant increase in the proportion of patients who received high/moderate potency statins. Clinical inertia is well documented with physician providers but less understood with pharmacists. In addition, a reluctance to prescribe statins for patients over 75 years, which was typically clinical decision based on assessment of risks and benefits may have contributed to the observed results.

There were several limitations in this single site quality improvement pilot. First, a relatively small sample size of patients as well as the limited number of clinicians

working in this area limit the ability to make generalizable claims about these findings. Second, this facility had a well-development culture of quality improvement and infrastructure to support cerebrovascular care, therefore findings may not extend to settings with different quality improvement cultures. Third, observational design limits inferences about causal relationships outcomes and pharmacist behaviour involved in the intervention. Fourth, although age, blood pressure and history of diabetes were available on all patients, the ABCD2 (age, blood pressure, clinical features, duration, diabetes) score could not be calculated because clinical features and symptom duration were not available in the electronic health record data. Finally, large artery atherosclerotic aetiology and capsular warning syndrome have been associated with increased risk of early recurrence among patients with TIA[45]; however, our dataset did not include event aetiology. Given that risk factor management may play a differential role based on event type (eg, hypertension management among patients with lacunar events), future research should explicitly examine the differential benefits of medical management among TIA patients with varying event aetiologies.

Early participation in programme development and leadership involvement contributed to wide penetration in outpatient clinics throughout the facility, demonstrating how clinical pharmacists may play an increasing role is treating low frequency, high-stakes cerebrovascular events where early treatment and follow-up are critical in improving outcomes.

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Acknowledgements The authors would like to acknowledge the time donated by providers who participated in the quality improvement evaluation, and special thanks to Ariel Chatham and Lauren Murphy with data collection. We thank Ali Sexson, Sean Baird and Jennifer Myers for assistance with manuscript preparation.

Contributors All authors made significant contributions to the manuscript. NR, TMD, AJP, LM and DMB analysed and interpreted data. NR and DMB drafted and revised the manuscript and prepared tables and figures with TMD, AJP, LM, DMB, BH and AJZ. CK, BF, AK, AB, JF, AZ, TMD and DMB made important intellectual contributions in the study design and in feedback on results. DMB is the guarantor of the article. All authors have read and gave final approval of the version submitted for publication.

Funding This work was supported by the Department of Veterans Affairs (VA), Health Services Research & Development Service (HSRD), Precision Monitoring to Transform Care (PRISM) and Quality Enhancement Research Initiative (QUERI) (QUE 15-280) and in part by the VA HSRD Research Career Scientist Award (Damush RCS 19-002) and Rattray Career Development Award-2 (Rattray D2642-W). The funding agencies had no role in the design of the study, data collection, analysis, interpretation or in the writing of this manuscript.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. This study was approved by the Indiana University Institutional Review Board (approval #1602800879). All participants gave consent for participation in this study. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information. The United States Department of Veterans Affairs (VA) places legal restrictions on access to veteran's health care data, which includes both identifying data and sensitive patient information. The analytic data sets used for this study are not permitted to leave the VA firewall without a Data Use Agreement. This limitation is consistent with other studies based on VA data.

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