

What Happens after Cardiac Arrest? The Role of Primary Care

Shaun Shaikh and Arthur Sweetman

ABSTRACT

**** Preliminary and not for distribution ****

Background:

In hospital cardiac arrest is a severe condition associated with high mortality. There are limited studies of ambulatory follow up after discharge for survivors, and none that have investigated if utilization differs systematically across enhanced primary care enrollment models in Ontario.

Methods:

Administrative health data in Ontario is used to identify adult patients who survive a cardiac arrest associated with an acute care admission over the period Apr 1st 2004 to Mar 31st 2010 (N = 7,274). Descriptive survival analysis techniques are applied to investigate time to death, and time to first GP visit, specialist visit, and lab test. Univariate analysis is presented using Kaplan-Meier survival curves, and multivariate analysis is performed with Cox proportional hazard models.

Results:

Kaplan Meier survival estimates suggest patients rostered with an enhanced patient enrollment model (PEM) have a lower mortality rate and higher first GP / specialist visit rate when compared to fee for service (FFS) patients (P < 0.0001 on all log-rank tests). Adjusted hazard ratio comparing PEM to FFS for mortality is 0.748 (p < 0.001), for first visit to any GP is 1.389 (p < 0.001), for first visit to any specialist is 1.229 (p < 0.001), and for first lab referral is 1.253 (p < 0.001). When we consider time to first visit with the enrolling GP, the hazard ratio increases to 1.821 (p < 0.001). A similar increase in the hazard ratio is noticeable when considering first lab / specialist referral made by the enrolling GP.

Conclusions:

Adult survivors of in-hospital cardiac arrest enrolled with an enhanced patient enrollment model in Ontario, which include remuneration by capitation and/or pay-for-performance bonuses alongside a fee-for-service component, have lower mortality, and get more timely post discharge care - in terms of first visits with a GP, specialist, and first lab test - when compared to FFS. It is not clear how much of this difference is due to selection, or matching of healthier patients to physicians in a PEM versus differences in quality of care.

What Happens after Cardiac Arrest? The Role of Primary Care

Shaun Shaikh
Arthur Sweetman

This research was funded by the Government of Ontario through a Ministry of Health and Long-Term Care Health System Research Fund grant entitled “Harnessing Evidence and Values for Health System Excellence”. The views expressed in this presentation are the views of the authors and should not be taken to represent the views of the Government of Ontario

**** Preliminary and Not for Distribution ****

© Shaun Shaikh and Arthur Sweetman, 2016. Do not cite without permission.

Background

- Cardiac arrest is a violent event associated with a high degree of mortality
 - 24% survival to discharge for in-hospital cardiac arrest in the U.S. (Neumar 2015)
- Patient response to *health shock*, and provider response to *signal*, result in an equilibrium utilization choice

Background

A physician who is remunerated through

- (1) pay for performance incentives
- (2) capitation

may have incentives to

- (1) provide better quality preventative care
- (2) “cream skim” healthier patients

Research Question

- For patients discharged after a cardiac arrest, how is primary care *enrollment* with a physician in an enhanced payment model associated with
 - Mortality?
 - Utilization?
 - **GP Visits**
 - **Specialist Referral**
 - **Lab Referral**

Data Sources

- 1. OHIP Claims / Lab Claims Databases**
 - Doctor visits, lab referrals
- 2. Registered Persons Database (RPDB)**
 - Patient mortality
- 3. Client Agency Program Enrollment (CAPE)**
 - Doctor and patient enrollment relationship
- 4. Corporate Provider Database (CPDB)**
 - Doctor groups and payment models
- 5. Discharge Abstract Database (DAD)**
 - Patient demographic and clinical characteristics
- 6. FHT Group Enrollment Files**
 - Interdisciplinary doctor group data
- 7. Rurality Index of Ontario (RIO) File**
 - Rurality Index of Ontario

Sample Selection

- OHIP patients discharged alive from acute care facility in Ontario (DAD) from Apr 1st 2004 to Mar 31st 2010
- Cardiac arrest (ICD-10-CA I46) is a comorbidity which occurs prior to or during admission
- Age 18 or above

N = 8,043

- Excludes
 - Subsequent admissions with a cardiac arrest – N = 527 (6.5%)
 - Other Primary Care Payment Models – N = 84 (1.0%)
 - Missing Rurality Data - N = 158 (2.0%)

N = 7,274

Statistical Methods – Survival Analysis

- **Time to Event** is important
- **Time at Risk** starts at discharge

(1) Kaplan Meier Survival Curves (Non-Parametric)

For events at which a failure or censoring event occurs

(2) Cox Proportional Hazard Models (Semi-Parametric)

Where X is a vector of covariates and the *baseline hazard* is unspecified

Dependent Variables

- **Time to Death**
- **Time to First Lab Test**
- **Time to First Ambulatory Visit**
 - General Practitioner
 - Any Specialist
 - Cardiologist
 - General Internist
 - Diagnostic Radiology

Dependent Variables - Details

Time to First GP Visit (3 Definitions)

- 1) First visit with *any GP*
- 2) First visit with *rostering GP*
- 3) First visit with *GP other than rostering GP*

Time to Specialist Visits (3 Definitions)

- 1) First visit referred by *anyone*
- 2) First visit referred by *rostering GP*
- 3) First visit NOT referred by *rostering GP*

Time to Lab Test (5 Definitions)

- 1) First test referred by *anyone*
- 2) First test referred by *any GP*
- 3) First test referred by *any specialist*
- 4) First test referred by *rostering GP*
- 5) First test referred by *GP other than rostering GP*

Main Explanatory Variables

- Primary Care Enrollment Variables
 - Payment model indicators (FHO, FHN, FHG, CCM)
 - Interdisciplinary practice indicator (FHT)
- Virtual / True Rostering
 - Virtual Rostering: maximum FFS equivalent claims in last 2 years
 - True Rostering from CAPE
- Four Possible Nested Specifications (Chosen by LR Test)
 1. FHT × FHO, FHN × FHN, FHG, CCM
 2. FHN, FHO, FHG, CCM
 3. Capitated (FHO or FHN), Enhanced FFS (FHG or CCM)
 4. PEM (Patient Enrollment Model)

Additional Control Variables

I. Demographic Variables

- Age, Sex, Rurality

II. Clinical Variables

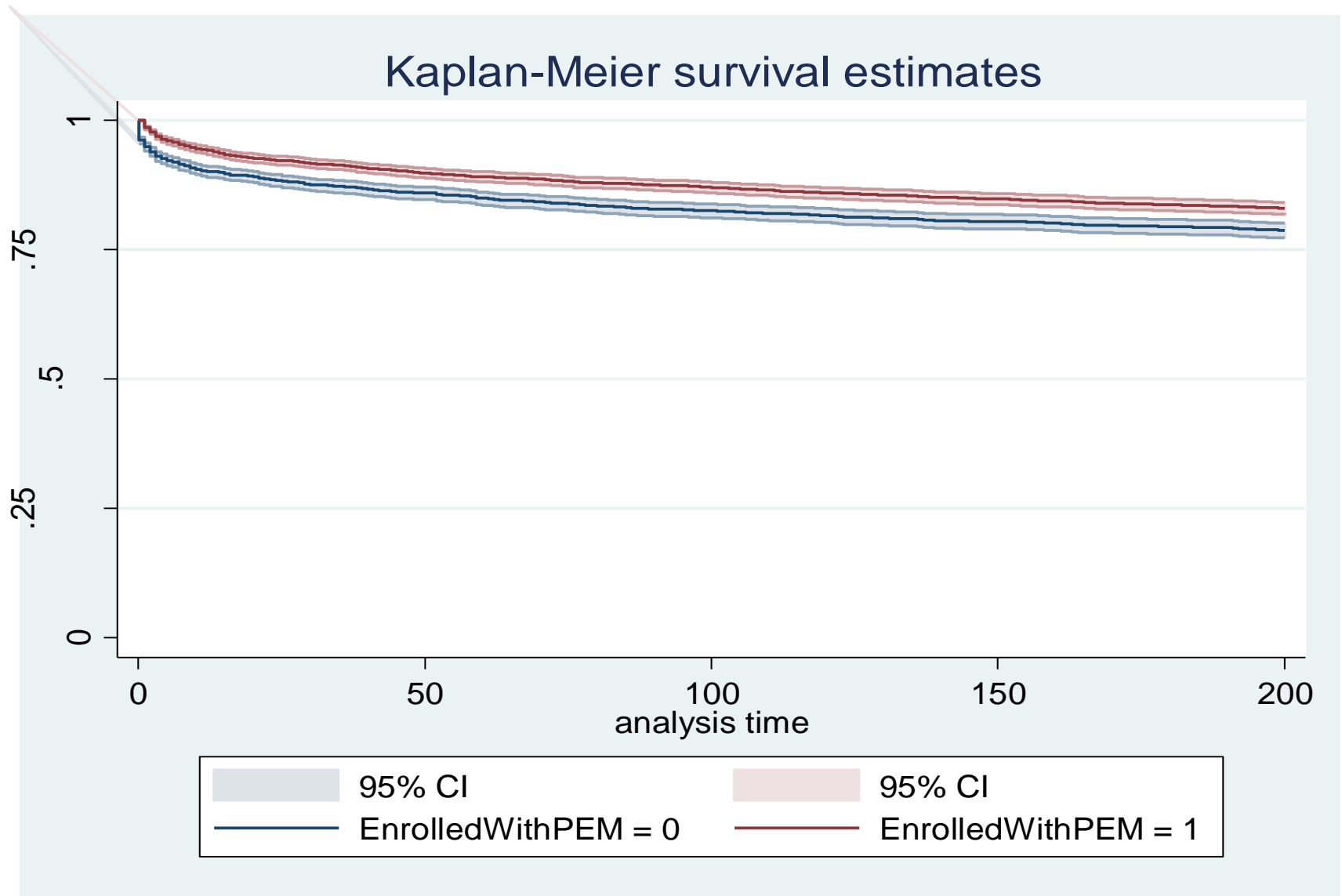
- Charlson Comorbidity Index

- Comorbidities

- Myocardial Infarction, Congestive Heart Failure, Arrhythmia, Cerebrovascular Disease, Peripheral Vascular Disease, Chronic Ischemia, Angina, Diabetes, Hypertension, Chronic Pulmonary Disorder, Liver Disease, Renal Disease, Cancer, Dementia

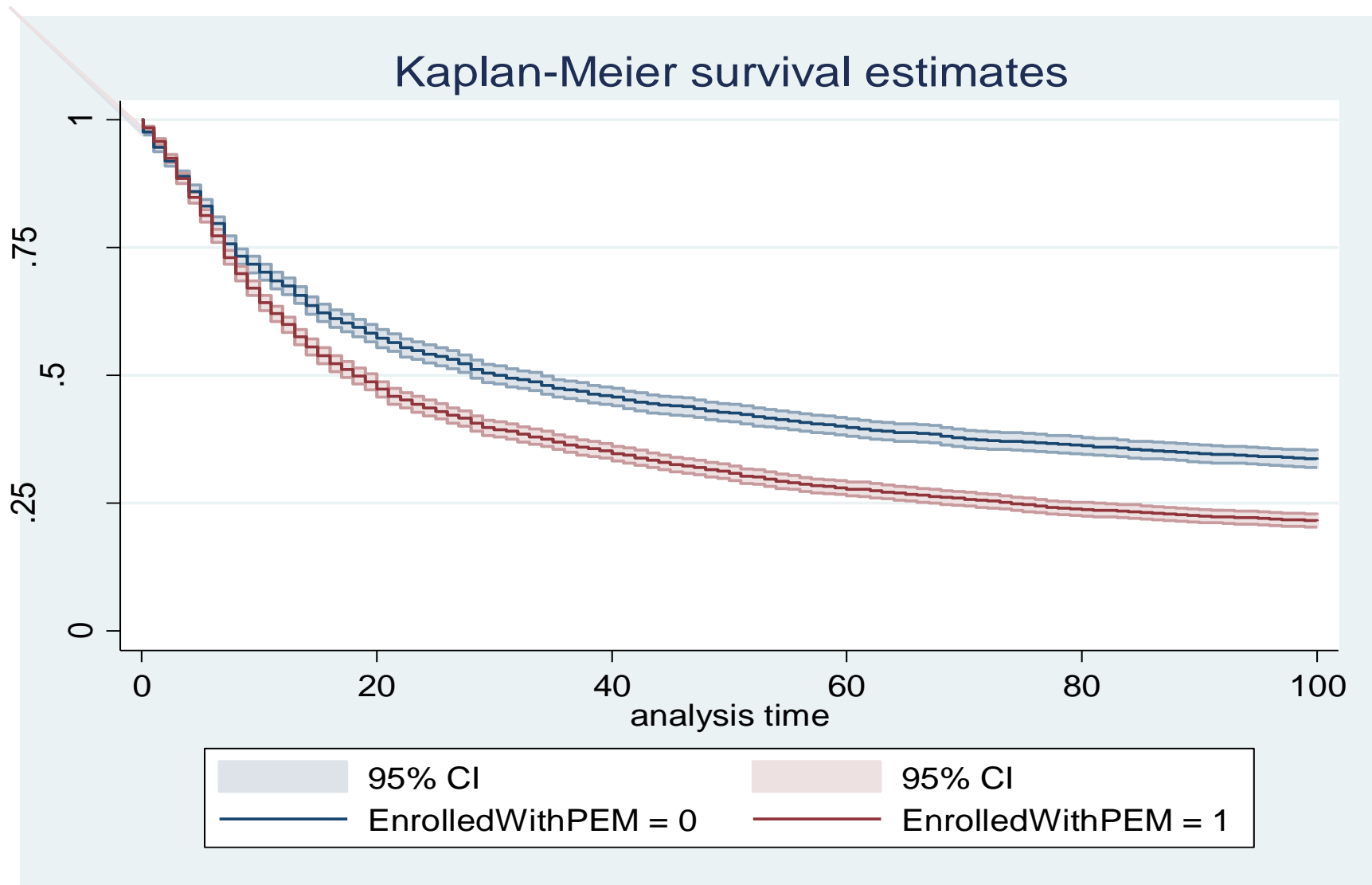
III. Year and Hospital Fixed Effects (DAD)

Survival Curve – Time to Death (days)



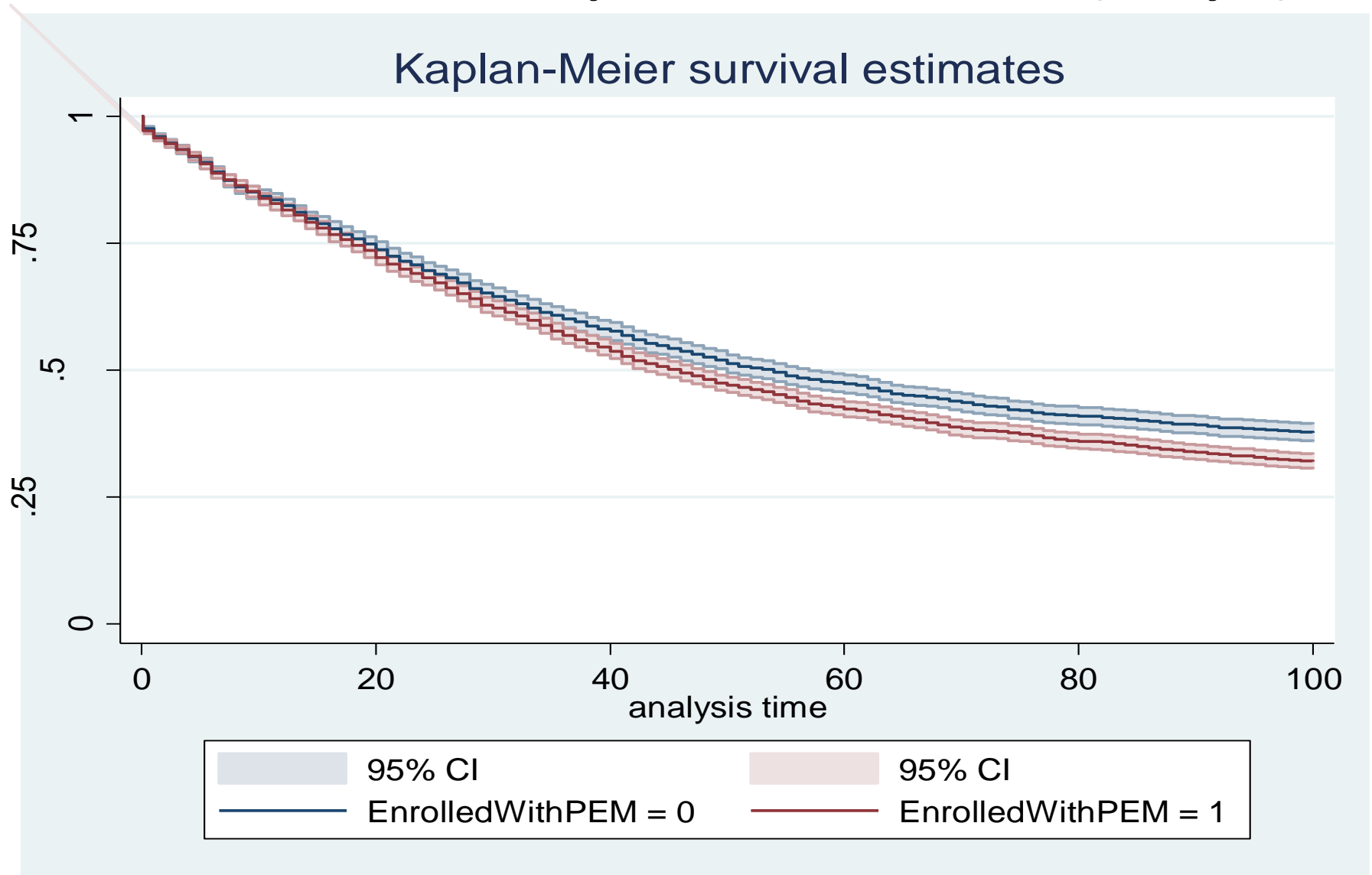
Log Rank Test: $p < 0.0001$

Time to First GP Visit (days)



Log Rank Test: $p < 0.0001$

Time to First Specialist Visit (days)



Log Rank Test: $p < 0.0001$

Cox Regressions - Mortality

Hazard Ratios - Time to Death

Variables	Unadjusted	Adjusted
PEM	0.815*** (0.0317)	0.748*** (0.0331)
N	7,274	7,274

Unadjusted Model Specification: PEM enrollment indicator only

Adjusted Model Specification: Includes Enrollment, Demographic, Comorbidity, and Hospital / Year Fixed Effects.

PC enrollment variables are compared to base FFS

* p<0.05, ** p<0.01, *** p<0.001

Cox Regressions – First Visit

Hazard Ratios - Time to Visit					
Variables	Any GP	Any Specialist	Cardiologist	General Internist	Diagnostic Radiologist
Enrolled	1.389*** (0.040)	1.229*** (0.036)	1.184*** (0.051)		1.251*** (0.048)
FHO AND FHT				0.964 (0.087)	
FHO NOT FHT				1.326*** (0.098)	
FHN AND FHT				1.396 (0.26)	
FHN NOT FHT				1.087 (0.090)	
FHG				1.190*** (0.048)	
CCM				1.062 (0.125)	
N	7,274	7,274	7,274	7,274	7,274

Additional Controls include Demographic, Comorbidity, and Hospital / Year Fixed Effects.

PC enrollment variables are compared to base FFS

* p<0.05, **p<0.01, *** p<0.001

Cox Regressions – First Lab Test

Hazard Ratios - Time to Lab Test			
		Referral by Anyone	Referral by Any GP
PEM		1.253*** (0.039)	
FHO			1.273*** (0.062)
FHN			1.140* (0.073)
FHG			1.250*** (0.0413)
CCM			1.03 (0.090)
N		7,274	7,274

Additional Controls include Demographic, Comorbidity, and Hospital / Year Fixed Effects.

PC enrollment variables are compared to base FFS

* p<0.05, ** p<0.01, *** p<0.001

Note: Time to Lab Test Referred by Specialist is not explained by PC variables after controlling for Hospital Fixed Effects and Comorbidities

GP Visits / Lab Referral (Virtual Rostering)

Hazard Ratios					
Variables	Time to GP Visit			Time to Lab Referral	
	To Virtually Rostering GP	To Other GP		By Virtually Rostering GP	By Other GP
PEM	1.821*** (0.067)			1.867*** (0.078)	
Capitation		0.699*** (0.033)			
Enhanced FFS		0.787*** (0.028)			
FHO					0.800*** (0.046)
FHN					0.623*** (0.049)
FHG					0.777*** (0.030)
CCM					0.775** (0.072)
N	6,770	6,770		6,770	6,770

Additional Controls include Demographic, Comorbidity, and Hospital / Year Fixed Effects.

PC enrollment variables are compared to base FFS

* p<0.05, p<0.01**, p<0.001

Specialist Visits Referred by Virtually Rostered GP

Hazard Ratios - Days to First Specialist Visit

Variables	Any Specialist	Cardiologist	General Internist	Diagnostic Radiologist
PEM	1.8340*** (0.0785)			1.903*** (0.111)
Capitation		2.295*** (0.214)		
Enhanced FFS		1.828*** (0.146)		
FHO AND FHT			1.063 (0.139)	
FHO NOT FHT			1.514*** (0.163)	
FHN AND FHT			1.229 (0.309)	
FHN NOT FHT			1.456*** (0.162)	
FHG			1.532*** (0.097)	
CCM			1.322* (0.184)	
N	6,770	6,770	6,770	6,770

Additional Controls include Demographic, Comorbidity, and Hospital / Year Fixed Effects.

PC enrollment variables are compared to base FFS

* p<0.05, ** p<0.01, *** p<0.001

Specialist Visits NOT Referred by Virtually Rostered GP

Hazard Ratios – Days to First Specialist Visit				
Variables	Any Specialist	Cardiologist	General Internist	Diagnostic Radiologist
PEM	0.922** (0.028)	0.868** (0.040)		
Capitation			0.705*** (0.040)	0.646*** (0.043)
FFS			0.818*** (0.034)	0.769*** (0.036)
N	6,770	6,770	6,770	6,770

Additional Controls include Demographic, Comorbidity, and Hospital / Year Fixed Effects.

PC enrollment variables are compared to base FFS

* p<0.05, ** p<0.01, *** p<0.001

Summary / Discussion

- GPs are observed to be earlier secondary prevention responders for cardiac arrest patients than specialists
- Patients enrolled with GPs in enhanced payment models tend have earlier utilization
 - Earlier GP Visits
 - Earlier Specialist Referral / Visit
 - Earlier Lab Referrals
- Comment 1:
 - Stronger doctor / patient relationship?
 - Preventative care inclination in enhanced models?
 - “Eagerness” of patients, possibly related to greater higher valuation of health?

Summary / Discussion

- Patients enrolled with GPs in enhanced payment models tend to have higher survival
- Comment 2:
 - Preventative care inclination in enhanced models leading to earlier and higher quality care?
 - “Eagerness” of patients, possibly related to greater higher valuation of health, and other subsequent healthy behaviours?
 - Differences in predetermined health due to earlier quality of care by PEM doctor, or earlier healthy behaviour by patient?
 - Selection behaviour of PEM doctors due to incentives to enroll healthier patients?
- Limitations
 - No plausible causal identification / descriptive results only

References

Neumar RW, Eigel B, Callaway CW, et al. *American Heart Association Response to the 2015 Institute of Medicine Report on Strategies to Improve Cardiac Arrest Survival*; 2015.

The End

Thank You