Impact Of Transportation Barriers On High-Quality Anticoagulation Management In Underserved Patients

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THESIS

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LIST OF ABBREVIATIONS

INR	International Normalized Ratio
CYP2C9	cytochrome P450, family 2, subfamily C, polypeptide 9
VKORC1	vitamin K epoxide reductase complex subunit 1
SES	socioeconomic status
ATC	Antithrombosis Clinic
EHR	electronic health record
VTE	venous thrombosis
AF	atrial fibrillation
CVA	cerebrovascular accident
MVR	mechanical valve replacement
VHD	valvular heart disease
TTR	within-patient proportion of INR levels spent in therapeutic range
Y	outcome variable
M	mediator variable
X	predictor variable
SD	standard deviation

SUMMARY

The objective of this study was to evaluate the relationship between transportation barriers to anticoagulation monitoring visits and the quality of anticoagulation control in an inner-city underserved population. We conducted a cross sectional survey of patients treated with warfarin and managed at the University of Illinois at Chicago Hospital and Health Sciences System Antithrombosis Clinic, between September 2010 and February 2011. A 23-item survey questionnaire was administered to participants to elicit responses to variables such as access to health care barriers, socio-economic characteristics, and opinions regarding anticoagulation patient-centered management models. Additional data on patient demographics, clinical characteristics and outcomes were extracted from the EHR for each patient for a total follow-up period of 12 months (February 2010 to February 2011) prior to survey administration. Descriptive statistics were performed to characterize the sample stratified by transportation barriers.

Chi-square, Fisher's exact, student's t-test, and Wilcoxon signed rank test, were used as appropriate to examine differences between covariates and the exposure variable. Multivariate linear regression analysis was used to determine the association between transportation barriers and TTR, while adjusting for potential confounders. Patients with transportation barriers compared to patients without transportation barriers were older (57.89 $\pm$ 17.37 vs. 51.24 $\pm$ 16.55), more likely to be female (72.67% vs. 61.42%), more likely to be African American (64.67% vs. 58.27%) or Hispanic (24% vs. 18.11%), more likely to have their primary language other than English (14.67 vs. 7.20), more likely to have

less than a 12th grade education (41.38% vs. 21.26%), more likely to have an annual income of < $15,000 (52.82% vs. 31.45%), less likely to have private insurance (8.67% vs. 38.58%), and more likely to be dependent on a caregiver (48.99% vs. 3.97%), all values significant ($p<0.05$). After adjusting for confounders, TTR was lower in patients with transportation barriers than in those without transportation barriers (absolute difference 6.04%, $p=0.009$).

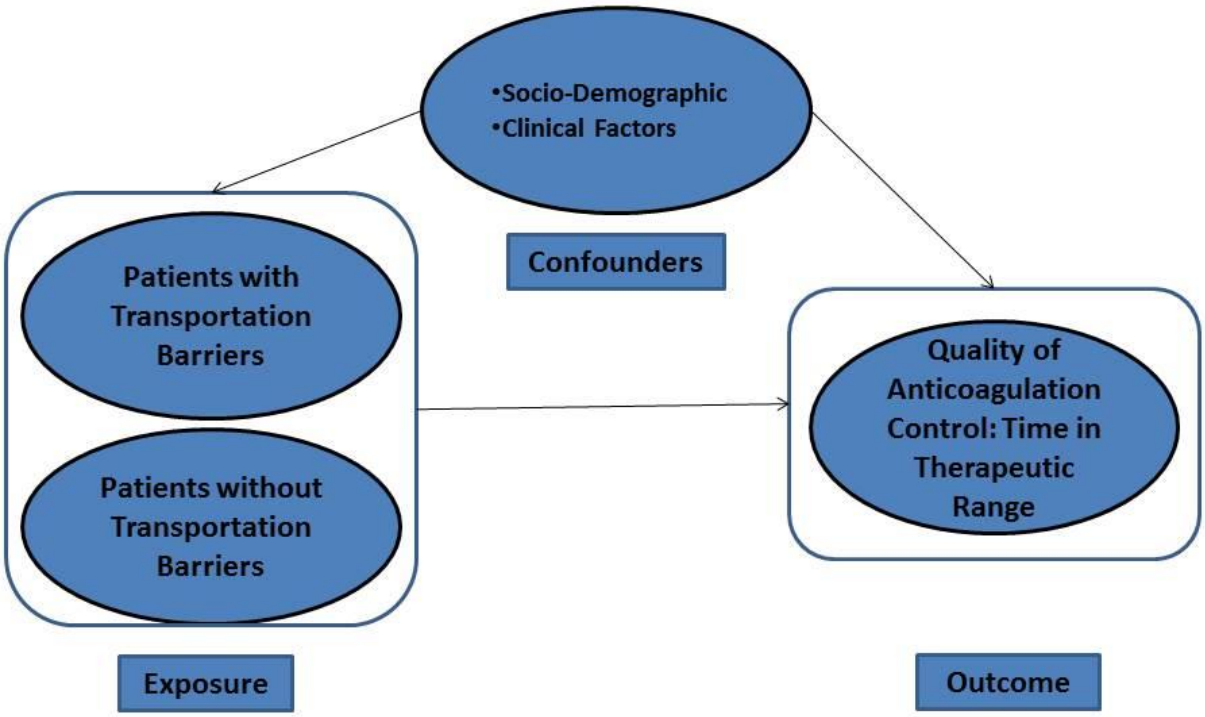
Our study is significant in that is among the first to evaluate the relationship between transportation barriers and anticoagulation related clinical outcomes such as quality of anticoagulation control in a largely minority, underserved population. Understanding this relationship is especially important in underserved, minority patients who are at highest risk for anticoagulation related complications. Future studies should focus on elucidating the feasibility of adopting alternate models of anticoagulation monitoring such as telehealth guided patient-centered interventions such as self-testing and self-monitoring.

I. INTRODUCTION

Despite the emergence of several novel target specific oral anticoagulants, warfarin remains the most commonly prescribed oral anticoagulant with over 30 million prescriptions dispensed and 2.5 million patients treated annually in the United States.(1) At the same time, warfarin is among the top ten medications with the highest incidence of serious adverse event reports and the leading cause of drug-related hospitalizations and emergency room visits among older adults.(2) Due to its narrow therapeutic index and inter-patient variability in dose-response, warfarin requires frequent monitoring of its anticoagulant effect by measurements of the International Normalized Ratio (INR) and dose adjustments to maintain patients within the therapeutic range. Adherence to monitoring is critical in order to ensure safe and effective anticoagulation. The time in therapeutic INR range (TTR) is a common measure used to evaluate the quality of anticoagulation control and can serve as a surrogate marker for anticoagulation complications.(3) Low TTR can result in complications of therapy such as bleeding, clotting, and hospitalizations. (4-8) Data demonstrate that minority patients are more prone to complications of warfarin therapy due to inadequate TTR. (9-11) Patients with low TTR require more intensive laboratory testing leading to increased health care costs. (12-13) Thus, increasing TTR should be a priority for clinicians managing patients on warfarin therapy.

Specialized anticoagulation clinics provide a mechanism for frequent patient monitoring and have been reported to improve TTR and clinical and resource utilization outcomes compared to patients managed by routine medical care. (14-18) However, patient access to clinic appointments for monitoring may be limited by several socioeconomic, clinical and demographic factors. Transportation barriers comprise a major impediment to health care access, especially in those with lower socioeconomic status (SES) and the under or uninsured. (19) While associations of several socioeconomic, demographic, clinical and genetic factors with quality of anticoagulation control have been studied, the impact of transportation barriers to anticoagulation monitoring visits has not been evaluated. (20-23) Therefore, the objective of this study was to evaluate the relationship between transportation barriers to anticoagulation monitoring visits and the quality of anticoagulation control in an inner-city underserved population. (Figure 1)

Figure 1: Conceptual Framework.



II. METHODS

A. Study Population

Patients treated with warfarin and cared for at the clinical pharmacist managed Antithrombosis Clinic (ATC) at the University of Illinois at Chicago Hospital and Health Sciences System (UI Health) were enrolled in the study. The ATC serves approximately 500 warfarin treated patients and provides approximately 750 patient visits per month, with 35 to 40 patients seen in clinic each day. The majority of the population served by the clinic is African American (60%), followed by Hispanics (20%), Caucasians (17%), and Asians and those of other ethnicities (3%). Clinical pharmacists in ATC follow a structured process of care and all patients receive targeted assessment and education that includes the indication and duration of warfarin therapy, INR and other pertinent laboratory assessment, dosing adjustment and instruction, importance of adherence with therapy and monitoring clinic appointments, tablet recognition and refill procedures, signs and symptoms of thrombosis, potential food and drug interactions and how to manage consistent intake of vitamin K containing foods, procedures for emergencies, and notifying ATC of any changes in therapy or disease status. Once a stable warfarin dose is reached after initiation of therapy, patients are seen in clinic approximately every 4 weeks with shorter intervals for unstable patients and with longer intervals for more stable patients. Data on laboratory tests including the INR, warfarin dose, adherence status, any missed clinic appointments, fluctuations in vitamin K intake, any acute illness, alcohol intake, smoking status, changes in concurrent medications (prescription and over the counter), and bleeding and

thromboembolic complications are routinely collected at each clinic visit using a standardized data collection and documentation form and entered into an electronic health record (EHR), Cerner Millenium Data Repository.

B. Study Design and Data Collection

We conducted a cross sectional survey of patients treated with warfarin and managed at the UI Health ATC between September 2010 and February 2011. A 23-item survey questionnaire was developed and administered to participants to elicit responses to variables such as access to health care barriers, socio-economic characteristics, and opinions regarding anticoagulation patient-centered management models. Specifically, the survey contained 5 questions about access barriers to the ATC which included the type of transportation used to arrive at the clinic, distance from the clinic, time taken to travel to the clinic, dependency on a caregiver, and the need for travel assistance. We established face validity by pre-testing the questionnaire in 10 patients managed at ATC and 5 clinical pharmacist anticoagulation specialists who were not members of the research team. Survey revisions were based on respondent feedback and pre-test results. Additional data on patient demographics, clinical characteristics and outcomes were extracted from the EHR for each patient for a total follow-up period of 12 months (February 2010 to February 2011) prior to survey administration. A 12 month follow-up period was chosen to allow a sufficient window to capture the incidence of temporal factors associated with anticoagulation control. Patients were eligible for the study if they were treated with warfarin

and received care in the ATC for ≥ 3 months. Patients were excluded from the study if they were < 18 years old (unless a caregiver or family member recorder the responses) and if they had difficulty in communicating or completing the survey. The local institutional review board approved this study (IRB 2010-0500).

C. Measurements and Study Variables

The primary outcome variable was the quality of anticoagulation control measured as the percentage of time patients spent within the therapeutic INR range (TTR), a commonly accepted method of reporting quality of anticoagulation management. (3, 24) The exposure variable was the presence of transportation barriers to anticoagulation clinic monitoring visits. Patients were categorized to have transportation barriers if they depended on travel assistance (from a family member, friend, or relative), needed to borrow or rent a vehicle, or relied on state Medicaid supported transportation services such as a medical car to travel to clinic. Additional socio-demographic and pertinent clinical variables (age, gender, race, primary language spoken, marital status as a proxy for social support, housing status, living arrangements, education level, income level, insurance status, dependence on caregivers, travel time to clinic, distance to clinic, indication for therapy, length of therapy, interest in alternate methods of monitoring such as self-testing, concurrent medications, total number of clinic appointments, missed clinic appointments, and non-adherence with therapy over the 12 month follow-up period) known to affect anticoagulation outcomes were included for testing as covariates. (Table I)

TABLE I

STUDY VARIABLES

Variable	Type	Description
Key outcome variable		
Time in therapeutic range	Continuous	Within-patient proportion of INR levels spent in therapeutic range / 12 months
Key exposure variable		
Transportation barriers	Categorical	Indicator variable for having transportation barriers
Covariates		
Age	Continuous	Values in years
Gender	Categorical	Indicator variable for being male
Race	Categorical	Indicator variables for being Caucasian, African American, Hispanic, other
Language	Categorical	Indicator variable for speaking English
Marital status	Categorical	Indicator variables for being married, single, divorced, widowed or separated
Education level	Categorical	Indicator variable for having education level of < 9^{th} grade, 9-12^{th}, high school diploma, some college, college graduate or above
Income level	Categorical	Indicator variables for having income < $15,000, $15,000-$25,000, > $25,000-$50,000, > $50,000-$75,000, other
Insurance status	Categorical	Indicator variables for having Private, Medicare, Medicaid or no insurance
Distance to travel to clinic	Continuous	Distance in miles calculated using zip codes
Travel time to clinic	Continuous	Time to travel to clinic (minutes)
Housing status	Categorical	Indicator variable for owning home
Living arrangements	Categorical	Indicator variable for living with someone
Dependence on caregiver/s	Categorical	Indicator variable for being dependent on caregiver/s
Indication for therapy	Categorical	Indicator variables for being treated for VTE, AF, CVA, MVR/VHD, other
Concurrent medications	Continuous	Total number of concurrent medications
Length of therapy	Continuous	Duration of therapy in years
Missed clinic appointments	Continuous	Percentage of missed clinic appointments / 12 months
Non-adherence to therapy	Continuous	Percentage of clinic appointments with documented non-adherence to prescribed therapy / 12 months
Total appointments	Continuous	Total number of clinic monitoring appointments
Interest in self-testing	Categorical	Indicator variable for being interested in self-testing

D. Sample Size and Power Calculation

A range of sample sizes were calculated using G*Power 3.1.3 to detect a difference in TTR in patients with and without transportation barriers to anticoagulation monitoring visits. The parameters used for input were effect size (F^2) (25) and the number of predictors. Three standard effect sizes were used to calculate the sample size. For a one-tailed t-test with significance (alpha) set to 0.05 and power set to 80%, the required sample size to detect a small effect of 0.02 was 1022, a medium effect of 0.15 was 150, and a large effect of 0.35 was 74.

E. Data Analysis

Statistical analyses were conducted in SAS® 9.2 (SAS Institute, Cary, NC). We conducted descriptive statistics to characterize the sample stratified by transportation barriers. Chi-square, Fisher's exact, student's t-test, and Wilcoxon signed rank test, were used as appropriate to examine differences between covariates and the exposure variable. Multivariate linear regression analysis was used to determine the association between transportation barriers and TTR, while adjusting for potential confounders. Covariates considered for inclusion were initially selected using prior literature / clinical knowledge (as also described in section C and Table I above) and were then tested using a change in coefficient approach. (26) After determining the crude parameter estimate between transportation barriers and TTR, we then calculated an adjusted parameter estimate for transportation barriers by adding to the model one covariate at a time. The confounders included in the final model were the ones that altered

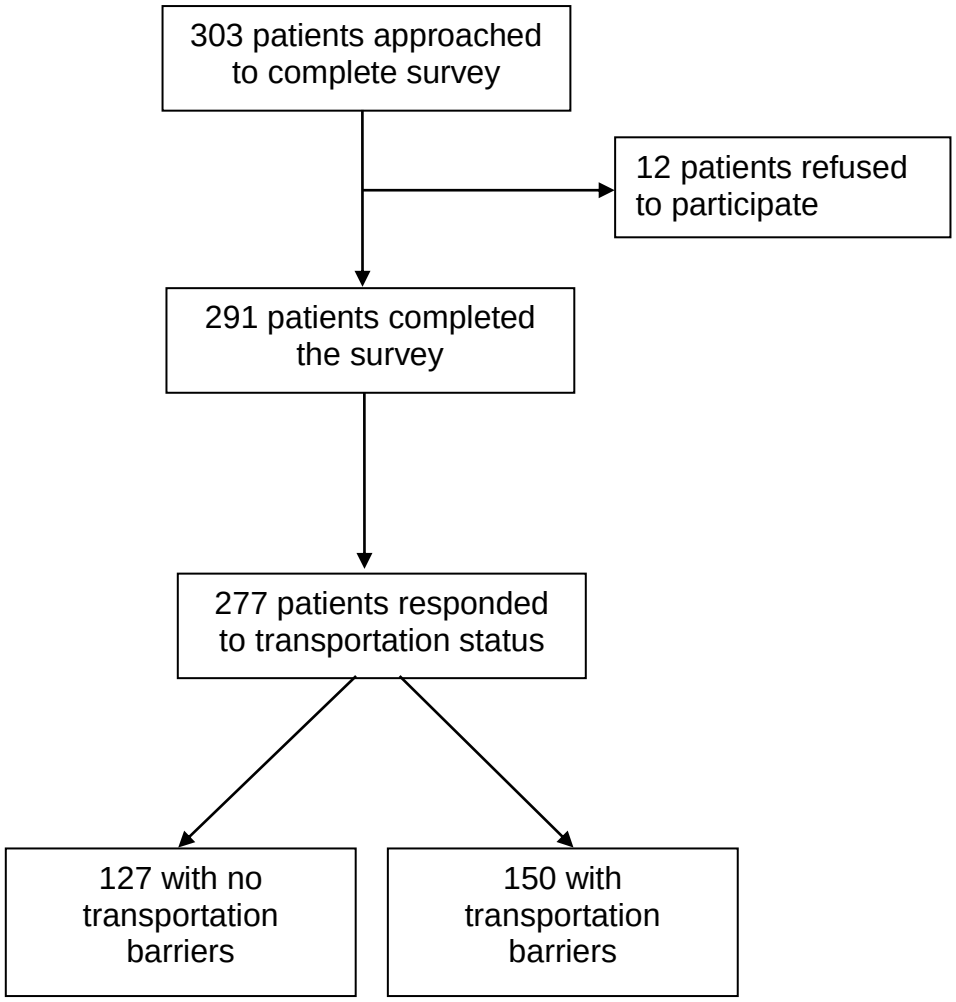
the crude estimates of the independent-dependent variable relationship by > 10%. We evaluated the main effects and all 2-way interactions between exposure and covariates.

III. RESULTS

A. Description of Study Cohort

A total of 291 patients completed the survey and 277 patients provided information on transportation status. (Figure 2) A total of 150 patients reported to have transportation barriers to anticoagulation monitoring visits, while 127 patients reported having no transportation barriers.

Figure 2. Study Cohort.



B. Characteristics of the Study Cohort

The study cohort was mainly comprised of females (67%) and the average age was 54.6 years. The majority of patients were African Americans (61.5%), followed by Hispanics (21.05%), Caucasians (13.63%) and other race (3.85%). Table II presents baseline socio-demographic characteristics of the study population stratified by the presences or absence of transportation barriers. Patients with transportation barriers compared to patients without transportation barriers were older (57.89 $\pm$ 17.37 vs. 51.24 $\pm$ 16.55), more likely to be female (72.67% vs. 61.42%), more likely to be African American (64.67% vs. 58.27%) or Hispanic (24% vs. 18.11%), more likely to have their primary language other than English (14.67 vs. 7.20), more likely to have less than a 12^{th} grade education (41.38% vs. 21.26%), more likely to have an annual income of < $15,000 (52.82% vs. 31.45%), less likely to have private insurance (8.67% vs. 38.58%), and more likely to be dependent on a caregiver (48.99% vs. 3.97%), all values significant ($p<0.05$).

Table III presents baseline clinical characteristics of the study population stratified by the presences or absence of transportation barriers. Patients with transportation barriers compared to patients without transportation barriers had worse anticoagulation control as expressed by the TTR (47.50 $\pm$ 20.67 vs. 52.22 $\pm$ 19.58, $p=0.05$), were on a higher number of concurrent medications (10.58 $\pm$ 6.53 vs. 7.45 $\pm$ 5.38, $p<0.0001$), were more likely to be non-adherent with their warfarin therapy (14.09 $\pm$ 14.23 vs. 11.64 $\pm$ 12.17, $p=0.07$), and were on warfarin therapy for a shorter duration of time (3.09 $\pm$ 5.23 years vs. 3.67 $\pm$ 3.75 years, $p=0.01$). Other characteristics were similar between the 2 groups.

TABLE II

SOCIODEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION STRATIFIED BY TRANSPORTATION BARRIERS

Patient Characteristics	No Transp. Barriers (n=127)	Transp. Barriers (n=150)	P Value
Age (mean, SD)	51.24 (16.55)	57.89 (17.37)	0.0020
Gender (n, %)			0.0464
Male	49 (38.58)	41 (27.33)	
Female	78 (61.42)	109 (72.67)	
Race (n, %)			0.0015
Caucasian	27 (21.26)	9 (6.00)	
African American	74 (58.27)	97 (64.67)	
Hispanic	23 (18.11)	36 (24.00)	
Other	3 (2.36)	8 (5.33)	
Language (n, %)			0.0512
English	116 (92.80)	128 (85.33)	
Other	9 (7.20)	22 (14.67)	
Marital Status (n, %)			0.3713
Married	40 (31.50)	43 (28.67)	
Single	68 (53.54)	72 (48.00)	
Widowed	8 (6.30)	16 (10.67)	
Divorced	11 (8.66)	19 (12.67)	
Education Level (n, %)			0.0033
< 9th grade	10 (7.87)	29 (20.00)	
9-12th grade	17 (13.39)	31 (21.38)	
High School Diploma	35 (27.56)	36 (24.83)	
Some College	41 (32.28)	36 (24.83)	
College Graduate	24 (18.90)	13 (8.97)	
Income Level (n, %)			<.0001
< $15,000	39 (31.45)	75 (52.82)	
$15,000-$25,000	29 (23.39)	28 (19.72)	
>$25,000-$50,000	33 (26.61)	16 (11.27)	
>$50,000-$75,000	20 (16.13)	5 (3.52)	
Other	3 (2.42)	18 (12.68)	
Insurance Status (n, %)			<.0001
Medicare	38 (29.92)	75 (50.00)	
Medicaid	35 (27.56)	60 (40.00)	
Private	49 (38.58)	13 (8.67)	
Uninsured	5 (3.94)	2 (1.33)	
Travel Time to Clinic, minutes (mean, SD)	38.32 (28.01)	38.52 (24.79)	0.5817
Distance to Travel to Clinic, miles (mean, SD)	10.93 (11.36)	11.39 (13.66)	0.5804
Housing Status (n, %)			0.1598
Own Home	56 (44.09)	53 (36.30)	
Rent Home	63 (49.61)	75 (51.37)	
Other	8 (6.30)	18 (12.33)	
Living arrangements (n, %)			0.4286
Live Alone	28 (22.22)	27 (18.37)	
Live with Someone	98 (77.78)	120 (81.63)	
Caregiver Depend. (n, %)			<.0001
Yes	5 (3.97)	73 (48.99)	
No	121 (96.03)	76 (51.01)	

TABLE III

CLINICAL CHARACTERISTICS OF THE STUDY POPULATION STRATIFIED BY TRANSPORTATION BARRIERS

Patient Characteristics	No Transp. Barriers (n=127)	Transp. Barriers (n=150)	P Value
Indication (n, %)			0.8279
VTE	85 (66.93)	103 (68.67)	
AF	14 (11.02)	20 (13.33)	
CVA	7 (5.51)	9 (6.00)	
MVR/VHD	7 (5.51)	7 (4.67)	
Other	14 (11.02)	11 (7.33)	
Concurrent Medications (mean, SD)	7.45 (5.38)	10.58 (6.53)	<.0001
Length of therapy, years (mean, SD)	3.67 (3.75)	3.09 (5.23)	0.0141
Time in Therapeutic Range (mean, SD)	52.22 (19.58)	47.50 (20.67)	0.0535
Self-Testing Interest (n, %)			0.5937
Yes	108 (85.04)	124 (82.67)	
No	19 (14.96)	26 (17.33)	
Total No. of Monitoring Appointments /INRs (mean, SD)	18.09 (9.10)	18.43 (9.66)	0.7339
Missed Monitoring Appointments (mean, SD)	17.24 (18.17)	15.15 (17.68)	0.2785
Non-Adherence Warfarin (mean, SD)	11.64 (13.17)	14.09 (14.23)	0.0799

C. Multivariate Linear Regression Analysis of Association Between Transportation Barriers and Quality of Anticoagulation Control

The variables retained in the final model were age and its interaction term, non-adherence with warfarin regimen, length of warfarin therapy (> 12 months vs < 12 months), an interest/preference for self-testing of anticoagulation, and missed clinic appointments for anticoagulation monitoring. Table IV displays the multivariate regression analysis of the association between transportation barriers and quality of anticoagulation control. After adjusting for confounders, TTR was lower in patients with transportation barriers than in those without transportation barriers (absolute difference 6.04%, p=0.009).

TABLE IV

MULTIVARIATE REGRESSION ANALYSIS OF THE ASSOCIATION BETWEEN TRANSPORTATION BARRIERS AND QUALITY OF ANTICOAGULATION CONTROL

	Model 1[a]		**Model 2[b]**		**Model 3[c]**	
	β *(SE)*	*p-value*	β *(SE)*	*p-value*	β *(SE)*	*p-value*
Transportation barriers	**-4.72 (2.43)**	**0.05**	**-6.04 (2.31)**	**0.009**	**-5.81 (2.35)**	**0.01**
Age	-	-	0.38 (0.10)	0.0003	0.44 (0.10)	<0.0001
Age*transportation barriers [Interaction]	-	-	-0.36 (0.13)	0.007	-0.38 (0.14)	0.005
Non-adherence with warfarin	-	-	-0.16 (0.08)	0.05	-0.20 (0.08)	0.01
Interest in self-testing	-	–	-7.54 (3.07)	0.01	-6.75 (3.11)	0.03
Length of therapy > 12 months vs. < 12 months	-	–	7.95 (2.70)	0.003	7.47 (2.75)	0.006
Missed clinic appointments	-	–	-0.22 (0.07)	0.0008	–	–
Intercept	52.22	<0.0001	53.86	<0.0001	53.45	<0.0001
R^2	0.01		0.18		0.15	

[a] Model 1: Crude estimate from the unadjusted regression analysis

[b] Model 2: Multivariate regression model controlling for all confounders that altered the crude estimate of the independent-dependent variable relationship by > 10%

[c] Model 3: Multivariate regression model controlling for all confounders that altered the crude estimate of the independent-dependent variable relationship by > 10% minus missed appointments

Interestingly, the missed clinic appointments covariate was found to alter the crude estimates of the independent-dependent variable relationship by > 10% and was included as one of the confounders in the final model. Based on clinical experience and existing literature (19) we would expect that the presence of transportation barriers would lead to missed clinic appointments, Thus, missed clinic appointments could potentially be a mediator of the relationship between our predictor (transportation barriers) and outcome variable (TTR). Even after removing the missed appointments variable from the model, TTR was lower in patients with transportation barriers than in those without transportation

barriers (absolute difference 5.81%, p=0.01). It is fair to ask however: to what extent (if any) is the effect of transportation barriers on anticoagulation control transmitted through missed appointments? To further elucidate this question, we conducted a 4-step mediation analysis (27) and found that while both transportation barriers and missed appointments were independently associated with TTR, missed appointments did not meet the criteria of mediator of the association between transportation barriers and TTR. Table V and Figure 3 depict the results of our mediation analysis.

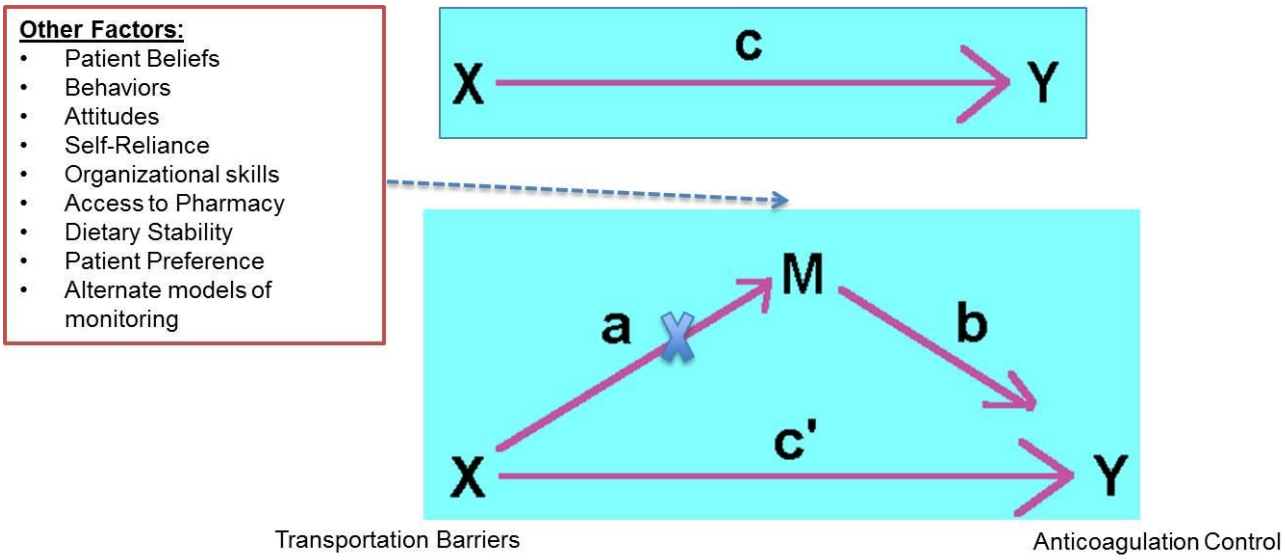
TABLE V

RESULTS OF THE 4-STEP MEDIATION ANALYSIS

Analysis Steps	**β (SE)**	**p-value**
$Y = B_0+B_1X+e$	-4.72 (2.43)	0.05
$M=B_0+B_1X+e$	-2.09 (2.16)	0.33
$Y=B_0+B_1M+e$	-0.26 (0.07)	<0.0001
$Y=B_0+B_1X+B_2M+e$		
Transportation Barriers	-5.45 (2.37)	0.02
Missed Appointments	-0.27 (0.07)	<0.0001

Y=outcome variable; M=mediator variable; X=predictor variable

Figure 3: Mediation Analysis.



Y=outcome variable; M=mediator variable; X=predictor variable

IV. DISCUSSION

Safe and effective management of warfarin requires frequent visits for INR monitoring and dosing adjustments, however barriers to transportation can result in delays to timely health care access and clinical interventions. Such delays can result in disease exacerbations and complications of anticoagulation therapy such as thromboembolism and bleeding. While previous studies have shown that transportation barriers are a major impediment to health care access especially in those with lower SES and ethnic minorities (19) and that minority patients have worse anticoagulation control compared to non-minorities (21), studies to date have not evaluated the impact of transportation barriers on anticoagulation related clinical outcomes. Our study is significant in that it evaluated the relationship between transportation barriers and anticoagulation related clinical outcomes such as quality of anticoagulation control in a largely minority, underserved population. We found that patients with transportation barriers had significantly lower TTR compared to those without transportation barriers, effect which remained significant after controlling for socio-demographic and clinical confounders.

As minority patients are at particularly high risk for poor outcomes as a result of non-therapeutic anticoagulation (9-11), our findings highlight the importance of addressing barriers to transportation and finding alternate methods of increasing TTR in these patients. One option that could lessen the burden of frequent clinic visits for monitoring are the target specific oral anticoagulants (apixaban, dabigatran, edoxaban, and rivaroxaban). However, due to their higher acquisition costs and lack of generic alternatives, warfarin is projected to

remain a mainstay therapy for the prevention and treatment of venous and arterial thrombosis especially in the underinsured and disadvantaged minorities who can't readily access these agents.

In our study, the association between transportation barriers and TTR was not explained by a higher number of missed clinic appointments suggesting that other factors such as patients' beliefs and attitudes, self-reliance and organizational skills, access to pharmacies and medications, time between clinic visits, and preference for alternate models of monitoring maybe driving this effect. Another consideration is that our definition of transportation barriers reflected whether patients "relied on" or "depended on" someone else for their transportation to clinic and did not only reflect cases that had no transportation available at all. There is no consistently, accepted definition of transportation barriers to health care/clinic appointments. (19) It is possible that a modified definition of transportation barriers could have found a mediation effect of missed appointments. In addition, we did not assess genotype and dietary vitamin K, which can contribute to variation in INR, however we excluded the 1st 3 months of therapy which excludes the dose response variably attributed by genotype.

In summary, our results suggest a negative association between the presence of transportation barriers and quality of anticoagulation control, even after controlling for socio-demographic and clinical factors associated with anticoagulation control. Understanding this relationship is especially important in underserved, minority patients

who are at highest risk for anticoagulation related complications. Our work serves as a first step towards understanding this relationship. Future studies should focus on elucidating additional factors that are potentially driving this effect and the feasibility of adopting alternate models of anticoagulation monitoring such as telehealth guided patient-centered interventions such as self-testing and self-monitoring.

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12. Sorensen SV, Dewilde S, Singer DE, Goldhaber SZ, Monz BU, Plumb JM. Cost-effectiveness of warfarin: trial versus “real-world” stroke prevention in atrial fibrillation. *Am Heart J* 2009;157(6):1064-73.

13. Garcia DA, Schwartz MJ. Warfarin therapy: tips and tools for better control. *J Fam Pract.* 2011;60(2):70-75.

14. Chiquette E AM, Bussey HI. . Comparison of an anticoagulation clinic and usual medical care: anticoagulation control, patient outcomes, and health care costs. *Arch Intern Med* 1998;158(1641-7).

15. Witt DM, Sadler MA, Shanahan RL, Mazzoli G, Tillman DJ. Effect of a centralized clinical pharmacy anticoagulation service on the outcomes of anticoagulation therapy. *Chest* 2005;127(5):1515-1522.

16. Young S, Bishop L, Twells L, Dillon C, Hawboldt J, O'Shea P. Comparison of pharmacist managed anticoagulation with usual medical care in a family medicine clinic. *BMC Fam Pract.* 2011;12(1):88.

17. Rudd KM DJ. Comparison of two different models of anticoagulation management services with usual medical care. *Pharmacotherapy.* 2010 Apr;30(4):330-338.

18. Garton L CJ. A retrospective assessment comparing pharmacist-managed anticoagulation clinic with physician management using international normalized ratio stability. *J Thromb Thrombolysis.* 2011;32(4):426-430.

19. Syed ST, Gerber BS, Sharp LK. Traveling Towards Disease: Transportation Barriers to Health Care Access. *J Community Health* 2013; 38:976–993.

20. Cavallari LH, Aston JL, Momary KM, Shapiro NL, Patel SR, Nutescu EA. Predictors of unstable anticoagulation in African Americans. *J Thromb Thrombolysis.* 2009;27:430-7.

21. Bhandari VK WF, Bindman AB, Schillinger D. Quality of anticoagulation control: do race and language matter? *J Health Care Poor Underserved.* 2008;19(1):41-55.

22. Estrada CA, Martin-Hryniewicz M, Peek BT, Collins C, Byrd JC. Literacy and numeracy skills and anticoagulation control. *Am J Med Sci*. 2004;328(2):88-93.

23. White PJ. Patient factors that influence warfarin dose response. *J Pharm Pract.* 2010;23(3):194-204.

24. Rosendaal FR, Cannegieter SC, van der Meer FJ, Briet E. A method to determine the optimal intensity of oral anticoagulant therapy. *Thromb Haemost* 1993;3:236–9.

25. Cohen J. Statistical power analysis for the behavioral sciences 2nd ed. Hillsdale, NJ: Lawrence Eribaum Associates 1988.

26. Rothman E, Ericson WA. Statistics: methods and applications. Dubuque, IA: Kendall/Hunt Publishing Co., 1987.

27. Baron RM, Kenny DA. J Personality and Social Psychology 1986;51:1173-1182.

VITA

NAME **EDITH NUTESCU**

EDUCATION /
POST GRADUATE TRAINING:

2011 – 2014	Master in Clinical and Translational Science University of Illinois at Chicago School of Public Health Health Policy and Administration Division Chicago, Illinois
2010 – 2011	Clinical Research Methods – Graduate Certificate Program University of Illinois at Chicago School of Public Health Health Policy and Administration Division Chicago, Illinois
1995 - 1996	Primary Care Specialty Residency - ASHP Accredited University of Illinois at Chicago Medical Center College of Pharmacy Chicago, Illinois
1994 - 1995	Pharmacy Practice Residency - ASHP Accredited Lutheran General Hospital/Advocate Health Care Park Ridge, Illinois
1990 - 1994	Doctor of Pharmacy, graduated with high-honors University of Illinois at Chicago College of Pharmacy Chicago, Illinois
1989 - 1990	Pre-Pharmacy Curriculum Wilbur Wright College Chicago, Illinois
1983 - 1988	Chemical Engineering - Bachelor of Science Program Politechnical Institute of Bucharest Bucharest, Romania

LICENSURE: Registered Pharmacist, Illinois # 051-039827

ACADEMIC APPOINTMENTS:

2011 - Present	Clinical Professor Department of Pharmacy Systems Outcomes and Policy University of Illinois at Chicago College of Pharmacy Chicago, Illinois
2009 - Present	Clinical Professor Department of Pharmacy Practice University of Illinois at Chicago College of Pharmacy Chicago, Illinois
2009 – Present	Clinical Professor Center for Pharmacoepidemiology & Pharmacoeconomic Research (CPR) University of Illinois at Chicago College of Pharmacy Chicago, Illinois
2008 – 2009	Clinical Associate Professor Center for Pharmacoeconomic Research (CPR) University of Illinois at Chicago College of Pharmacy Chicago, Illinois
2004 - 2009	Clinical Associate Professor Department of Pharmacy Practice University of Illinois at Chicago College of Pharmacy Chicago, Illinois
2005 – 2008	Affiliate Faculty Center for Pharmacoeconomic Research (CPR) University of Illinois at Chicago College of Pharmacy Chicago, Illinois
1996 - 2004	Clinical Assistant Professor Department of Pharmacy Practice University of Illinois at Chicago College of Pharmacy Chicago, Illinois

PROFESSIONAL AND CLINICAL EXPERIENCE:

2013 – Present	Co-Director Center for Pharmacoepidemiology & Pharmacoeconomic Research (CPR) University of Illinois at Chicago Chicago, Illinois
2012 - Present	Co-Director UI-Health Pharmacogenetics Service University of Illinois Hospital & Health Sciences System Chicago, Illinois
1996 - Present	Clinical Director Antithrombosis Center (ATC), Heart-Center University of Illinois Hospital & Health Sciences System Chicago, Illinois
2007 - Present	Clinical Pharmacist - Ambulatory Care Services covered: Heart Center – Antithrombosis Clinic / Pharmacogenetics University of Illinois Hospital & Health Sciences System Chicago, Illinois
2000 – 2008	Assistant Director, Wellness Center Clinics Ambulatory Care Pharmacy University of Illinois at Chicago Chicago, Illinois
1996 - 2007	Clinical Pharmacist Ambulatory Care – Wellness Center Services covered: Stroke Risk Reduction - Hyperlipidemia, Antithrombosis, Medication Management University of Illinois at Chicago Medical Center Chicago, Illinois
1994 - 1997	Registered Pharmacist Lutheran General Hospital/Advocate Health Care Park Ridge, Illinois
1992 - 1994	Pharmacy Extern St. Joseph Hospital – Department of Pharmacy Chicago, Illinois
1991 - 1993	Research Assistant University of Illinois at Chicago Medical Center Department of Urology, Chicago, Illinois

POST-DOCTORAL FELLOWS/RESIDENTS AND GRADUATE STUDENTS MENTORED:

- Beth Duplaga, Pharm.D; Ambulatory Care Resident. University of Illinois at Chicago. 1999-2000.
- Christina Rivers, Pharm.D; Ambulatory Care Resident. University of Illinois at Chicago. 2000-2001.
- Simon Lee, Pharm.D; Ambulatory Care Resident. University of Illinois at Chicago. 2000-2001.
- Juan Blackburn, MD; Pharmacoeconomics Research Fellow (research emphasis in cardiovascular-antithrombotic therapy). University of Illinois at Chicago. 2003-2005.
- Vikrant Vats, Ph.D.; Pharmacoeconomics Research Fellow (research emphasis in cardiovascular-antithrombotic therapy). University of Illinois at Chicago. 2005-2008.
- Funda Tyriaki, Pharm.D.; Pharmacoeconomics Research Fellow. University of Illinois at Chicago. 2009-2010.
- Zenobia Dotiwala, BS Pharm, MS Candidate - Graduate Student. University of Illinois at Chicago. 2009-2011.
- Sacheeta Bathia, BS Pharm, MS Candidate - Graduate Student. University of Illinois at Chicago. 2010-2013.
- Vardhaman Patel, PhD Candidate – Graduate Student. University of Illinois at Chicago. 2011-2013
- Adam Bress, Pharm.D. – Cardiovascular-Pharmacogenetics Fellow, MS Candidate. University of Illinois at Chicago. 2012-2013
- Christine Rash, Pharm.D. – Primary Care Specialty Resident. University of Illinois at Chicago. 2012-2013
- Wei-Han Cheng, MS, PhD Candidate – Graduate Student. University of Illinois at Chicago. 2012-2014
- Beenish Manzoor, MPH, PhD Candidate – Graduate Student. University of Illinois at Chicago. 2012-
- Katarzyna Drozda, Pharm.D. – Cardiovascular-Pharmacogenetics Fellow, MS Candidate. University of Illinois at Chicago. 2012-2013
- Shishir Sarangpur, MS Candidate – Graduate Student. University of Illinois at Chicago. 2013-2014.
- Yee Ming Lee, Pharm.D. – Cardiovascular-Pharmacogenetics Specialty Resident. University of Illinois at Chicago. 2013-2014.
- Deval Gor, MS, PhD Candidate – Graduate Student. University of Illinois at Chicago. 2014-

PUBLICATIONS (RECENT):

1. Drozda K, Labinov Y, Jiang R, Thomas MR, Wong SS, Patel S, Nutescu EA, Cavallari LH. A pharmacogenetics service experience for pharmacy students, residents, and fellows. *Am J Pharm Educ*. 2013;77(8):175.

2. Lefebvre P, Coleman CI, Bookhart BK, Wang ST, Mody SH, Tran KN, Zhuo DY, Huynh L, Nutescu EA. Cost-effectiveness of rivaroxaban compared with enoxaparin plus a vitamin K antagonist for the treatment of venous thromboembolism. *J Med Econ.* 2013; Oct 25. [Epub ahead of print] PMID: 24156243
3. Laliberté F, Nutescu EA, Lefebvre P, Rondeau-Leclaire J, Bookhart BK, Lamori JC, Damaraju CV, Schein J, Kaatz S. Risk factors associated with myocardial infarction in venous thromboembolism patients. *Curr Med Res Opin*. 2013 Oct 25. [Epub ahead of print] PMID: 24102370
4. Lefebvre P, Laliberté F, Nutescu EA, Duh MS, Lamori J, Bookhart BK, Olson WH, Dea K, Hossou Y, Schein J, Kaatz S. All-cause and disease-related health care costs associated with recurrent venous thromboembolism. *Thromb Haemost*. 2013;110(6):1288-1297. PMID: 24085327
5. Nutescu EA, Dager WE, Kalus JS, Lewin JJ III, Cipolle MD. Management of bleeding and reversal strategies for oral anticoagulants: Clinical practice considerations. *Am J Health Syst Pharm* 2013;70 1914-1929. http://www.ajhp.org/cgi/content/abstract/70/21/1914?etoc
6. Perera MA, Cavallari LH, Limdi NA, Gamazon ER, Konkashbaev A, Daneshjou R, Pluzhnikov A,Crawford DC, Wang J, Liu N, Tatonetti N, Bourgeois S, Takahashi H, Bradford Y, Burkley BM, Desnick RJ, Halperin JL, Khalifa SI, Langaee TY, Lubitz SA, Nutescu EA, Oetjens M, Shahin MH, Patel SR, Sagreiya H, Tector M, Weck KE, Rieder MJ, Scott SA, Wu AHB, Burmester JK, Wadelius M, Deloukas P, Wagner MJ, Mushiroda T, Kubo M, Roden DM, Cox NJ, Altman RB, Klein TE, Nakamura Y, Johnson JA. Genetic variants associated with warfarin dose in African-American individuals: a genome-wide association study. *The Lancet* 2013;in press. The Lancet, Early Online Publication, 5 June 2013; doi:10.1016/S0140-6736(13)60681-9
7. Cavallari LH, Nutescu EA, Duarte JD. Personalized Medicine in Cardiology: The Time for Genotype-Guided Therapy is Now. *Future Cardiol*. 2013;9(4):459-64. doi: 10.2217/fca.13.35.
8. Smythe MA, Fanikos J, Gulseth MP, Wittkowsky AK, Spinler SA, Dager WE, Nutescu EA. Rivaroxaban: Practical Considerations for Ensuring Safety and Efficacy. *Pharmacotherapy* 2013; in press. doi: 10.1002/phar.1289
9. ACCP (2013) Board of Regents: Haas CE, Yee GC, Cohen LJ, Haase KK, Phillips BG, Farrington E, Nesbit SA, Nutescu EA, Rodgers JE, Schwinghammer TL, Seaton TL. Qualifications of Pharmacists Who Provide Direct Patient Care: Perspectives on the Need for Residency Training and Board Certification. *Pharmacotherapy* 2013;33(8):888-891. doi: 10.1002/phar.1285
10. Nutescu EA. New approaches to reversing oral anticoagulant therapy. *Am J Health Syst Pharm* 2013;70:S1-S2. doi:10.2146/ajhp120039
11. Nutescu EA. Oral anticoagulant therapies: Balancing the risks. *Am J Health Syst Pharm* 2013; 70:S3-S11. doi:10.2146/ajhp130040
12. Nutescu EA, Wittkowsky AK, Burnett A, Merli GJ, Ansell JE, Garcia DA. Delivery of Optimized Inpatient Anticoagulation Therapy: Consensus Statement from the Anticoagulation Forum. *Ann Pharmacother* 2013;47(5):714-24 [PMID: 23585642]

13. Baker WL, Marrs JC, Davis LE, Nutescu EA, Shaun Rowe A, Ryan M, Splinter MY, Vardeny O, Fagan SC. Key Articles and Guidelines in the Primary Prevention of Ischemic Stroke. *Pharmacotherapy* 2013; [Epub ahead of print; PMID: 23401140]
14. Baker WL, Marrs JC, Davis LE, Nutescu EA, Rowe AS, Ryan M, Splinter MY, Vardeny O, Fagan SC. Key Articles and Guidelines in the Acute Management and Secondary Prevention of Ischemic Stroke. *Pharmacotherapy* 2013; [Epub ahead of print; PMID: 23401103]

ABSTRACTS AND SCIENTIFIC PRESENTATIONS (RECENT):

1. Patel R, Drozda K, Lee YM, Nutescu EA, Cavallari L. "Influence of cytochrome P4502C9 and vitamin k epoxide reductase complex subunit one variants on time to achieve first therapeutic international normalized ratio." Poster Presentation: 48th American Society of Health System Pharmacists Midyear Clinical Meeting. Orlando, FL, December 10, 2013. [Also presented at the UI Health Annual Quality Fair: University of Illinois at Chicago Hospital & Health Sciences System. Chicago, IL, November 8, 2013]
2. McDowell M, Patel R, Cavallari LH, Drozda K, Nutescu EA. "The impact of a pharmacist guided pharmacogenetics service on prediction of warfarin stable dose." Poster Presentation: 48th American Society of Health System Pharmacists Midyear Clinical Meeting. Orlando, FL, December 10, 2013. [Also presented at the UI Health Annual Quality Fair: University of Illinois at Chicago Hospital & Health Sciences System. Chicago, IL, November 8, 2013]
3. Duncan M, Bress A, Cavallari L, Nutescu EA, Drozda K, Galanter W. Clinical Decision Support for initial dosing of warfarin and promotion of pharmacogenetic testing. Poster Presentation: American Medical Informatics Association Annual Symposium. Washington, DC, November 16-20, 2013.
4. Bathija S, Walton S, Lau D, Galanter W, Schumock G, Nutescu EA. Patient outcomes with anticoagulation therapy after hip and knee replacement: comparison of two models of care. Poster Presentation: American College of Clinical Pharmacy Annual Meeting. Albuquerque, NM, October 13-16, 2013. Abstract published in: *Pharmacotherapy* 2013;33(10):e191/31E.
5. Manzoor B, Bautista A, Stamos T, Gao W, Nutescu EA. Outcomes of Systematic Anticoagulation Management in Pharmacist vs. Nurse Specialized Clinics. Poster Presentation: American College of Clinical Pharmacy Annual Meeting. Albuquerque, NM, October 13-16, 2013. Abstract published in: *Pharmacotherapy* 2013; 33(10):e229/157.
6. Labinov Y, DiDomenico R, Nutescu EA, Cavallari LH. Comparative accuracy of pharmacogenetic warfarin dosing algorithms and the warfarin dosing label plus clinical judgment. Poster Presentation: American College of Clinical Pharmacy Annual Meeting. Albuquerque, NM, October 13-16, 2013. Abstract published in: *Pharmacotherapy* 2013;33(10):e190/28.

7. Drozda K, Nutescu EA, Bress AP, Galanter W, Stevenson JM, Duarte JD, Cavallari LH. Description and Feasibility of a Comprehensive Warfarin Pharmacogenetics Service. Poster Presentation: American College of Clinical Pharmacy Annual Meeting. Albuquerque, NM, October 13-16, 2013. Abstract published in: *Pharmacotherapy* 2013; 33(10):e269/289.
8. Stone RH, Bress AP, Nutescu EA, Shapiro NL. Upper extremity deep vein thrombosis (UEDVT) in a sickle cell subset population: a retrospective cohort evaluation at a university teaching hospital antithrombosis clinic. Poster Presentation: American College of Clinical Pharmacy Annual Meeting. Albuquerque, NM, October 13-16, 2013. Abstract published in: *Pharmacotherapy* 2013; 33(10):e246/213.
9. Lefebvre P, Coleman CI, Bookhart B, Wang ST, Mody SH, Tran K, Zhuo D, Huynh L, Nutescu EA. Cost-effectiveness of rivaroxaban compared with enoxaparin plus a vitamin K antagonist for the treatment of venous thromboembolism. Poster Presentation: American College of Clinical Pharmacy Annual Meeting. Albuquerque, NM, October 13-16, 2013. Abstract published in: *Pharmacotherapy* 2013;33(10):e227/150.
10. Kaatz S, Fu AC, AbuDagga A , LaMori J, Bookhart B, Damaraju CV, Tan H, Schein J, Nutescu EA. Does anticoagulant treatment duration vary by the risk of venous thromboembolism recurrence in clinical practice ? Poster Presentation: XXIV Congress of the International Society on Thrombosis and Haemostasis. Amsterdam, Netherlands, June 29 – July 4 2013.
11. Kaatz S, Fu AC, AbuDagga A , LaMori J, Bookhart B, Damaraju CV, Tan H, Schein J, Nutescu EA. Association between bleeding risk and persistence on warfarin therapy in patients with VTE in clinical practice. Poster Presentation: XXIV Congress of the International Society on Thrombosis and Haemostasis. Amsterdam, Netherlands, June 29 – July 4 2013.
12. Cheng WH, Galanter WL, Schumock GT, Lambert BL, Cavallari LH, Nutescu EA. The Impact of Race on Quality of Anticoagulation after Major Orthopedic Surgery in an Inner-City Underserved Population. Poster Presentation: International Society for Pharmacoeconomics and Outcomes Research 18th Annual International Meeting. New Orleans, LA, May 18-22, 2013. Abstract published in: *Value in Health* 2013;16(3): A114.
13. Lefebvre P, Laliberté F, Nutescu E, Duh MS, LaMori JC, Bookhart B, Olson WH, Dea K, Hossou Y, Schein JR, Kaatz S. All-cause and disease-related costs associated with recurrent venous thromboembolism. Poster Presentation: International Society for Pharmacoeconomics and Outcomes Research 18th Annual International Meeting. New Orleans, LA, May 18-22, 2013. Abstract published in: *Value in Health* 2013;16(3): A187.
14. Bathija S, Walton SM, Lau DT, Galanter WL, Schumock GT, Nutescu EA. Referral patterns for patients treated with warfarin thromboprophylaxis after hip and knee replacement surgery. Poster Presentation: International Society for Pharmacoeconomics and Outcomes Research 18th Annual International Meeting. New Orleans, LA, May 18-22, 2013. Abstract published in: *Value in Health* 2013;16(3).

15. Bathija S, Schumock GT, Sharp LK, Cavallari LH, Gerber BS, Fitzgibbon ML, Hellenbart E, Shapiro NS, Chevalier A, Drambarean B, Nutescu, EA. Factors affecting awareness and interest of patient-self-testing (PST) in patients on warfarin therapy in an inner-city underserved minority population. Poster Presentation: 12th National Conference on Anticoagulation Therapy. Phoenix, AZ, May 9-11, 2013. Abstract published in: *J Thromb Thrombolysis* 2013;35:402-E2.
16. Rash CP, Bathija S, Pickard S, Galanter W, Berbaum M, Shapiro NL, Stamos TD, Nutescu EA. Contemporary Model for Clinical Thrombosis Management. Poster Presentation: 12th National Conference on Anticoagulation Therapy. Phoenix, AZ, May 9-11, 2013. Abstract published in: *J Thromb Thrombolysis* 2013;35:402-A5.

GRANTS AND CONTRACTS:

1. *Patient-Centered Anticoagulation Self-Monitoring in Minority Patients.* Role: **Principal Investigator.** Period: 02/07/13-1/31/2017. Grant: Funded by the National Institutes of Health/National Heart Lung and Blood Institute. [1K23HL112908-01A1] Amount Funded: $526,567
2. *Evaluation of Cranberry-Warfarin Drug-Interaction*. Role: **Principal Investigator.** Period: 4/1/13 – 12/31/14. Grant: Funded by The Cranberry Institute. [2013-04954] Amount Funded: $10,000
3. *Barriers to Appropriate Anticoagulation Therapy in Patients Undergoing Major Orthopedic Surgery.* Role: **Principal Investigator.** Period: 6/1/09-7/30/15. Grant: Funded by Janssen Pharmaceuticals - Health Outcomes. [2009-04486] Amount Funded: $131,336
4. *David J. Riback 2013 Summer Research Fellowship for Project Titled: Impact of Novel Oral Anticoagulants on Patient Quality of Life.* Role: **Primary Mentor**; Patel (Awardee-Trainee) Period: 5/15/2013-8/15/2013. Grant: Funded by the University of Illinois at Chicago College of Pharmacy. Amount Funded: $6,000
5. *Contemporary Pharmacy Practice Model for Clinical Thrombosis Management.* Role: **Primary Mentor**; Rash (PI-Trainee). Period: 01/15/2013 - 16/15/2014. Grant funded by American Pharmacists Association Foundation. [2013-02756-00-00] Amount Funded: $1,000

HONORS AND AWARDS:

- American College of Clinical Pharmacy, elected Regent, Board of Regents, 2011 – 2014.
- Pharmacotherapy - The Journal of Human Pharmacology and Drug Therapy. Appointed to the Board of Directors, 2012 – 2014.
- National Blood Clot Alliance (www.stoptheclot.org). Appointed to the Medical and Scientific Advisory Board. 2011 – present.
- American Society of Health System Pharmacists. Distinguished Service Award, December 2010.

- Ruth L. Kirschtein National Research Service Award. January 2010 - March 2012.
- American College of Clinical Pharmacy, Clinical Practice Award, October 2009.
- American College of Clinical Pharmacy, Fellow, October 2007.
- ASHP Foundation's Antithrombotic Pharmacotherapy Traineeship Program: selected as main preceptor and one of eight national training sites. 2006 – Present.
- Appointed as Vice President of the Anticoagulation Forum, 2007 – Present.
- NQF National Steering Committee for the Prevention and Care of VTE: Appointed as the only pharmacist member on the committee. 2006 -2009.
- International Academy of Clinical and Applied Thrombosis and Hemostasis, Fellow, January 2005.
- Bristol Myers Squibb Antithrombosis Management Service Excellence Award, November, 2002**.**
- The Illinois Pharmacy Foundation Literature Award, September 1998.

EDITORIAL BOARDS:

- *Anticoagulation Forum: Centers for Excellence OnLine Resource.* Editorial Board Member, 2012 – present.
- *Thrombosis.* Editorial Board Member, 2011 – present.
- *Pharmacotherapy*. Editorial Board Member, 2011 – present.
- *Annals of Pharmacotherapy.* Editorial Board Member, 2008 – present.
- *American Journal of Health System Pharmacists*. Editorial Board Member, 2007 – 2010.
- *Reviews on Recent Clinical Trials.* Peer-Reviewed Journal published by Bentham Science Publishers. Editorial Board Member, 2005 – 2006; Associate Editor, 2006 - present.
- *ClotCare*. OnLine Resource for Health-Care Professionals. Editorial Board Member, 2004 – present.

PROFESSIONAL SERVICE (RECENT):

<u>Service to the University:</u>

- Executive Committee. (Elected). The University of Illinois at Chicago, College of Pharmacy. 2013 – 2015.
- Mentoring Program: Mentor to 2 faculty members. (Voluntary) The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2011-present.
- Promotion and Tenure Committee. (Appointed). The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2010 – Present.
- Faculty Advisory Committee. (Elected). The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2009 – 2011.
- Clinical Track Promotion Review Committee (Appointed). The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2010.

- Clinical Tenure Track Ad-hoc Committee (Appointed). The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2011.
- Translational Research Academy. (Appointed). The University of Illinois at Chicago, Center for Clinical and Translational Science (CCTS). 2008 – Present.
- Research and IRB Review Committee. (Appointed). The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2008 – Present.
- Reimbursement for Clinical Services and Payment Task Force. Chair. (Appointed). The University of Illinois at Chicago, College of Pharmacy, Department of Pharmacy Practice. 2008 – 2010.
- Anticoagulation Task Force. Co-Chair. (Appointed). The University of Illinois Medical Center Chicago. 2007 - Present.
- ACPE Self-Study Committee on Faculty and Staff. (Appointed). The University of Illinois at Chicago, College of Pharmacy. 2006 – 2007.

Service to the Profession:

- American College of Clinical Pharmacy. Regent, Board of Regents, 2011 – 2014.
- National Blood Clot Alliance (www.stoptheclot.org). Medical and Scientific Advisory Board. Member. 2011 – present.
- American College of Clinical Pharmacy Practice Based Research Network – Community Advisory Panel. Chair 2011-2012; Co-Chair 2009-2010.
- American College of Clinical Pharmacy. Ambulatory Care PRN. Treasurer. 2008 - 2010.
- American College of Clinical Pharmacy. Ambulatory Care PRN. Education Committee. 2007 - 2009.
- American College of Clinical Pharmacy. Awards Committee. Member. 2006-2007.
- National Institutes of Health, Office of Dietary Supplements: Expert Committee on Dietary Supplements and Coagulation. Participant Member/Consultant, 2006.
- Anticoagulation Forum. Member, Board of Directors, 2006 – Present. Vice President, 2007 – Present. Programming Committee, 2008 – 2009.
- American College of Clinical Pharmacy. Spring Forum (2007) Program Committee. Member. 2005-2007.
- American Society of Health-System Pharmacists, Section of Home, Ambulatory, and Chronic Care Practitioners - Cognitive Services Reimbursement Resources Advisory Group. Member. 2005 – Present.
- American Society of Health-System Pharmacists, Section of Home, Ambulatory, and Chronic Care Practitioners – Programming Committee (2006 Midyear Clinical Meeting). Member. 2005 – 2006.
- American College of Clinical Pharmacy. Ambulatory Care PRN - Frontiers Fund Committee. Member. 2004-2005.
- American Society of Health System Pharmacy. Section of Clinical Specialists and Scientists – Committee on Nominations. Member. 2004 – 2005; 2005 – 2006; 2006-2007; 2007-2008.

- The National Quality Forum and the Joint Commission on the Accreditation of Healthcare Organizations. National Consensus Standards for the Prevention and Care of Deep Vein Thrombosis. Member, Steering Committee. (Nominated by the American Society of Health System Pharmacists) 2005 – present.

PROFESSIONAL AFFILIATIONS:

- International Society for Pharmacoeconomics and Outcomes Research, 2013 - present.
- International Society of Thrombosis and Haemostasis, 2001- present.
- American Association of Colleges of Pharmacy, 1997 - present.
- Anticoagulation Forum, 1997 - present.
- American College of Clinical Pharmacy, 1994 - present.
- Illinois Council of Health System Pharmacists, 1994 - present.
- American Society of Health System Pharmacists, 1994 – present.